Construction Documents

VOLUME 2 of 2

New Amesbury Elementary School

Amesbury, Massachusetts

Set Number

CONSTRUCTION DOCUMENTS
for the
NEW AMESBURY ELEMENTARY SCHOOL
AMESBURY, MASSACHUSETTS

Date: 02 NOVEMBER 2020

ARCHITECT: DiNISCO DESIGN, INC.
99 Chauncy Street, Suite 901
Boston, MA 02111
(617) 426-2858

OWNER'S PROJECT MANAGER: NV5
44 Pleasant Street
Watertown, MA 02472
(617) 744-3110

CIVIL ENGINEER: DGT Associates
1071 Worchester Road
Framingham, MA 01701
(508) 879-0030

LANDSCAPE ARCHITECT: BROWN SARDINA, INC.
24 Roland Street
Boston, MA 02129
(617) 482-4703

STRUCTURAL ENGINEER: FOLEY BUHL ROBERTS & ASSOCIATES
2150 Washington Street
Newton, MA 02462
(617) 527-9600

GEOTECHNICAL ENGINEER: GZA GeoEnvironmental, Inc.
31 State Street, 8th Floor
Boston, MA 02109
(617) 963-1000

FOODSERVICE CONSULTANT: CRABTREE MCGRATH ASSOCIATES, INC.
161 West Main Street
Manchester, NH 03103
(603) 647-9700

CODE CONSULTANT: HASTINGS CONSULTING, INC.
142 Hanlon Road
Holliston, MA 01746
(508) 397-8417

ACOUSTICAL CONSULTANT:	L.G. COPLEY ASSOCIATES 53 Barrett Street, PO Box 920479 Needham, MA 02492 (781) 455-8814
FIRE PROTECTION and PLUMBING ENGINEERS	VAV INTERNATIONAL, INC. 400 West Cummings Park S. 4700 Woburn, MA 01801 (781) 935-7228
MECHANICAL ENGINEER:	VAV INTERNATIONAL, INC. 400 West Cummings Park S. 4700 Woburn, MA 01801 (781) 935-7228
ELECTRICAL ENGINEER:	THOMPSON ENGINEERING COMPANY, INC. 10 City Square Boston, MA 02129 (617) 886-9066
TECHNOLOGY CONSULTANT:	EDVANCE TECHNOLOGY DESIGN, INC 300 Brickstone Square, Suite 201 Andover, MA 01880 (978) 256-9900
ENVIRONMENTAL CONSULTANT:	ECMS, INC. 288 Grove St., #391 Braintree, MA 02184 (617) 338-2121
TRAFFIC CONSULTANT:	PARE CORPORATION 8 Blackstone Valley Place Lincoln, RI 02865 (401) 334-4100
LEED CONSULTANT:	THE GREEN ENGINEER 23 Bradford Street Concord, MA 01742 (978) 369-8978

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SECTION 210001

FIRE PROTECTION

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.00 TIME, MANNER AND REQUIREMENTS FOR SUBMITTING SUB-BIDS

A. Sub-bids to be submitted in accordance with provisions of the General Laws (Ter. Ed.), Chapter 149, Section 44A to 44L, inclusive, as amended. The time and place for submission to Sub-Bids to be set forth under INSTRUCTIONS TO BIDDERS.

B. Each Sub-Bid filed with the Awarding Authority must be accompanied by BID BOND, OR CERTIFIED CHECK, or a TREASURER'S CHECK OR CASHIER'S CHECK issued by a responsible bank or trust company, payable to the City of Amesbury, in the amount stipulated in the INSTRUCTIONS TO BIDDERS. A Sub-Bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Each Sub-Bid submitted for the work, under this SECTION, to be on a form furnished by the Awarding Authority, by SECTION 44F of Chapter 149 of the General Laws, as amended.

D. Work to be done under this section is shown on Contract Drawings numbered

E. 7.0.01, 7.4.01, 7.4.02, 7.4.03 & 7.4.04 inclusive. Remaining Contract Drawings are included for reference and coordination.

F. Additional Requirements:

1. Sub-bidder's attention is directed to Massachusetts G.L. Chapter 149 §44H, as amended, which provides in part as follows:

2. Each sub-bidder to list in Paragraph E of the "Trade Contractor Bid Form" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub-trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work to be listed in Paragraph E under the conditions indicated herein.

Classes of Work	Reference	Specification Paragraphs
None		

1.01 GENERAL PROVISIONS

A. Part A and Division 1 of Part B are hereby made a part of this Specification Section.

B. Examine all Drawings and all Sections of the Specifications and requirements and provisions affecting the work of this Section.

1.02 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning.

B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per requirements of Section 019113 and manufacturers written instructions/requirements.

1.03 SCOPE OF WORK

A. Provide all labor, equipment, implements and material required to furnish and install all Fire Protection work, complete as indicated on drawings and specifications, without limiting the generality thereof, the following are major items of work and includes the following:

1. Complete (shop drawings) development of fire protection system layout.
2. Fire protection system from blind flange inside the building as indicated on associated drawings, installed in accordance with NFPA-13 (2013 edition).
3. Complete automatic wet pipe fire sprinkler systems.
4. Complete automatic wet standpipe system.
5. Quick response sprinkler heads.
6. Sprinkler accessories.
7. All zone control assemblies as indicated on the contract drawings.
8. Sprinkler system/standpipe system drains.
9. Inspectors test connections.

10. Pressure switches, flow switches, fire department connections, fire department valves.
11. All sprinkler alarm and supervisory devices.
12. All required hangers, supports and braces.
13. All operational pre-testing and acceptance testing.
14. All sleeves
15. Coordination drawings.
16. Shop drawings and submittals.
17. Permits, fees, and inspections.
18. System and equipment start-ups; instructions.
19. Operation and Maintenance Manuals.
20. Record drawings and similar requirements.
21. Hoisting Equipment: The Fire Protection subcontractor to furnish, install and maintain in safe and adequate condition all mechanical hoisting equipment, operating personnel and rigging that is necessary for the proper execution of the Work of this Section.
22. Fire stopping and smoke stopping of penetrations made by/ for this subcontractor. Maintain indicated fire ratings of walls, ceilings and floors at pipe penetrations for fire stopping specified in section 210001. Provide UL listed fire rated assembly submittals for each job specific application required for your work. Follow the approved details at each location and provide acceptable fire rated labels at all locations.
23. All coring, cutting and channeling required for holes five (5) inches in diameter or less.

B. This subcontractor to furnish, install and maintain in a safe, adequate condition all staging and scaffolding that are necessary for the proper execution of the work of this SECTION.

C. Refer to Division 0 for CM Supplemental instructions to Trade Contractors for additional requirements.

1.04 RELATED WORK SPECIFDIED ELSEWHERE

A. The following work to be performed by other trades indicated:

1. Fire Protection Service: Section 331000 – Water Distribution
2. Electrical wiring and control wiring: Section 260001 – Electrical
3. Fire Alarm: Section 260001 – Electrical
4. Painting: Section 090007 - Painting

1.05 REFERENCES

A. The following is a partial list of documents to be referenced and utilized as part of this specification document:

NFPA-13, 2013 Edition, Installation of Sprinkler Systems

NFPA-14, 2013 Edition, Standpipes and Hose Systems

NFPA-24, 2010 Edition, Private Fire Service Mains and their Appurtenances

NFPA-72, 2010 Edition, National Fire Alarm Code

NFPA-101, 2010 Edition, Life Safety Code

527 CMR, Commonwealth of Massachusetts Regulations (Fire Prevention Code)

780 CMR, Commonwealth of Massachusetts Regulations (State Building Code), 9th Edition

M.G.L. Chapter 146, Section 81 through 89 and 528 CMR, Section 11 and 12, (Sprinkler Contractor and Fitters Licensing Laws and Regulations).

1.06 INTENT

A. It is the intent of the Contract Documents to require and specify a complete operational automatic fire protection system throughout the proposed facility. Anything that is not shown or mentioned but reasonably implied to be furnished.

B. The drawings are diagrammatic only and are not intended to indicate all offsets, fittings and valves.

C. All work to be accurately laid out and coordinated with other trades and building features, such as lights and HVAC equipment to avoid conflicts and to obtain a neat, workmanship installation. The Fire Protection Sub-contractor is responsible for all field verification of building dimensions and piping measurements related to his work and to coordinate with other trades prior to submission of sprinkler layout shop drawings for Architect/Engineer's approval.

D. It is the intent that all piping installed in areas with drop-tile ceilings to be installed concealed above the tiles and all piping installed in spaces without ceilings to be exposed.

E. Piping changes, coordination conflicts or alternatives to be reviewed with the Architect and Engineer for approval prior to proceeding with any work.

F. Fire Protection Sub-Contractor is responsible for coordinating his work with all other trades.

1.07 CODES, PERMITS AND FEES

A. All fire protection work to be installed in accordance with the Massachusetts State Building Code, 9th Edition (780 CMR), the applicable NFPA Standards as referenced, along with any local requirements of the building or fire department, as they may apply to the installation.

B. All necessary permits and fees to the local municipalities to be provided by the Fire Protection Sub-Contractor.

1.08 QUALITY ASSURANCE

A. Obtain approval of system design prior to fabrication and installation from:

1. State Building Inspector.

2. Amesbury Fire Department.

Owners' Insurance Company.

3. Architect and Specifying Engineer.

Note: Any deviation (modifications to design concept as shown on drawings) from bid documents must be submitted to Architect and specifying Engineer for review and comment prior to any work proceeding.

B. Upon receipt of comments and approvals from the above stated authorities, forward one properly stamped set to the owner's representative for comments.

1.09 SHOP DRAWINGS AND HYDRAULIC CALCULATIONS

A. The Fire Protection Sub-contractor is responsible for preparing and submitting shop drawings (complete system layout) depicting the full extent of the project with respect to fire protection system work and all other associated aspects, including final hydraulic calculations and a recent hydrant flow test.

B. Drawings to be prepared in accordance with the guidelines set forth in NFPA-13, 2013 Edition, *"Installation of Sprinkler Systems"*, Chapter 6 and NFPA-14, 2013 Edition "*Installation of Standpipe and Hose System*", Chapter 8.

C. Drawings to be 1/8 in. scale or ¼ in. scale AutoCAD Drawing, Version 2008 unless otherwise indicated or approved.

D. Drawings to indicate all building elements and features for the proper layout of the system.

E. The sprinkler system layout shop drawings to indicate all locations of flexible and fixed couplings and fittings including bracing types and details, fastener sizes in accordance with NFPA-13, 2013 Edition. The type and location of branch line restraints to also be provided and shown in accordance with Section 9.3.6 of NFPA 13, 2013 Edition.

F. Shop drawings to be submitted to authorities outlined in the preceding quality assurance section of this specification. Contact each Authority Having Jurisdiction (AHJ) regarding number of sets for submittal.

G. All shop drawings, hydraulic calculations and supporting design information to be prepared by a minimum NICET Certified Level III, Automatic Sprinkler System Layout Technician. The shop drawings to be stamped by a Massachusetts Licensed Fire Protection Professional Engineer by Amesbury Fire Department.

H. The coordination of the fire protection systems piping with other trades, building structure and interferences and means and methods established by NFPA-13 to be the responsibility of the Fire Protection Sub-contractor.

1.10 SUBMITTALS

A. Submit the following in accordance with SECTION 013300 - SUBMMITAL PROCEDURE.

1. Shop drawings, Fire Protection design narrative and hydraulic calculations in accordance with the requirements of NFPA 13 (2013 Edition).
2. Dimensional drawings for all equipment
3. Descriptive literature for all equipment
4. Material descriptions
5. Pressure rating for piping appurtenances.
6. Wiring diagrams for electrical components
7. Utility connection details
8. Electrical requirements for electrical components.
9. Coordination Drawings.

B. Upon completion of work, deliver one set of As-Built reproducible transparencies of all working drawings and soft files of all drawings in both AutoCAD 2008 and PDF formats to the Architect. Refer to Section 017839 – Project Record Documents.

C. Fire Protection Sub-Contractor to keep two sets of the approved shop drawings to be bound and submitted to the owner as a part of the Owner's Operations and Maintenance Manual at the end of the project, before the final payment is made. The Owner's Manual to be prepared as specified in the Execution hereinafter. The Engineer to review the Owner's Manual, and if found incomplete to his judgment, to so direct the Fire Protection Sub-Contractor to revise. Submittal of a satisfactory Owner's Operations and Maintenance Manual to be considered an integral part of this contract. Refer to SECTION 017700 – PROJECT CLOSEOUT and Section 017839 – Project Record Documents.

1.11 CONTRACT DOCUMENTS

A. Listing of Drawings does not limit responsibility of determining full extent of work required by Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, and other Drawings and other Sections that indicate types of construction in which work to be installed and work of other trades with which work of this Section must be coordinated.

B. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the Fire Protection Sub-contractor to provide all other components and materials necessary to make the systems fully complete and operational.

C. Information and components shown on riser diagrams but not shown on plans, and vice versa, to apply or be provided as if expressly required on both.

1.12 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, advise the Architect in writing before Award of Contract. Otherwise, the Architect's interpretation of Contract Documents to be final, and no additional compensation to be permitted due to discrepancies or un clarities thus resolved.

B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert the Architect in writing before installation. Otherwise, make changes in installed work as the Architect requires within Contract Price.

1.13 MODIFICATIONS IN LAYOUT

A. Fire Protection Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.

B. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Reflected Ceiling Plans for exact locations and where not definitely indicated, request information from the Architect.

1.14 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that affect work of this Section. No extra payment to be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observer.

1.15 EXISTING CONDITIONS AND PREPARATORY WORK

A. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or Contracts or by the User Agency. Report conditions that might affect work adversely in writing through General Contractor to the Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work to be construed as complete acceptance of existing conditions and preparatory work.

1.16 DESIGN CRITERIA

A. DENSITIES

The automatic sprinkler systems to be designed to provide the following specified sprinkler discharge density over the specified hydraulically most demanding discharge area: (Note: Design areas of wet-pipe systems may be reduced in accordance with the requirements of NFPA 13 (2013 Edition) where Quick-Response sprinklers are used and the ceiling heights do not exceed 20 ft-0 in).

Location and Occupancy:	Light Hazard Spaces (Offices, class rooms, Corridors)
Type of System:	Wet
Sprinkler Discharge Density:	0.10 gpm / sq. ft.
Design Area:	1500 SF (Design area may be reduced where permitted by NFPA 13, 2007 Edition).
Hose Stream Allowance:	100 gpm
Sprinkler Orifice:	½ in. thread, 5.6 K-Factor
Maximum Sprinkler Head Spacing:	225 sf (Or as determined by hydraulic calculations)

Location and Occupancy:	Ordinary Hazard Group I Spaces (Mechanical rooms, kitchen, storage rooms)
Type of System:	Wet
Sprinkler Discharge Density:	0.15 gpm / sq. ft.
Design Area:	1500 SF
Hose Stream Allowance:	250 gpm
Sprinkler Orifice:	½ in. thread, 5.6 K-Factor
Maximum Spacing:	130 SF (12 ft. x 10 ft. Spacing used in most cases) or as limited by hydraulic calculation results.

B. PRESSURE CUSHION

Maintain a minimum 10 psi safety margin or 10% of available water supply where possible on all calculations.

C. VELOCITIES

Maintain flow velocities in the sprinkler system branch line piping to below 20 ft. per second unless otherwise directed.

1.17 WATER FLOW TEST DATA

A. The following water supply data was utilized for Construction Documents. The Fire Protection Sub-Contractor to perform a new hydrant flow test prior to shop drawings submission and verify design conformance.

B. Static: 78 PSI

Residual: 68 PSI

Flow: 1138 GPM

Flow test conducted on 5/20/19

1.18 WELDING AND CUTTING

A. No welding and cutting operations to be permitted unless specifically approved and permits obtained from the Amesbury Fire Department.

1.19 CUTTING, PATCHING AND REFINISHING

A. Whether or not specifically called out on the drawings, the Fire Protection Sub-contractor to be responsible for all cutting, coring and channeling up to six in. diameter for the work of this section. The Fire Protection Sub-contractor to also include required fire seals of the minimum fire resistance rating for wall and floor penetration and 2-hour fire seals for stairwell, corridor and floor penetrations.

B. Use material which is identical to the material to be cut and patched or materials which match the materials to the greatest extent possible.

1.20 GUARANTEE

A. Refer to General Conditions and Supplementary Conditions for requirements, all of which to be included as part of this specification.

B. All materials, equipment and work furnished under this section to be guaranteed against defects in workmanship for a period of (1) year from date of substantial completion.

1.21 COORDINATION DRAWINGS

A. This Fire Protection Sub-Contractor to prepare coordination drawings clearly showing how his work is to be installed in relation to the other trades, including sections and details, Refer to Section 013300 – SUBMITTAL PROCEDURES, and Division 0 – CM supplemental instructions to Trade Bidders, Attachment A – BIM execution plan.

1.22 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee Work of this Section in writing for one year following the date of beneficial occupancy by the User Agency. The guarantee to repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to the Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

1.23 SPRINKLER WORKING PLANS

A. Definition: Working plans are the installation shop drawings required by NFPA Standard 13 and normally prepared by the installing Fire Protection sub-contractor.

B. Submit working plans to the authorities having jurisdiction for approval, including:

1. Building Department.

2. Fire Department.

3. Architect.

C. Prepare sprinkler head layout plans on reflected ceiling plans for submission to the Architect before submission of the working plans.

D. Submit working plans and hydraulic calculations to the Architect in one complete package, after review by the other authorities having jurisdiction. Plans submitted without review stamps or hydraulic calculations be returned without review.

1.24 ALTERNATES

A. Examine SECTION 012300-ALTERNATES for Scope of Work that may affect the work of this section and include and deletions or additions in the Form for Sub-bid under the appropriate alternate.

PART 2 - PRODUCTS

2.00 GENERAL

A. All devices, materials and related system pipe and fittings to be UL Listed for fire protection.

2.01 SPRINKLER SYSTEM

A. For description of work refer to Article 1.03.

2.02 VALVES

A. With the exception of drain and trim valves, all valves to be UL listed and FM approved and from one manufacturer.

B. Shut-off and/or control valves to be:

1. Outside screw and yoke valve. Cast iron body, bronze mounted, flanged ends, resilient wedge, 175 psi, 2 ½ in. in size and up. All bronze, 175 psi, resilient wedge, threaded ends, 2 in. and under in size both to be electrically supervised, or
2. Bronze supervised slow close butterfly valve, threaded ends, stainless steel disc and stem, built-in supervisory switch, slow-close operator, up to 21/2 in. in size, 175 psi, or
3. Butterfly type indicating valves, ductile iron body, bronze disc, rubber seat, 175 psi, gear operator, with built-in supervisory switch. Wafer body style is not acceptable.
    a. Basis of design: 300 psi (2065 kPa), grooved ends, black enamel coated ductile iron body (ASTM A-536, Grade 65-45-12). Electroless-nickel coated ductile iron disc, with pressure-responsive elastomer seat and stainless steel stem. (Stem to be offset from the disc centerline to provide complete 360-degree circumferential seating.). Complete with weatherproof actuator and pre-wired supervisory switches. Victaulic Series 705 FireLock® or Series 707C FireLock®. Victaulic FireLock® Series 765 to be used for high pressure systems up to 365 psi CWP.
    b. Or engineer approved equal.
4. Underground water supply valves to be non-rising stem (NRS) resilient wedge gate valve with post indicator or curb box.

C. Check valves to be:

1. Iron body, bronze mounted swing check with flanged ends, 175 psi, 2 ½ in. in size up to 8 in. size; or
2. Iron body, spring actuated, wafer check, 250 psi, sizes 4 in. through 8 in.; or
3. Grooved end, iron body, spring activated, 250 psi, sizes 2 in. through 6 in.

a. Basis of design: 2 in. (DN50) through 3 in. (DN75) Sizes Spring Assisted: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12, non-slam tilting disc, stainless steel disc and spring, brass shaft, 365 psi (2517 kPa). Victaulic Series 717H.

b. Or engineer approved equal.

c. Basis of design: 4 in. (DN100) through 12 in. (DN300) Sizes Spring Assisted: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12, elastomer encapsulated ductile iron disc suitable for intended service, stainless steel spring and shaft, welded-in nickel seat, 250 psi (1725 kPa). Victaulic Series 717. Designed to accept a riser check kit. Victaulic Series 717R.

d. Or engineer approved equal.

4. All check valves up to 2 in. in size to be all bronze with screwed ends.

D. Trim Valves: (for use on inspectors test set ups, alarm check valves and dry pipe valves)

1. Gate valves - all bronze, 175 psi, solid wedge, outside screw and yoke, rising stem, screwed ends.

2. Ball valves - all bronze, 400 lb. WWP, screwed ends.

3. Globe valves - all bronze, 200 lb. WWP, screwed ends.

4. Check valves - all bronze swing check, rubber disc, 200 lb. WWP, screwed ends.

E. Pressure regulating valves:

1. Cast brass, 400 lb. WWP, screwed ends.

F. All valves that are installed as a part of this specification to be provided with pressure ratings suitable for their intended service.

G. All test stations to be AGF Model #1000 sectional test and drain.

H. All valves exposed to the weather to be fully protected to prevent corrosion regardless of size and/or type.

2.03 PIPE & FITTINGS

A. Piping to meet applicable ANSI or ASTM standards requirements and to have manufacturer's name and standard marked on each length. Unless specified otherwise below, joints to meet applicable ANSI and ASTM standards requirements. Where ANSI and ASTM standard does not exist, joints and fittings to bear UL listing and FM approval symbols.

B. Underground fire protection service piping to be ductile-iron thickness class 52, ANSI A21-51 with cement lining per ANSI A21.4. Fittings to be ductile-iron 250 psi rating per ANSI A21.10 with cement lining per ANSI A21.4. Pipe Joints to be push-on ANSI A21.11 with retainer glands and thrust blocks. All materials and installation to conform to NFPA 24 as the minimum.

C. Piping for all wet pipe automatic standpipe and fire sprinkler systems 2 in. and smaller to be Schedule 40 black steel, 2-1/2 in. and larger to be Schedule 10 Black Steel, including drain piping.

1. Schedule 10 black steel pipe with Victaulic Installation Ready grooved fittings may be used as an alternate on 2-1/2 in. and down piping. Manufactured by Victaulic, Style 101, 102 & 103 and style 104 nipples with full housing, pre-lubricated grade-E EPDM Type A gaskets. (No substitutions allowed when utilizing this method).

D. Piping for all dry pipe and/or pre-action fire sprinkler systems regardless of size to be Schedule 40 galvanized steel. Fittings for all dry pipe and/or pre-action fire sprinkler systems regardless of size and type to be fully galvanized

E. Piping for use with grooved end fittings to be roll grooved without metal removal or as per manufacture requirements.

F. Fittings for grooved end steel pipe to be cast of ductile iron conforming to ASTM A-536 or malleable iron conforming to ASTM A-47, or forged steel conforming to ASTM A-234 (A-106, Gr. B), with grooved or shouldered ends for direct connection into grooved piping systems with steel pipe and to be UL listed and FM approved. Provide flush seal gaskets on dry pipe and/or pre-action system piping.

1. **Rigid Type**: Basis of design: “Installation Ready” rigid joints to be Victaulic FireLock® EZ Style 009H and 107N in sizes 1-1/4 in. (DN32) through 12 in. (DN300) sizes. Designed for direct “stab” installation onto grooved pipe without prior disassembly of the coupling. Victaulic Style 009N.

    a. Housings to be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13.

    b. Rigid couplings to require visual pad-to-pad verification of complete installation. Tongue and recess type couplings which require the use of a torque wrench to achieve the exact required gap between housings are not permitted.

    c. Approved Equals are Tyco, Viking or Gruvlock

2. **Flexible Type**: Use in seismic areas where required by NFPA 13.

   a. Basis of design: “Installation Ready” flexible joints to be Victaulic Style 177N QuickVic in sizes 2 in. (DN50) through 8 in. (DN200), which to be designed for direct “stab” installation onto grooved pipe without prior disassembly of the coupling. .

   b. Basis of design: Standard flexible couplings to be Victaulic Style 77.

   c. Approved equals are Tyco, Viking or Gruvlock

G. Mechanical tee type hole-cut branch connections, with locating collar engaging into hole and with standard pressure responsive gaskets and nuts and bolts; or outlet couplings, with outlets grooved or threaded with standard pressure responsive gaskets and bolts and nuts to be UL listed and FM approved, and rated for 500 psi on piping 3 in. and larger, and 300 psi on piping under 3 in. in size and to all be of one manufacture. No strap, snap and or one bolt outlet fittings shall be permitted.

   1. Basis of design: Branch reductions on 2 in.(DN50) through 8 in. (DN200) header piping. Bolted branch outlets to be manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with synthetic rubber gasket, and heat treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183. Victaulic Style 920 / 920N.

   2. Approved equals are Tyco, Viking or Gruvlock

   3. Basis of design: Header connections for sprinklers, drop nipples, sprigs, gauges, and drains on 1-1/4 in. through 2-1/2 in. header piping. Outlets to be manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with synthetic rubber gasket, and heat treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183. Victaulic FireLock Outlet Tee Style 922.

   4. Approved equal are Tyco, Viking or Gruvlock

H. Standard cast iron black (CIB) sprinkler pattern screwed fittings to be used on all piping 2 in. and smaller and may be used on larger sizes.

   1. Schedule 10 black steel pipe with Victaulic Installation Ready grooved fittings may be used as an alternate on 2-1/2 in. and down piping. Manufactured by Victaulic, Style 101, 102 & 103 and style 104 nipples with full housing, pre-lubricated grade-E EPDM Type A gaskets. (No substitutions allowed when utilizing this method).

I. All pipe, fittings, valves, devices and associated appurtenances to be rated for pressures that may be developed.

J. Bushings to not be permitted where fittings of required sizes are manufactured. Care to be taken in the design of this work to avoid piping arrangements that would require bushings.

K. All close and shoulder nipples to be of corresponding materials as the pipe and to be extra heavy pattern.

L. All pipe and fittings exposed to the weather to be fully galvanized regardless of size and/or type.

M. All water based suppression system piping to be pitched back to toward the point of supply regardless of any requirements of any Codes and/or Standards and/or any references to the contrary.

2.04 PRESSURE GAUGES

A. Install water pressure gauges as part of the straight-pipe riser assembly and where indicated on the drawings, before and after the backflow preventer. Gauges to be of the Double Spring Bourdon type and have a 6- inch diameter face.

2.05 SPRINKLER HEADS

A. Sprinkler heads to be UL Listed and FM Approved.

B. Refer to drawing 7.0.01 for head types.

C. All exposed heads in Gym, mechanical rooms and storage room to have cages.

D. Pendant heads in all other areas to be concealed heads.

E. Concealed heads where shown on the drawings marked with (CC) shall have Custom Colors as selected by the Architect. Up to four custom colors shall be selected. Covers in ATC ceilings to be white.

2.06 FLOW SWITCHES

A. Flow switches to be vane-type with retardant control and to be provided for all sprinkler system zones as indicated on the drawings. Flow switches to contain the proper contacts to be wired to the building's fire alarm system by the electrical subcontractor.

2.07 FIRE DEPARTMENT CONNECTIONS

A. Wall Type Siamese Connections: Polished cast brass, flush wall type, with wall escutcheon and two-way connections. Connection size to be 6-inch outlet and two 2-1/2 inch female inlets, having Amesbury Fire Department standard threads, for the connection size indicated, as specified in NFPA 1963. Each inlet to have a clapper valve, and brass plate and caps with chain, polished chrome finish. Unit to have wall escutcheon of cast brass, finish to match connections, with words "STANDPIPE - FIRE DEPT CONNECTION" or "AUTO SKR. - FIRE DEPT CONNECTION," or "AUTO SKR. & STANDPIPE FIRE DEPT CONNECTION" in raised letters.

B. Before installation confirm connection type with Amesbury Fire Department.

2.08 SUPERVISORY DEVICES

A. Tamper Switches

All sprinkler system control valves to be provided with tamper monitoring switches and tamper proof covers and to contain the proper contacts to be wired to the building fire alarm system.

B. Low Pressure Switch

Provide low pressure switch, test valve and pressure gauge, to be wired to Building Fire Alarm system.

2.09 HANGERS AND SEISMIC BRACING

A. The requirements of NFPA-13, 2013 Edition to govern the installation of hangers, supports, bracing and flexible couplings. All couplings on horizontal portions of the sprinkler system to be rigid couplings unless otherwise noted on the drawings.

2.10 SLEEVES, ESCUTCHEONS AND FIRE SLEEVES

A. All pipe passing through floors, walls or partitions to be provided with sleeves having an internal diameter one inch larger than the outside diameter of the pipe.

B. Sleeves through outside walls to be Schedule 40 Black Steel pipe, set flush with surfaces, and to be painted with one coat of bitumastic paint, inside and outside.

C. Sleeves through masonry floors and interior masonry walls to be Schedule 40 Black Steel Pipe. UL listed flexible couplings to be provided within one foot of both sides of fire rated floor and/or wall penetrations.

D. Fire sleeves through interior non-masonry walls and partitions to be Schedule 10 Black Steel, with UL Listed Fire Stopping.

E. Escutcheons, unless otherwise indicated, to be cast brass chrome plated type and provided with a set-screw to properly hold escutcheon in place.

2.11 SIGNS AND TAGS

A. Signs and a corresponding chart to be provided and placed indicating the purpose of each control valve, test connection, main drain, auxiliary drain, alarm tests, Valve tags, minimum 2 in. diameter with brass hooks and chains to be provided and numbered as directed. (Flow arrow signs for piping to be provided on all mains in areas where piping is exposed.)

B. Coordinate the identification of the valves with the Fire Alarm zoning and equipment supplier for proper identification.

C. Submit to specifying engineer for review prior to tag assignment.

2.12 INSPECTOR TEST VALVE

A. Provide an inspector's test valve and sight glass with appropriately sized sprinkler orifice for each system zone, including common drain piping and drain to a safe discharge area.

2.13 SPRINKLER CABINETS

A. Provide for each sprinkler system, a metal cabinet containing spare sprinkler heads and wrenches. The cabinet size and number of each type spare sprinkler head to conform to NFPA-13, 2013 Edition.

2.14 ALARMS

A. Provide an electric sprinkler alarm bell for exterior mounting. Location to be determined by Amesbury Fire Department. Coordinate with Fire Alarm subcontractor.

2.15 FIRE SAFING

A. Size sleeves to provide a minimum of 1-inch clearance around piping.

B. Pack clearance spaces with Thermafibre Fire stopping. Caulk with fire-resistant, resilient waterproof compound, Flintguard 120-13 or an approved equal.

C. Ensure that fire ratings of floors and walls are maintained.

D. Approved equals are Holdrite, STI Fire Stop or FireBlock, Inc.

2.16 FIRE DEPARTMENT HOSE VALVES & RELATED EQUIPMENT

A. Provide Fire Department valves (FDV) and Fire Department Valve Cabinets (FDVC) where noted on the fire protection drawings. Cabinets and valves to be as manufactured by Potter-Roemer, Croker, Elkhart or approved equal, as follows:

1. Fire Department Valves (FDV): Fire Department valves to be Croker #5035, female inlet by male outlet, 300psi working pressure, complete with 2 ½ in. female by 1 ½ in. male outlet reducer and 1 ½ in. cap and chain. All components to be chrome plated finish.

2. Pressure restricting (system pressures less than 175 PSI) type fire department valves to be Croker #5066, female inlet by male outlet, 300psi working pressure, adjustable outlet pressure, complete with 2 ½ in. female by 1 ½ in. male outlet reducer and 1 ½ in. cap and chain. All components to be chrome plated finish.

3. Pressure regulating (system pressures 175 PSI and greater) type fire department valves to be Croker #5580, female inlet by male outlet, 400psi working pressure, non-adjustable outlet pressure, complete with 2 ½ in. female by 1 ½ in. male outlet reducer and 1 ½ in. cap and chain. All components to be chrome plated finish.

4. Fire Department Valve Cabinet (FDVC): Fire Department Valve Cabinet (FDVC) to be Croker Model FR2700 or equal fire rated, recessed style steel cabinet with solid door, white enamel interior, electrostatic white powder coat finish, continuous piano hinge, pull handle with roller catch. Fire department valve to be provided as outlined in item 1 above. Provide signage on door per that section of the specifications.

5. All hose threads to conform to the requirements of the Local Department.

PART 3 - EXECUTION

3.00 GENERAL

A. All system installation to comply with the latest NFPA Standards and referenced material as listed in the specifications.

3.01 INSTALLATION

A. Install all fire protection work in accordance with applicable NFPA Standards, and the Massachusetts State Building Code.

B. Install piping only after approval of shop drawings layout.

3.02 TESTS

A. Conduct testing of all above-ground sprinkler piping in accordance with NFPA 13 (2013 Edition).

B. All sprinkler piping to be hydrostatically tested at a minimum of 200 PSI for 2 hours without loss.

C. Fire Protection Sub-Contractor to conduct a full flow test of the sprinkler system utilizing the combination test & drain connection to verify the activation of fire alarm and supervisory alarms.

D. Complete and submit all necessary certificates and documentation of testing to satisfy all requirements of the Massachusetts State Building Code.

3.03 WORKMANSHIP

A. Any and all work under this section of the Specification found improper or of poor workmanship to be removed, repaired, and/or replaced at no additional expense to the Contract.

B. The Fire Protection work to be performed in harmony with other work in the building, and at such times as to not interfere with or hold back in an unwarranted manner any other trade. The Fire Protection work to be installed as fast as conditions allow, and it must be ready for use when the building is complete. In the event that any changes are required because of the installation of any substitutions, the costs of such to be borne by the Fire Protection Subcontractor making such substitutions.

3.04 LOSS OR DAMAGE TO EQUIPMENT

A. Any materials or equipment lost or damaged to be replaced or repaired to the satisfaction of the Architect, at no additional cost to the Owner.

3.05 WIRING DIAGRAMS

A. This Subcontractor to furnish wiring diagrams for all equipment furnished under this section for which wiring is to be installed by the Electrical Subcontractor, as directed by the General Contractor (or Owner).

3.06 BASES AND SUPPORTS

A. Except where noted, the Fire Protection Subcontractor to provide all bases and supports not part of the building structure, of required size, type and strength, as approved by Architect, for all equipment and materials furnished by him. All equipment, bases and supports to be adequately anchored to the building structure or pads to prevent shifting of position under operating conditions.

3.07 OPERATING INSTRUCTIONS

A. This Subcontractor, upon completion of the project, to prepare and submit to the Owner three sets of Owner's Manuals in the form of book binders.

1. Each set of the manuals to contain catalog cuts, installation & maintenance manuals, wiring diagrams, As-Built drawings, and approved shop drawings.

2. Each section to contain clearly marked tag numbers, appropriate model numbers with accessories, and sales representative address and phone numbers.

3. Last section of the binders to be reserved for complete sets of the As-Built drawings neatly folded to 8-1/2 in. x 11 in. size and bound into the section so that it can be folded out for review without the need for removal from the binder.

B. Refer to Section 017823 – Operation and Maintenance Data

C. Refer to Section 017900 – Demonstration and Training

3.08 CLEANING

A. Flush and clean systems in accordance with applicable standards.

END OF SECTION

Division 22
Plumbing

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SECTION 220001

PLUMBING

(FILED SUB-BID REQUIRED)

PART 1 GENERAL

1.00 TIME, MANNER AND REQUIREMENTS FOR SUBMITTING SUB-BIDS

A. Sub-bids to be submitted in accordance with provisions of the General Laws (Ter. Ed.), Chapter 149, Section 44A to 44L, inclusive, as amended. The time and place for submission to Sub-Bids to be set forth under INSTRUCTIONS TO BIDDERS.

B. Each Sub-Bid filed with the Awarding Authority must be accompanied by BID BOND, OR CERTIFIED CHECK, or a TREASURER'S CHECK OR CASHIER'S CHECK issued by a responsible bank or trust company, payable to the City of Amesbury, in the amount stipulated in the INSTRUCTIONS TO BIDDERS. A Sub-Bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Each Sub-Bid submitted for the work, under this SECTION, to be on a form furnished by the Awarding Authority, by SECTION 44F of Chapter 149 of the General Laws, as amended.

D. Work to be done under this section is shown on Contract Drawings numbered 8.0.01, 8.4.01, 8.4.02,8.4.03,8.4.04, 8.4.05, 8.5.01, 8.5.02, 8.5.03, 8.5.04 & 8.5.05 inclusive. Remaining Contract Drawings are included for reference and coordination.

E. Additional Requirements:

1. Sub-bidder's attention is directed to Massachusetts G.L. Chapter 149 §44H, as amended, which provides in part as follows:

2. Each sub-bidder to list in Paragraph E of the "Trade Contractor Bid Form" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub-trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work to be listed in Paragraph E under the conditions indicated herein.

Classes of Work	Reference	Specification Paragraphs
(1) Insulation	220001	2.04

F. In any case in which the sub-bidder intends to perform with persons of his own staff the class of work listed above, he must never the less list his own name therefore under Paragraph E of the filed subcontractor sub bid form.

1.01 GENERAL PROVISIONS

A. Part A and Division 1 of Part B are hereby made a part of this Specification Section.

B. Examine all Drawings and all Sections of the Specifications and requirements and provisions affecting the work of this Section.

C. Heating, pumping, and refrigeration systems to be installed by subcontractors and personnel appropriately licensed in the Commonwealth of Massachusetts (Installing Contractor).

1.02 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 01 91 13 – General Commissioning.

B. Complete installation and startup checks and functional tests according to Section 01 91 13 – General Commissioning and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the start-up procedure.

D. Verify that equipment is installed and commissioned as per requirements of Section 01 91 13 and manufacturers written instructions/requirements.

E. All points to be data logged as soon as they have been activated and to be made accessible to the commissioning agent.

1.03 SCOPE OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. New domestic water service from flange in the building including meter and backflow preventer. Domestic water piping to plumbing fixtures and equipment as indicated on the plans. Provide meter as per Amesbury Water and Sewer Commission standard.

2. New Gas-fired Hot Water Heaters with recirculation system. Hot water and recirculation pipe to each fixture. Hot water heater to be provided with drain pan and flood sensor interlocked with cold water shut-off as indicated on the drawings. Provide temperature wells for temperature sensor installation and wiring by BAS (SECTION 250001).
3. Provide sub-meters for domestic hot water and make-up water from boiler to be remotely monitored through BAS (SECTION 250001).
4. Combustion air flues and vent for domestic hot water heaters.
5. Plumbing subcontractor responsible for balancing hot water recirculation system. Provide balancing valves as indicated on the drawings to completely balance the hot water system.
6. Plumbing Fixtures, Domestic Water Heater and Accessories.
7. New sanitary and vent system as indicated on drawings.
8. New Kitchen waste and vent system including interior and exterior grease traps as indicated on the drawings. All kitchen waste piping to the grease trap and vent back through the building to be by the Plumbing Sub-Contractor. Site Contractor to set the exterior grease trap in the ground. Refer to Civil drawings for installation information.
9. New storm system including roof drains as indicated on the drawings. Provide temporary rain leader piping to divert water from roofs out of the building and into stormwater collection structure in accordance with the project stormwater prevention plan in the event that permanent rain leader system is not installed or ready to be utilized.
10. Gas piping from gas meter to Boilers, hot water heaters, kitchen and dedicated gas line to generator as indicated on the drawings. All venting required from gas equipment gas trains or regulators.
11. All wall hydrant and hose bibbs as indicated on the drawings.
12. Valves.
13. Insulation.
14. Hangers, supports and attachments.
15. All cutting, core drilling and channeling for plumbing work to be installed under this contract for holes five (5) inches in diameter or less.
16. Fire Stopping for plumbing pipe penetration in fire rated construction. Maintain indicated fire ratings of walls, ceilings and floors at pipe penetrations for fire stopping specified in section 220001. Provide UL listed fire rated assembly submittals for each job specific application required for your work. Follow the approved details at each location and provide acceptable fire rated labels at all locations.
17. Coordination drawings and record drawings and similar requirements.
18. Hoisting Equipment: The Plumbing subcontractor to furnish, install and maintain in safe and adequate condition all mechanical hoisting equipment, operating personnel and rigging that is necessary for the proper execution of the Work of this Section.

19. Staging, Planking and Scaffolding: The Plumbing subcontractor to furnish, install and maintain in safe and adequate condition, all staging, planking and scaffolding that is necessary for the proper execution of the Work in this Section.

20. Caulking around plumbing fixtures and counter top faucets.

B. Perform work and provide material and equipment as shown on Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

C. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

D. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

E. Refer to Division 0 for CM Supplemental instructions to Trade Contractors for additional requirements.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. The following items are not included in this Section and to be performed under the designated Sections:

1. Section 23 00 01 – HEATING, VENTILATING AND AIR CONDITIONING for coordination with HVAC piping and ductwork and for condensate drains.

2. Food Service Equipment. SECTION 114000, FOOD SERVICE EQUIPMENT

3. In general, all wiring required for equipment provided by the Plumbing subcontractor that requires wiring for this Plumbing equipment that is not shown or indicated on the Electrical Drawings of SECTION 260001 ELECTRICAL, to be provided under SECTION 210001, Plumbing.

4. Cutting to be the responsibility of this Trades Subcontractor and patching to be performed by the respective trades. Refer to the respective sections.

5. Section 01 91 13 – General Commissioning

6. Setting exterior precast concrete grease trap; excavation and backfill. Section 333000-Sanitary Sewer Utilities, Section 312000 Earthwork.

1.05 SUBMITTALS

A. Comply with requirements specified in Section 013300 – SUBMITTAL PROCEDURE.

B. Material and equipment requiring Shop Drawing Submittals to include but not be limited to:

1. Plumbing fixtures and trim.
2. Water heater and accessories.
3. Hot Water Heater flues and combustion air piping.
4. Piping.
5. Backflow preventers
6. Fittings, unions, flanges, and couplings.
7. Interceptors
8. Insulation.
9. Valves
10. Water hammer arrestors.
11. No-hub couplings.
12. Hangers, plates, and inserts.
13. Vibration isolation and flexible connections.
14. Exterior grease trap.

C. DEFINITIONS

1. As used in this Section, "provide" means "furnish and install" and "POS" means "Provided Under Other Sections". "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."

1.06 CONTRACT DOCUMENTS

A. Listing of Drawings does not limit responsibility of determining full extent of work required by Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, and other Drawings and other Sections that indicate types of construction in which work to be installed and work of other trades with which work of this Section must be coordinated.

B. Except where modified by a specific notation to the contrary, it to be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

C. Items referred to in singular number in Contract Documents to be provided in quantities necessary to complete work.

D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the subcontractor to provide all other components and materials necessary to make the systems fully complete and operational.

E. Information and components shown on riser diagrams but not shown on plans, and vice versa, to apply or be provided as if expressly required on both.

F. Data that may be furnished electronically by the Architect (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and to not substitute for the Architect's sealed or stamped construction documents.

1.07 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, advise the Architect in writing before Award of Contract. Otherwise, the Architect's interpretation of Contract Documents to be final, and no additional compensation to be permitted due to discrepancies or unclarities thus resolved.

B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert the Architect in writing before installation. Otherwise, make changes in installed work as the Architect requires within Contract Price.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specs, this subcontractor to provide that material, installation, or work which is of the higher standard.

D. It is the intent of these contract documents to have the subcontractor provide systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents were insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the subcontractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the subcontractor to provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

E. In cases covered by Paragraph (D) above, where the subcontractor believes he needs engineering guidance, he to submit a sketch identifying his proposed solution and the Architect to review, note if necessary, and approve the sketch.

1.08 MODIFICATIONS IN LAYOUT

A. Plumbing Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.

B. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from the Architect.

C. Check Contract Drawings as well as Shop Drawings of all subcontractors to verify and coordinate spaces in which work of this Section to be installed.

D. Maintain maximum headroom at all locations. All piping and associated components to be as tight to underside of structure as possible.

E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C, D above. Systems to be run in a rectilinear fashion.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to the Architect for review and approval.

1.09 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that affect work of this Section. No extra payment to be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observer.

1.10 EXISTING CONDITIONS AND PREPARATORY WORK

A. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or Contracts or by the Owner. Report conditions that might affect work adversely in writing through General Contractor to the Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work to be construed as complete acceptance of existing conditions and preparatory work.

1.11 CODES, STANDARDS, AUTHORITIES AND PERMITS

A. Perform work strictly by rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have legal jurisdiction over the site. Materials and equipment to be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Local and state building, plumbing, fuel gas mechanical, electrical, fire and health department codes.
2. American Gas Association (AGA).
3. National Fire Protection Association (NFPA).
4. American Insurance Association (A.I.A.) (formerly National Board of Fire Underwriters).
5. Occupational Safety and Health Act (OSHA).
6. Factory Mutual Association (FM).
7. Underwriters' Laboratories (UL).
8. American National Standards Institute (ANSI).

B. Material and equipment to be listed by Underwriters' Laboratories (UL), and approved by ASME and AGA for intended service.

C. Plumbing Fixtures and Potable water to meet both the NSF 61, lead free and NSF 372 test standards via third-party testing and certification.

D. When requirements cited in this Specification conflict with each other or with Contract Documents, most stringent to govern work. The Architect may relax this requirement when such relaxation does not violate ruling of authorities that have jurisdiction. Approval for such relaxation to be obtained in writing.

E. Most recent editions of applicable specifications and publications of the following organizations form part of Contract Documents:

1. American National Standards Institute (ANSI).
2. American Society of Mechanical Engineers (ASME).
3. National Electric Manufacturers Association (NEMA).
4. American Society for Testing and Materials (ASTM).
5. American Water Works Association (AWWA).
6. Thermal Insulation Manufacturers Association (TIMA).
7. Institute of Electrical and Electronics Engineers (IEEE).
8. Insulated Cable Engineers Association (ICEA).
9. National Fire Protection Association (NFPA).

1.12 GUARANTEE AND 24-HOUR SERVICE

A. Guarantee Work of this Section in writing for one year following the date of beneficial occupancy by the User Agency. If the equipment is used for ventilation, temporary heat prior to initial beneficial occupancy by the User Agency, the bid price to include an extended period of warranty covering the one-year of occupancy, starting from the initial date of beneficial occupancy by the User Agency. The guarantee to repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to the Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

B. In addition to guarantee requirements of Division 01 and of Paragraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in User Agency's name.

C. Replace material and equipment that require excessive service during guarantee period as defined and as directed by the Architect.

D. Provide 24-hour service beginning on the date the project is first beneficially occupied by the User Agency, whether or not fully occupied, and lasting until the termination of the guarantee period. Service to be at no cost to school. Service can be provided by this subcontractor or a separate service organization. Choice of service organization to be subject to the Architect and Project Manager approval. Submit name and a phone number to be answered on a 24-hour basis each day of the week, for the duration of the service.

E. Submit copies of equipment and material warranties to the Architect before final payment.

F. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to User Agency.

G. Part 2 Paragraphs of this Specification may specify warranty requirements that exceed those of this Paragraph.

H. Use of systems provided under this Section for temporary services and facilities to not constitute Final Acceptance of work nor beneficial use by User Agency, and to not institute guarantee period.

I. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately, advise the Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. The Architect shall suggest course of action.

1.13 RECORD DRAWINGS

A. Comply with requirements specified in Section 017839 - Project Record Documents

B. Drawings to show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules to show actual manufacturer and make and model numbers of final equipment installation.

1.14 BULLETINS, MANUALS, OPERATING INSTRUCTIONS, AND PROTECTION

A. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in coordinated manuals with additional information describing combined operation of field-assembled units, including as-built wiring diagrams. Manual to contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into three sections or books as follows:

1. Directions for and sequence of operation of each item of Plumbing systems. Sequence to list valves, switches, and other devices used to start, stop and control system. Include approved valve directory showing each valve number, location of each valve, and equipment or fixture controlled by valve.
2. Detailed maintenance and troubleshooting manuals containing data furnished by manufacturer for complete maintenance. Include copy of balancing report.
3. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment. Include additional instructions necessary for implementation of first class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.

B. Furnish three copies of manuals to the Architect for approval and distribution to owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit User Agency's personnel to become familiar with equipment and operation prior to acceptance.

C. Provide framed and glazed charts as follows: mount as directed by the Architect.

1. Flow diagrams from first part of manual as described above.
2. Valve directory.
3. Lubrication chart from third part of manual.

D. Operating instructions: Upon completion of installation or when Project Manager accepts portions of building and equipment for operational use, instruct User Agency's operating personnel in any or all parts of various systems. Instructions to be performed by factory-trained personnel. User Agency to determine which systems require additional instructions. Duration of instructions to take equipment through complete cycle of operation (at least five working days). Make adjustments under operating conditions. The Plumbing subcontractor to videotape all instructions given to the owner, and to provide up the three hours of videotape instructions. Three copies of the videotaped instructions to be submitted by the owner.

E. Each subcontractor to be responsible for his work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plug during construction to prevent entry of obstructing material.

F. Each separate subcontractor to protect the work and material of other trades that might be damaged by his work or workmen and make good all damage thus caused.

G. Refer to sections 017823 – Operation and Maintenance Data, Section 017839 – Project Record Documents and Section 017900 – Demonstration and Training.

1.15 COORDINATION DRAWINGS

A. This plumbing sub-contractor to prepare coordination drawings clearly showing how his work is to be installed in relation to the other trades such as HVAC, Electrical, Fire Protection and including sections and details, under Section 013300 – SUBMITTALS, and Division 0 – CM supplemental instructions to Trade Bidders, Attachment A – BIM execution plan.

1.16 LOCATION OF FIXTURES AND EQUIPMENT

A. The Architect shall establish the exact location of all fixtures, equipment, and devices to be located in finished spaces of the building. Such precise locations are, for the most part, indicated on the Architectural Plans of the various spaces, and it to be the responsibility of this SECTION 22 00 01 Subcontractor to obtain instructions from the Architect for the location of any items whose location is not specifically given on the Architectural Drawings. Any work installed contrary to the Architectural Drawings, or without the prior approval of the Architect, to be relocated and any necessary changing or patching of the surrounding work to be done at the expense of this SECTION 220001 Subcontractor.

1.17 ALTERNATES

A. Examine SECTION 012300-ALTERNATES for Scope of Work that may affect the work of this Section and include any deletions or additions in the Form for Sub-bid under the appropriate alternate.

PART 2 PRODUCTS

2.00 PIPE, FITTINGS AND JOINTS

A. All exposed gas piping to be painted by General Contractor. Outdoor piping to be color gray. Indoor piping to be color yellow.

B. Perforated PVC Piping (For Slab Drainage)

1. Pipe to be manufactured from virgin rigid PVC (Polyvinyl chloride) vinyl compound with a cell class of 12454 as identified in ASTM D 1784. PVC D 2729 sewer pipe dimensions and physical properties to conform to ASTM D 2729. All pipe to be manufactured in the United States.
2. Perforated pipe to have two rows of 7/8 in. diameter holes every 6 inches. Rows should be parallel to the pipe axis 120 degrees apart.

2.01 VALVES AND SUNDRIES

A. All systems under this section to be provided with valves to permit complete and sectional control of the system. They to be located to permit easy operation, replacement specified herein. They to be as manufactured by one of the following companies: Jenkins Brothers, Nibco, Apollo or approved equal, and to conform to description listed below. All valves 2-1/2 in. and smaller to be bronze body, 316 stem, extended handle (for insulation), Teflon seats and seals, adjustable packing box with removable retaining collar; sweat connection. 3 in. and larger to be iron body, bronze fitted solid body flanged.

B. Hot & Cold Water

1. Gate Valves: 1/2 in. - 2 in. Jenkins Model No. 1240
2. Ball Valves: 1/2 in. - 2 in. Apollo Series 82-100
3. Check Valves: 1/2 in. - 2 in. Jenkins Model No. 1222
4. Viega ProPress Valves: 1/2 in. – 2 in.

C. Gas valves 2 inch and smaller to be all bronze tapered thread Boston pattern with plug cock. 2-1/2 inch and larger, bronze body gate screw end, Jenkins #370 or equal.

D. Master mixing valves to be of the two-stage high-low solid bimetal type linked directly to valve porting, adjustable limit stop, color coded scale. Unit to be all brass/bronze construction, chrome plated suitable for exposed wall mounting complete with stops, pressure reducing valve, temperature and pressure gauges. Provide on HW main at HW Tank.

E. Drain Valves to consist of hose drain valve with cap and chain Jenkins Fig. No. 372.

F. Flanges on water piping to be companion type, faced and drilled for not less than 125 pounds of steam working pressure complete with necessary adapter, and to be of size and material of adjacent piping.

G. Unions on water piping to be suitable for a working pressure of not less than 150 pounds and to be of size and material of adjacent piping. Provide unions, screwed or flanged, where indicated and in the following locations:

1. In long runs of piping (over 40 ft.) to permit convenient disassembly for alterations or repairs.
2. In all equipment by-passes.
3. At all equipment connections such as tanks, pumps, heaters or equipment requiring disconnection for servicing, repairs, or replacement; locate all unions between shut off and equipment.

H. Provide shutoff valves where indicated and specified, and in the following locations, whether indicated or not:

1. At all bases of all risers either at the riser or at the point of takeoff from the main.
2. At all individual takeoffs to individual toilet rooms.
3. Locate all valves for easy access, operation and serviceability. Locate all valves with the stem in the vertical position.

I. Nonmetallic pipe insulators to be installed between all dissimilar pipe materials to prevent corrosion. Insulators to contain plastic separators for metallic-non-metallic contact. Pipe hangers that come in contact with piping of dissimilar materials to also be insulated via plating or shielding to guard against galvanic or cathodic corrosion.

J. Wall Hydrants to be Zurn Z-1310, Watts, JR Smith, Mifab, or equal all bronze, non-freeze type.

K. Automatic trap primer devices to be Zurn Z-1022, Watts, JR Smith, ProFlo, or equal. Trap primer piping is shown diagrammatically on plans. Run an individual 1/2 in. trap primer water line from the trap primer device to each floor drain or trench drain regardless of what is indicated on the plans.

L. Reduced pressure backflow preventers to be Watts Model #009QT, Zurn, Aqua, or approved equal, all bronze, of the sizes indicated on the drawings, with full port ball valves and spare parts kit.

M. Provide Circuit Solver, or approved equal, balancing valves of all brass construction and suitable for potable water duty. If standard balancing valves are used approved manufactures are taco, watts or nibbco, Plumbing subcontractor is responsible for balancing hot water recirculation system if standard balancing valves are used.

N. Shock Absorbers to be Watts LF15M2, or approved equal. Shock absorbers to be installed at all quick closing valves such as water closets, urinals and washing machines.

2.02 HANGERS AND ACCESSORIES

A. General

1. Provide pipe stands, supports, hangers and other supporting appliances as necessary to support work required by Contract Documents. All components of the hanger support system to comply with the standards set forth in MSS-SP58 and MSS-SP69 (Manufacturers Standardization Society) latest publication.

2. Manufacturers: Subject to compliance with requirements, provide hangers and supports of Carpenter and Patterson, Inc, ITT Grinnel Corp., Elecen Metal Products or approved equal.

B. Secure vertical piping to building construction to prevent sagging or swinging.

C. Space hangers for horizontal piping as follows:

Pipe Size	Rod Diameter	Maximum Spacing
1/2 and 3/4 A	3/8 in.	6 ft.- 0 in.
1 in. and 1-1/4 in.	3/8 in.	8 ft.-0 in.
1-1/2 and 2 in.	3/8 in.	10 ft.-0 in.
2-1/2 and 3 in.	2 in.	10 ft.-0 in.
4 and 5 in.	5/8 in.	12 ft.-0 in.
6 in.	3/4 in.	12 ft.-0 in.
8 in. and over	7/8 in.	12 ft.-0 in.

D. Friction clamps to be equal to Figures 126 and copper plated when in direct contact with copper or brass piping.

E. Hangers for uncovered (uninsulated) copper or brass piping 2 in. and smaller to be Carpenter & Patterson Figure 1ACT steel, copper plated band type.

F. Hangers for uncovered (uninsulated) steel or cast-iron piping 2 in. and smaller to be Carpenter & Patterson Figure 1A steel band type.

G. Hangers for all insulated piping to be clevis type with insulation shield specified below.

H. Where three or more pipes are running parallel to each other, factory fabricated gang type hangers with pipe saddle clips, or rollers may be used in lieu of the hereinbefore specified Clevis hangers. These hangers to be sized to provide for insulation protectors as hereinafter specified. Pipe saddle clips to be not less than 16-gauge metal and to be copper when installed with uninsulated copper piping. Where pipe rollers are provided for uninsulated copper or brass piping, insulation protectors to be provided at each set of rollers and filled with a section of heavy density fiberglass pipe covering specified hereinafter. (Refer to insulation of this specification.) Fig. 342 sized to suit loading with hanger rods and nuts.

I. Extension type split ring hangers with wall plates to be equal to Carpenter & Patterson Figures 81, 81-CT, 90-CT and 85, 85-CT plates for iron, steel and copper.

J. Hanger rods for other installations to be sized in accordance with the recommended load capacities of ASTM Specifications Designation A-107, latest amendment.

K. Insulation protectors (shields) for horizontal piping to be constructed of galvanized steel formed to a 180-degree arc and 12 in. long, equal to Carpenter & Patterson Figure 265P, 18-gauge type H for hangers 5 in. in size and smaller, 16 gauge for hangers larger than 5 in. in size.

L. Exposed rods, clamps and hangers to be electrogalvanized coated.

M. Installation of hangers which permit wide lateral motions of any pipe shall not be acceptable.

N. "C" clamps installed with pipe hangers or equipment hangers shall not be permitted unless provided with retaining straps.

O. All no-hub cast iron pipe 6 in. or larger in diameter to be braced to prevent horizontal movement by code and recommended by the Cast Iron Soil Pipe Institute by using braces, blocking or rodding as illustrated in the CISPI Handbook, Vol. II, Specification Section 310-78.

2.03 INSERTS AND ESCUTCHEONS

A. Inserts to be individual or strip type of pressed steel construction with accommodation for removable nuts and threaded rods up to 3/4 inch diameter, permitting lateral adjustment. Individual inserts to have an opening at the top to allow reinforcing rods up to 2 inch diameter to be passed through the insert body. Strip inserts to have attached rods with hooked ends to allow fastening to reinforcing rods.

B. Unless otherwise specified herein, escutcheons to be cast brass chrome plated type and provided with a set screw to properly hold escutcheon in place.

2.04 PIPE COVERING (INSULATION)

A. General

1. The pipe covering specified herein for piping system to be provided to strict accordance with the manufacturer's printed instructions, the best practice of the trade and to the full intent of this Specification.
2. Flame/Smoke Ratings: Provide complete fibrous glass pipe insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
3. Manufacturer: Subject to compliance with requirements, provide products of Johns Manville "Micro-Lok HP", Knauf Fiber-Glass, Owens Corning or approved equal.
4. Apply insulation after systems have been tested, proved tight and approved by the Architect. Remove dirt, scale, oil, rust and foreign matter prior to installation of insulation.
5. No leaks in vapor barrier or voids in insulation shall be accepted.
6. Insulation and vapor barrier on piping which passes through walls or partitions to pass continuously through sleeve, except that piping between floors and through fire walls or smoke partitions to have space allowed for application of approved packing between sleeves and ping, to provide fire stop by NFPA. Seal ends to provide continuous vapor barrier where insulation is interrupted.

B. Interior Cold, Hot Water, Hot Water Recirculation and horizontal rain water pipe insulation:

1. 1- inch insulation for all pipe sizes.
   a. ASTM E-547, Class I
2. Fire retardant foil face jackets for piping insulation: ASTM C-921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at installation option.
3. Encase piping fittings insulation with one piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.
4. Encase exterior piping insulation with aluminum jacket with weatherproof construction.
5. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
6. Provide product document submittals according to the LEEDv4-S rating system. The product must achieve IEQ Credit 2 Low emitting Materials rating requirement.

C. All exposed piping under sinks or lavatories to be provided with undersink piping cover equal to Lab Guard, Handy-Shield, Pro-Extreme or approved equal.

2.05 CLEANOUTS

A. Cleanouts to be Jay R. Smith, Josam, MIFAB or approved equal.

B. Bodies of cleanout in hub and spigot or no-hub piping to be standard pipe size conforming in thickness to that required for pipe and fittings, and to extend not less than 3/4 inch above the hub of the pipe. The cleanout plug to be of cast brass and to be provided with a raised nut 3/4 inch high. Cleanouts in threaded waste piping to be cast iron drainage "T" pattern 90 degree branch fittings with extra heavy brass screw plugs of the same size as the pipe.

2.06 PLUMBING FIXTURES

A. In general, the work of this Article to include, but not be limited to:

1. Plumbing fixtures and trim.
2. Faucets.
3. Stops and supplies.
4. Traps and tailpieces.
5. Drain outlets.
6. Mixing valves.
7. Flow controls.
8. Lavatory insulators.

B. Fixtures and Trim

1. Acceptable Manufacturers: Submit manufacturers not listed below for review and approval as specified for substitutions in this Section. All newly installed toilets, urinals and showerheads that are eligible for labeling must be WaterSense labeled.
    a. Faucets: Chicago Faucet Co., Kohler or Moen or equal.
    b. Stainless Steel Sinks: Elkay, Just Manufacturing, Metcraft Inc or equal.
    c. Wall hung sinks: American Standard, Kohler or Sloan
    d. Water closets and Urinals: Toto, Kohler or American Standard.
    e. Drinking Fountain: Halsey Taylor, Elkay or Haws
    f. Stops and Supplies: Chicago Faucet Co., Kohler or McGuire.
    g. P-Traps: McGuire, Sanitary-Dash, or Jameco.
2. Fixture Trim and Accessories: Provide fixtures faucets, drain outlets, tailpieces, P-traps and stops and supplies.
    a. Color and Finish: All trim exposed to view to be polished chrome plated, and all fixtures and toilet seats to be white unless specified otherwise.

b. Drain Outlets: Provide drain outlet of the same manufacturer as the fixture or faucet trim with chrome plated 17-gauge minimum weight tailpiece.

1) Provide 1-1/2-inch tailpiece on sinks.

2) Provide offset drain outlets on handicapped use lavatories and sinks.

3. P-Traps: Cast brass adjustable P-trap with cleanout plug, ground joint and 17 gage minimum weight extension with escutcheon.

a. Provide McGuire No. 8090 1-1/4 inch by 1-1/2 inch on lavatories.

b. Provide McGuire No. 8089 1-1/2 inch by 1-1/2 inch on sinks.

4. Stops and Supplies: Provide stops and supplies of the same manufacturer as the fixture or faucet trim, or provide McGuire Model 170-LK loose key angle stop with 5 inch long 2-inch nominal copper sweat extension, bell escutcheon, and 3/8 inch O.D. by 12 inch flexible riser.

5. Sinks: Seamlessly drawn, self-rimming minimum 18 gauge, type 302 (18-8) nickel bearing stainless steel with 1-3/4 inch minimum rounded corners, satin finish, and fully undercoated.

6. Faucets: Chrome plated cast brass with stainless steel seats and monel stems. Gooseneck spouts to be interchangeable and convertible rigid/swing type. Handles to be interchangeable with square handle broachings.

7. Water Conservation: Provide water conserving fixtures (water sense labeled) and trim incompliance with the following maximum water use requirements.

a. Water closets – 1.28 GPF

b. Urinals – 1/8 GPF

c. Lavatories – .35 GPM

d. Classroom – .5 GPM

e. Breakroom Sinks – 1.5 GPM

C. Refer to plumbing schedule on 8.0.01 for fixture make and model.

2.07 GAUGES AND THERMOMETERS

A. General

1. Gauges and thermometers to be as manufactured by U.S. Gauge Ashcraft, Trerice or equal.

2. The accuracy of all gauges and thermometers to be within one percent of the scale range.

3. Thermometers to be located at all water heater outlets and on all hot water return after immersion aqua stat. Provide copper separable socket and socket wells.

B. Thermometers: (At Hot Water Heaters)

1. Thermometers without mercury type. The Thermometer to be graduated to "degrees F" and to have a range so that the normal operating temperature shall be in the middle of the scale.

2. The face of the thermometer to be large enough so it may be read from the floor.

2.07 VACUUM BREAKERS AND PRESSURE GAUGES

A. Approved vacuum breakers to be installed with any plumbing fixture or equipment in which the potable supply outlet may be submerged and which cannot be protected by the minimum air gap. This includes all fixtures with hoses or a means for attaching hoses.

B. All vacuum breakers to be certified by a recognized testing laboratory acceptable to the Administrative Authority.

C. Vacuum breakers to be installed with the critical level at least six in. (6 in.) above the fixture they serve and on the discharge side of any control valve.

D. Pressure gauges to be brass or stainless steel case, and to be four in. (4 in.) in diameter with a range of 0 to 150 psi, as manufactured by U.S.Gauge, Ashcraft or Omega. Furnish gauge cocks on all gauge connections to permit removal and/or repair without shutting down systems. All gauges to also be equipped with "snubbers" or to be liquid fill.

2.08 ACCESS PANELS

A. Furnish access doors and frames for walls and ceilings to applicable trades for installation. Size for access and maintenance, minimum 16 in. by 16 in.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. J. L. Industries, Inc.
2. Karp Associates, Inc.
3. Larsen's Manufacturing Company.
4. Milcor Inc.

C. Flush Access Doors and Trimless Frames: Fabricated from steel sheet.

1. Locations: Wall and ceiling surfaces as applicable.
2. Door: Minimum 0.060-inch-thick sheet metal, set flush with surrounding finish surfaces.
3. Frame: Minimum 0.060-inch-thick sheet metal with suitable bead flange.
4. Hinges: Continuous piano.

5. Lock: Cylinder, keyed alike.

D. Fire-Rated, Insulated, Flush Access Doors and Trimless Frames: Fabricated from steel sheet.

1. Locations: Wall and ceiling surfaces as applicable.
2. Fire-Resistance Rating: Not less than that of adjacent construction.
3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch .
5. Frame: Minimum 0.060-inch thick sheet metal with suitable bead flange.
6. Hinges: Continuous piano.

   Automatic Closer: Spring type.
7. Lock: Self-latching device with cylinder lock, keyed alike.

2.09 WATER HEATER (DWH-1 & 2)

A. Each hot water heater to be gas-fired of the size and capacity noted, glass lined complete with Watts, or equal, pressure / temperature relief valve, vacuum breaker, thermostatic mixing valve, Expansion tank and shut-off valves on hot and cold-water piping.

B. DWH-1 & 2 Gas-Fired Hot Water Heater to be LAARS Model 120T4003NA, Lochinvar, PVI, or equal, high efficiency condensing type having 120-gallon storage capacity, 399,000 BTU/HR gas input, 456 GPH, 40 to 140 degrees F and 96% efficiency. Tank to be of glass-lined steel tank construction and design certified by the Underwriter Laboratories under Volume III tests for commercial heaters. Tank to be constructed in accordance with ASME code 125# working pressure and to bear the ASME labels. The condensing flue coil to be coated on the flue gas side with an acid resistant glass lining designed for use in condensing heaters. The heater to be suitable for sealed combustion direct venting using 4 in. round high temperature PVC air intake and exhaust vent piping. Heater to be factory assembled and tested and to be approved for 0 in. clearance to combustibles. Heater tank to have a 3-year warranty against corrosion or sediment build-up. Tank to be factory insulated with foam insulation. Insulation to meet or exceed the thermal efficiency requirements and energy factor requirements of ASHRAE/IES standard 90.1b-1992. The outer tank jacket to have a baked enamel finish over a bonderized undercoating.

C. Manufacturer representative should be present for hot water heater start-up and start up report to be submitted for record.

D. Combustion Air and Vent Flues for high efficiency condensing type gas-fired domestic hot water heaters and boilers to be furnished and installed by the Plumbing subcontractor. The installation to be performed in strict accordance with the manufacturer's installation manual.

E. Combustion air and vent flues to be of the non-metallic type (high temperature CPVC) and of the size as specifically recommended by the equipment manufacturer, complete with weather proof concentric fitting, thimbles, flashing, fire stop spacers (at all wall/floor/ceiling penetrations) and all required fittings & accessories to make a complete and operable installation.

F. Furnish and install a Powers – LFISO75VL00 Intellistation JR., or equal, Digital water mixing valve for DWH-1 & DWH-2, Domestic Water System. Mixing valve to be installed in strict accordance with manufactures recommendation.

G. Recirculation pump to be Grundfos Magna 32-60, or approved equal. Taco, vilo & Bell & Gossett. Provide interface for BMS.

H. Expansion tank to be Elbi, or approved equal. Flexcon, Amtrol or Taco.

2.10 KITCHEN EQUIPMENT

A. All kitchen equipment to be furnished and set in place, complete with faucets by the Kitchen Equipment subcontractor.

B. Plumbing subcontractor to furnish and install all trim including traps, supplies, stops as specified under fixtures above in this section.

C. Interior grease trap to be Schier Great Basin, Zurn, JR Smith, MIfab or approved equal, rated for 50 gpm flow rate and provided with an acid resistant coating and receiving cradle for floor recessed installation.

D. Provide inline backflow preventers Watts Model 9 D, Appollo, Zurn, or equal for any kitchen equipment required by code, including but not limited to coffee machine, ice machines, dishwashers and pot sink.

E. Provide Gas solenoid valve system interlocked with Ansul system and co/methane detection. Refer to drawings for more information,

2.11 FIRE STOPPING

A. Seal openings of fire rated construction with a material or product that has been tested at an independent testing laboratory, such as UL, FM. Fire stopping to conform to ASTM E-814 and UL 1479, with fire ratings equal to or exceeding the fire rating of the construction involved. Fire stopping to be UL classified, and to be similar to the 3M brand Fire Barrier Penetration Sealing Systems, GE Silicones, Calpico Inc or approved equivalent. Fire stopping of this type to also be utilized for openings through smoke rated construction.

B. If desired by the Subcontractor and approved by local codes, the “Pro-Set” piping penetration system also may be utilized. Penetration system to be UL certified and to be the “Pro-Set” System A. Firestop coupling (sleeve) to be filled with ceramic fiber material to provide insulation and fire stopping. System to be capable of maintaining a 3-hour fire rating. Penetration system to be secure, waterproofed, fire rated and smoke proof and to allow for pipe expansion and contraction.

C. Smoke proof and Seal all plumbing pipe penetration in corridor wall regardless it is rated or unrated wall construction.

2.12 SLEEVES AND PENETRATIONS

A. Piping penetrations through fire rated construction to comply with a listed fire rated assembly as detailed in the UL Fire Resistance Directory. Pipe sleeves through floors, exterior walls and fire-rated construction to be galvanized Schedule 40 steel pipe. Pipe sleeves through non-fire-rated partitions to be 26-gauge galvanized steel.

1. Sleeves Through Exterior Below Grade Foundation Walls and Floor Slabs on Grade: Provide galvanized Schedule 40 steel with continuous weld slop on welding flange water stop. Provide waterproof caulking assembly by Link-Seal or Sure-Seal.
2. In areas where pipe is exposed, install sleeves flush with the finish floor, except in mechanical rooms, and janitor's closets extend sleeves at least 4 in. above finish floor.
3. Annular Space Requirements: Sleeves to be sized to provide a total clearance of approximately 1 inch around pipe including insulation cover. Annular space around fire rated through penetrations assemblies to be in compliance with the Listed Assembly.
4. Packing between the pipe and sleeve in fire rated construction to be a combination of listed insulation and fire-proof caulk.

B. Where piping passes below grade beams and footings, provide a ductile iron sleeve three sizes larger than the pipe being served. Sleeve to be a minimum of six feet in length.

2.13 VALVE TAGS

A. Upon completion of piping installation work provide valve tags on all valves installed under the work of the mechanical sections. Valve tags to be at least 1-1/2-inch diameter brass or engraved plastic with 1/4 inch high lettering for service designation over 2 inch high consecutively numbered valve identification. Engraved valve tags to be color coded as specified for piping identification. Coordinate valve tag numbers with the City of Amesbury facility management program. Provide service designation prefix as scheduled:

1. Plumbing Systems:		Prefix:
a.	Domestic Cold-Water	CW
b.	Domestic Hot Water	HW
c.	Domestic Hot water recirc.	HWR

B. Valve tags on plumbing systems may be engraved laminated plastic tags color-coded to match the pipe identification marks.

2.14 PIPING IDENTIFICATION

A. Provide matching flow arrows to indicate direction of flow. Markers to be equal to Seton Setmark. Pipe marking for outside diameters of 6 in. or greater may be springs or metal bands secured to the corners at each end of the semi-rigid plastic marker to hold each end of the marker firmly against the pipe.

1. Color coding and size of legend letters to comply with the standards of ANSI A13.1.

2. Provide markers with legend letters sized in compliance with the following schedule:

Outside Diameter (Over Insulation)	Size of Letters	Length of Color Code
1-1/4 in. and smaller	2 in.	8 in.
1-1/2 in. to 2 in.	3/4 in.	8 in.
2-1/2 in. to 6 in.	1-1/4 in.	12 in.
8 inch	2-1/2 in.	24 in.
10 in. and larger	3-1/2 in.	32 in.

3. Plumbing Systems: Provide color-coded identification markers in compliance with the following schedule with contrasting legend letters.

Service	Identification	Color Code
Cold Water	Dom. Cold Water	Green
Hot Water	Dom. Hot Water	Yellow
Soil or Waste	Sanitary	Green
Vent	Plumbing Vent	Green

2.15 IDENTIFICATION OF EQUIPMENT

A. Equipment: Stencil equipment such as pumps, water heaters, and tanks with the name of the equipment and equipment number. Coordinate equipment numbers with the User Agency's maintenance personnel. Stencils to be at least 6 in. high and of a color to provide a contrast with the equipment finish.

B. Equipment markings to be prominently displayed on each normally visible side of equipment. Equipment intended for installation in finished area to have markings located behind normally used access panels mounted so as to be readily found. Equipment identification designations to be taken from equipment schedules as indicated on the Drawings.

2.16 SUMP PUMPS

A. General: Sump pumps to be Stancore, Little Giant or Webtrol.

B. Sump pumps at Elevator Pits to be Stancore Model SE-50, or approved equal, of all stainless steel construction and with 10 ft. power cord and integral float switch, 50 GPM @ 25 ft. head, 1/3 HP, 115V/1 PH.

1. Each elevator sump pit pump to be provided with water Minder detection system, or approved equal, oil/water detection system complete with control panel, alarm panel, oil “film” level sensor, 10 ft. power cord and extra set of dry contacts for DDC monitoring, 115V/1 Ph power. Connection to BAS to be by ATC sub-subcontractor under HVAC Section.

2.17 EXTERIOR GREASE TRAP

A. Grease trap to be provided and piped by the Plumbing Sub-contractor. Site contractor to install the grease trap and provide the covers to grade. Refer to Civil drawings and details for more information.

B. Grease trap to be of reinforced precast concrete construction. Connections, capacity and openings to be as detailed on the drawing 8.6.02. Structure to be reinforced for H20 loading. A minimum 24-inch diameter opening to be cast in the center of the tank and over the inlet and outlet tees. Manhole covers to be raised to finish grade by providing watertight precast 24-inch i.d. risers, or approved equal. Each riser to be topped with a watertight frame and cover per Section 2.03, brought to finished grade as shown on the civil plans.

2.18 DOMESTIC WATER SUB-METERS

A. Furnish and install ONICON or equal, model F-3500 water flow meter. Furnish 24VDC power supply with plug connection. Coordinate power wiring with Section 260000. Unit to be capable of providing BACnet output. All BACnet control wiring to be by Section 230000.

PART 3 EXECUTION

3.00 GENERAL

A. The work of this section to be coordinated with that of associated trades.

B. The Plumbing Subcontractor is fully responsible for the proper execution and performance of the work described herein.

C. Pipe to be cut accurately to measurements established at the site, to be worked into place without springing or forcing. All pipes, without and exceptions throughout the job, to be reamed smooth and all burrs removed before being installed. All work to be executed in a workmanlike manner, and to present a neat and mechanical appearance. All pipes to run parallel or perpendicular to building lines and to be properly graded. All pipe connections to be made in a manner that shall allow for freedom of movement during expansion and contraction. All installation methods to comply fully with all applicable Codes and Standards. All plumbing work to be in accordance with the State Plumbing Code (248 CMR).

D. Piping system to be installed so as to have sufficient flexibility to prevent thermal expansion caused damages to the piping materials or anchors, leakage at joints or distortion at connected equipment. The flexibility to be provided by properly designed offsets, loops or expansion joints. All pipe lines containing expansion joints or loops to contain anchors and guides and to be made in the horizontal position to avoid water pocketing.

E. Unions or Flanges and valves to be provided to all plumbing equipment allowing proper replacement or servicing.

F. The Plumbing subcontractor to coordinate and provide all necessary information to the General Contractor of all plumbing related penetrations, opening, access, cutting and patching requirements.

G. No plumbing fixtures, devices equipment or piping to be installed which shall provide a cross connection between a distribution supply for cold water or domestic hot water system and a polluted supply or drainage system.

H. Fixtures, equipment and accessories to be set level, plumb and in proper alignment with reference to adjacent walls. All surfaces coming in connection with walls, floors or other equipment and fixtures to have properly leveled surfaces with suitable contact on wall and floor.

I. Clean all exposed metal surfaces of grease, oil, dirt or other foreign material. Chrome plated piping, fittings and trimmings to be polished upon completion. Fixtures and equipment to be properly protected from damage during the construction period and to be cleaned in accordance with manufacturer's instructions. The Plumbing Subcontractor to be held responsible for the proper location of all blocking and supports and proper alignment of all fixtures. Unless otherwise noted, all trim above and below fixtures to be chrome plated. Upon completion of work, adjust all stop valves, flush valves, balancing valves, control valves and faucets.

3.01 SANITARY & RAINWATER LEADER SYSTEM - INSTALLATION

A. Interior sanitary and Rainwater leader systems to pitch in accordance with Code requirements, unless otherwise noted.

B. All changes in pipe size and direction on soil and waste piping to be made with Y's and clean out, reducing fittings or recessed reducers. Y's and 45-degree fittings or 45-degree combination fittings to be used wherever conditions permit.

C. Sanitary long sweep bends and Y's to be used for connections on branch lines for fixtures and TY's on vertical runs of pipe. Long turn fittings to be used wherever conditions permit.

D. All fittings, regardless of type, to be furnished complete with the necessary bolts, nuts and washers, as well as brass or chrome plated nipples of the proper length.

E. Clean out to be installed where indicated on the drawings, or approximately every 50 feet (50 ft.) for 4 in. and smaller and every 100 feet (100 ft.) for 5 in. and larger along horizontal runs, at all changes of direction, and at the base of all soil and waste stacks. Test tees with brass clean out plugs to be installed at the base of all vertical piping. Clean out in or back of walls to be extended out to finished wall and finished with flush metal access panel. Clean out located above hung ceiling are to be accessible through metal access panels.

F. Vents to be extended sufficiently above roof so that outlet to be minimum of 24 in. above roof.

G. Fittings for piping above ground to be drainage pattern for all threaded and/or soldered drain and waste piping.

H. Horizontal piping to be installed with a pitch of not less than 1/8 in. per ft., unless otherwise indicated. Buried piping to be laid on a firm bed surrounded by 2 diameters of pea stone for its entire length, except where support is otherwise provided for and approved by the Architect prior to backfilling. All vents to be provided as shown and in accordance with local requirements. Provide hangers, as noted above in this section.

3.02 DOMESTIC HOT AND COLD-WATER SYSTEM - INSTALLATION

A. Also refer to 220000-3.01.

B. All water piping to be installed without traps or pockets and to pitch to draw-offs so that the whole system or individual sections can be completely drained. Piping to be graded and valved to allow for complete drainage of the system. All draw-off valves to have hose connections and to be capped. Piping to be pitched upward toward risers and fixtures for proper air relief. Piping subject to expansion to be flexible and made to accept shock without damage or noise.

C. Change in pipe sizes to be made with concentric reducing fitting. Use of bushing to not be permitted.

D. All water piping to be protected from water hammer by use of manufactured shock absorbers, with air chamber separated from water contact, at ends of all branch risers, ends of battery branches and at all fixtures.

E. Water piping to be installed complete to all plumbing fixtures.

F. Check with Local Authorities regarding any specific requirements above and beyond the specified herein.

3.03 GAS SYSTEM INSTALLATION

A. Service work to include connection to the gas service at the meter location.

B. Work to include a complete elevated pressure and low-pressure gas piping system for all gas-fired equipment as indicated on the drawings, complete with all necessary pressure reducing regulators and vent piping.

C. Refer to other parts of this SECTION for description of piping, valves and other appurtenances to the gas system.

D. Piping inside the building to be installed as shown, firmly secured to building structure with mains and branches all graded evenly to drip points. Gas shut-off valves to be provided on branches to all risers at each appliance or outlet connection, and where shown. Suitable approved drip pockets to be provided at all low points in piping. Straight malleable iron couplings to be used in extending the piping.

3.04 TESTING OF PIPING SYSTEMS

A. General

1. Test all piping systems with water at the pressure head stated for the time interval required without adding water. While any system is being tested, required head pressure to be maintained until all joints are inspected.
2. All tests to be witnessed by the inspector having jurisdiction with 48-hour notice given these authorities
3. Provide all equipment, material, and labor required for testing any of the various systems or any part thereof.

B. Sanitary and Rainwater Leader Systems

1. Test all drainage systems either in their entirety or in sections, after rough piping has been installed. Each section to be filled with water but no section to be tested with less than a ten ft. head of water. In testing successive sections at least, the upper ten feet of the next preceding section to be tested so that no joint of piping in the building except the upper most ten feet of the systems to be submitted to a test of less than a ten ft. head of water. The water to be kept in the system for at least 15 minutes before the inspection starts, the system to than be made tight at all points.

C. Interior Water Piping Systems

1. Upon completion of the entire water supply system or a section of it, it to be tested and proved tight under water pressure of 150 psi. Gauge should be located on the lowest point in the system and pressure to hold for a period of one hour without introducing additional water. The water used for testing to be from a potable source of supply.

D. Natural Gas System

1. Test entire natural gas system in strict accordance with the local gas company requirements but, not at less than 6 in. of mercury.

E. Additional Tests

1. Provide all additional tests such as smoke or pressure tests by the regulations or as directed by authorities making the inspection.
2. Provide for any repeated test as directed by the Architect, to make all systems tight. Upon completion of the work, and after the systems are set, this Subcontractor to conduct performance tests of the various systems. These tests to be carried out under the supervision of the Architect prior to acceptance of the systems and to be arranged for the purpose of demonstrating satisfactory functional and operating efficiency and he shall provide all adjustments, ladders, lubricants, test equipment and personnel required for these tests.
3. Visual inspections of joints, valves, to be made as directed by the Architect.

F. Defective Work

1. If inspection or tests show defects, such defective work or material to be replaced and inspection tests to be repeated. All repairs to piping to be made with new material. No caulking or screwed joints or holes shall be acceptable.

3.05 DISINFECTION OF WATER SYSTEM

A. All water piping to be filled with a solution of chlorine and water (0.5-1.5 ppm) and allowed to stand for at least 48 hrs. After the system has been drained and flushed, and refilled, a sample of the water to be taken to the local health department for testing. If it has been that all impurities have not been removed, the above to be repeated until the system is free of all impurities and has been approved by the Department of Health. A copy of said certificate to be turned over to the Architect for record.

B. All labor and fees associated with the disinfection activities along with any premium time for work conducted outside of normal working hours included.

3.06 VALVE TAGS AND CHARTS

A. All valves on pipes of every description to have neat circular brass valve tags of at least 1-1/2 in. in diameter, attached with brass hook to each valve stem. Stamp on these valve tags in letters as large as practical the number of the valve and the service zone, such as “H.W.”, “C.W.” for hot water, cold water respectively. The numbers of each service to be consecutive.

B. These numbers to correspond to the numbers indicated for the valves on the record drawings and on two printed detailed lists. These printed lists to state the numbers and locations of each valve and fixture or group of fixtures which it controls, and other necessary information, such as requiring the opening or closing of another valve or valves, when any one valve is to be opened or closed.

C. These printed lists to be typed and framed under glass, and mounted as directed by the Architect.

3.07 CLEANING AND ADJUSTING

A. After the completion of the work, all material and equipment surfaces to be cleaned and polished in accordance with the finish of the material. All chromed surfaces to be highly polished. All systems to be thoroughly adjusted for perfect intended operation. Flushometers, faucets, tempering valves to be adjusted for flow, temperature of water. Pumps, relief valves, and pressure reducing valves to be adjusted.

3.08 TRAINING

A. Conduct a training course for the maintenance and operating staff. The training period of 40 hours normal working time to start after the system is functionally complete but before final acceptance tests. The training to include all of the items contained in the operating and maintenance instructions as well as demonstrations of routine maintenance operations. The owner’s Representative to be given at least two weeks advance notice of such training.

B. During all working hours of the one-week operating test, the Plumbing Subcontractor's instruction personnel to be available for and provide thorough and detailed training to the Owner's operating and maintenance personnel in operation, maintenance and adjustment of all equipment installed. The instructions to be videotaped by the Subcontractor. The master tape and one(1) copy to be turned over to the Owner not more than 10 days following the completion of the training.

C. Give sufficient notice to the designated operating personnel of the owner in advance of this period. Upon completion of instruction, obtain from such representatives written verification on that which the above mentioned instruction has been performed, such verification to be forwarded to the Architect.

D. A factory-trained field representative to provide on-site training for subcontractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative to periodically review the product installation. Subcontractor to remove and replace any improperly installed products.

3.09 INSPECTION

A. The Plumbing subcontractor to inspect all surfaces, areas and other contingent construction in or to which his work is to be installed and assure himself that they are in proper condition to receive the work to be performed under this section. The Subcontractor to notify the Architect in writing, before any work is installed, of any condition requiring corrections. Failure to make such a report to be construed as acceptance of the existing conditions and the responsibility to provide an acceptable installation.

3.10 COORDINATION

A. Obtain detailed information from the manufacturers of apparatus which is to be furnished as to the proper method of installing and connecting same. Obtain all information from the General Contractor (or Owner) and other subcontractors which may be necessary to facilitate the work and to complete the whole project.

B. Refer to the HVAC drawings and also to all other drawings for a full comprehension of the extent and detail of the work to be performed. Any HVAC work indicated, on any drawings, is to be considered.

C. The Plumbing subcontractor, before installing any of his work to see that it does not interfere with the clearance required for finished columns, pilasters, partitions, walls, and ceilings, as shown on the contract Architectural Drawings and details.

D. Any work installed by the Plumbing subcontractor, which interferes with or modifies the Architectural designs as shown on the contract drawings to be changed as directed and at all costs incident to such changes to be paid by the subcontractor

E. In any and all cases of discrepancy in figures, plans or specifications, the matter to be immediately submitted to the Architect for decision before doing any work.

3.11 WORKMANSHIP

A. Any and all work under this section of the Specification found improper or of poor workmanship to be removed, repaired, and/or replaced at no additional expense to the Contract.

B. The Plumbing work to be performed in harmony with other work in the building, and at such times as to not interfere with or hold back in an unwarranted manner any other trade. The Plumbing work to be installed as fast as conditions allow, and it must be ready for use when the building is complete. In the event that any changes are required because of the installation of any substitutions, the costs of such to be borne by the Plumbing Subcontractor making such substitutions.

3.12 CODES, ORDINANCE AND PERMITS

A. All work to be performed in strict accordance with local and state codes and regulations of such offices having jurisdiction. All equipment to comply with the requirements of all pertinent Codes and Authorities, including that of the Owner's insurance company.

B. Any material or labor called for or implied in the above-mentioned requirements, even though not specified or shown on the drawings, to be furnished and installed by the Subcontractor as though they had been specifically mentioned or indicated. If the drawings or specifications are at variance with any of the above-mentioned regulations, the bidder to so notify the Architect in writing before signing the contract. Failure to do so to relieve the Owner of responsibility in this regard.

C. Secure and pay for any and all permits that may be necessary in connection with the installation of this work.

D. The Subcontractor, under this section of the Specifications, to be responsible for the supervision of his personnel at the site and the inspection of equipment and appliances provided by him to assure a safe working environment in compliance with OSHA rules and regulations. In addition, this Subcontractor to report all possible violations to the General Contractor in writing, observed in areas by his personnel. Failure to do so to constitute this Subcontractor's compliance of the working conditions and responsibility. This Subcontractor to ascertain, from examination of the contract drawings, whether any special temporary openings in the building for the admission of apparatus furnished under this Contract shall be necessary. He is required to notify the General Contractor with sufficient notice. He to pay all costs of making all opening in case of failure to give his notification in time for the General Contractor to arrange for same during construction. This Subcontractor to take particular care to protect any finished work from vandalism or possible injury and must remedy any and all injury caused thereto by his operation of the operations of other Subcontractors. This Subcontractor to provide suitable protection for all equipment furnished under this contract while stored at this project site, during and after installation. This protection to be suitable to guard equipment items against damage from the weather or from construction activities. Such protection to not be removed until directed by the Architect. Piping and equipment to be kept in a clean condition, free from dirt and debris. All piping and equipment items to be thoroughly cleaned before the startup of any equipment or system

3.13 LOSS OR DAMAGE TO EQUIPMENT

A. Any materials or equipment lost or damaged to be replaced or repaired to the satisfaction of the Architect, at no additional cost to the Owner.

3.14 WIRING DIAGRAMS

A. This Plumbing Subcontractor to furnish wiring diagrams for all equipment furnished under this section for which wiring is to be installed by the Electrical Subcontractor, as directed by the General Contractor (or Owner).

3.15 BASES AND SUPPORTS

A. Except where noted, the Subcontractor to provide all bases and supports not part of the building structure, of required size, type and strength, as approved by Architect, for all equipment and materials furnished by him. All equipment, bases and supports to be adequately anchored to the building structure or pads to prevent shifting of position under operating conditions.

3.16 IDENTIFICATION & NAME TAGS

A. Equipment Identifications.

1. All equipment to have nonferrous metallic manufacturers name plate secured.
2. When installation of equipment results in access to the name plate difficult due to obstructions and/or insulation, a new name plate containing identical information must be secured to the unit in such locations to afford easy access. The new name plate to have all information typed on white paper, plastic laminated for weather proofing, and secured to the equipment. Each equipment to have tag name and number stenciled on with designation as indicated on the equipment schedule using black enamel paint.
3. All equipment to have stenciled on enamel black paint the tag numbers as assigned on the equipment schedules on locations clearly visible.

B. Pipe Identification

1. Provide color coded pipe identification markers on all piping in the building installed under this Section. Pipe markers to be heavy plastic faced cloth labels with heat resistant backing, Set Mark by Seton Nameplate Corporation, Zipper Tubing Co., or equal by the W. H. Brady Company, or equal.
2. Provide an arrow marker with each pipe content marker to indicate the direction of flow.
3. Piping mains to be labeled at 20 ft. intervals and on entrance and exit from the Mechanical Room, adjacent to each valve and at both sides of wall penetrations. This work to be done after finish painting has been completed.

4. In general, a 2 in. high legend to be used for pipe lines 4-inch diameter and larger, and a 3/4 in. high legend to be used for pipe lines 3-inch diameter and smaller.

5. All markers to be OSHA approved.

6. In addition, all elevated pressure gas piping to be painted yellow and all low-pressure gas piping to be painted grey.

3.17 OPERATING INSTRUCTIONS

A. The Plumbing Subcontractor, upon completion of the project, to prepare and submit to the Owner three sets Owners Manuals in a form of book binders.

1. Each set of the manuals to contain catalog cuts, installation & maintenance manuals, wiring diagrams, As-built drawings (including the schedule sheets revised to reflect actual equipment installed), and approved shop drawings. Applicable parts to be clearly highlighted and non-applicable parts to be clearly crossed out.

2. Each section to contain clearly marked tag numbers, appropriate model numbers with accessories, and sales representative address and phone numbers.

3. Last section of the binders to be reserved for complete sets of the as-built drawings neatly folded to the 8-1/2 in. x 11 in. size and bound into the section so that it can be folded out for review without the need for removal from the binder.

B. The Plumbing Subcontractor to conduct an Owner training session, to be arranged so that Owners representatives and Architect be present for the session, to be conducted by the Plumbing Subcontractor and his pertinent Subcontractors. Refer to Section 017900 – Demonstration and Training.

3.18 CLEANING

A. All items of work to be thoroughly cleaned in a manner suitable for the work of trades to follow.

B. All work adjacent to operations under this section to be inspected for damage and stains and repaired or cleaned prior to the completion of work.

3.19 CLEANUP

A. During the progress of the work, the Plumbing Subcontractor to keep the premises clear of debris resulting from his operations and to remove surplus and waste materials from the site daily.

B. Upon completion of the work, the Plumbing Subcontractor to remove from the site all equipment and materials used on the work as well as any debris resulting from the operations.

3.20 OBJECTIONABLE NOISE & VIBRATIONS

A. All equipment to operate without objectionable noise and vibration. If such objectionable noise or vibration should be produced and transmitted to portions of the building by apparatus or other part of mechanical work, make necessary changes and additions as approved without extra cost to the owner.

B. Architect to be the sole judge of the such objectionable levels.

3.21 TESTING OF STRUCTURES

A. The Grease Trap to be tested for watertightness. Test to consist of low pressure vacuum testing per ASTM c 1227, sec 9.2.1, or water testing per ASTM c 1227, sec 9.2.2 if allowed by the SWSC.

B. Make all repairs and retesting required to accomplish a successful test.

C. Provide all water, labor and equipment necessary to perform testing.

D. Test procedure proposed to be submitted to Amesbury DPW and the SWSC for approval.

3.22 COMMISSIONING

A. Refer to spec section 019113.

3.23 TRAINING

A. Conduct a training course for the maintenance and operating staff. The training period of 40 hours normal working time to start after the system is functionally complete but before final acceptance tests. The training to include all of the items contained in the operating and maintenance instructions as well as demonstrations of routine maintenance operations. The owner's Representative to be given at least two weeks advance notice of such training.

B. During all working hours of the one-week operating test, the Plumbing Subcontractor's instruction personnel to be available for and provide thorough and detailed training to the Owner's operating and maintenance personnel in operation, maintenance and adjustment of all equipment installed. The instructions to be videotaped by the Subcontractor. The master tape and one(1) copy to be turned over to the Owner not more than 10 days following the completion of the training.

C. Give sufficient notice to the designated operating personnel of the owner in advance of this period. Upon completion of instruction, obtain from such representatives written verification on that which the above mentioned instruction has been performed, such verification to be forwarded to the Architect.

D. factory-trained field representative to provide on-site training for subcontractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative to periodically review the product installation. Subcontractor to remove and replace any improperly installed products.

END OF SECTION

Division 23
Heating, Ventilating and Air Conditioning

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SECTION 230001

HEATING, VENTILATING AND AIR CONDITIONING

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.00 TIME, MANNER AND REQUIREMENTS FOR SUBMITTING SUB-BIDS

A. Sub-bids shall be submitted in accordance with provisions of the General Laws (Ter. Ed.), Chapter 149, Section 44A to 44L, inclusive, as amended. The time and place for submission to Sub-Bids shall be set forth under INSTRUCTIONS TO BIDDERS.

B. Each Sub-Bid filed with the Awarding Authority must be accompanied by BID BOND, OR CERTIFIED CHECK, or a TREASURER'S CHECK OR CASHIER'S CHECK issued by a responsible bank or trust company, payable to the CITY OF AMESBURY, in the amount stipulated in the INSTRUCTIONS TO BIDDERS. A Sub-Bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Each Sub-Bid submitted for the work, under this SECTION, shall be on a form furnished by the Awarding Authority, as required by SECTION 44F of Chapter 149 of the General Laws, as amended.

D. Additional Requirements:

1. Sub-bidder's attention is directed to Massachusetts G.L. Chapter 149 §44H, as amended, which provides in part as follows:

2. Each sub-bidder shall list in Paragraph E of the "Trade Contractor Bid Form" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub-trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

Classes of Work	Reference	Specification Paragraphs
(1) Water Treatment	230001	2.20
(2) Insulation	230001	2.28, 3.11
(3) Sheet Metal Work	230001	2.21, 2.22, 2.23, 2.24, 2.34, 3.13,
(4) Automatic Temperature Controls	250001	

(5) Balancing (independent company) 230001 3.16

1.01 GENERAL PROVISIONS

A. Part A and Division 1 of Part B are hereby made a part of this Specification Section.

B. Examine all Drawings and all Sections of the Specifications and requirements and provisions affecting the work of this Section.

C. Heating, pumping, and refrigeration systems shall be installed by subcontractors and personnel appropriately licensed in the Commonwealth of Massachusetts (Installing Contractor).

1.02 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 01 91 13 – General Commissioning.

B. Complete installation and startup checks and functional tests according to Section 01 91 13 – General Commissioning and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per requirements of Section 01 91 13 and manufacturers written instructions/requirements.

E. All points shall be data logged as soon as they have been activated and shall be made accessible to the commissioning agent.

1.03 SCOPE OF WORK

A. The work under this Section shall include the furnishing of all materials, labor, equipment and supplies and the performance of all operations to provide complete working systems, in general, to include the following items:

1. Piping and Fittings (all types)
    a. Hot Water Heating & Chilled Water Piping
    b. Refrigerant Piping
    c. Make-up Water Piping
    d. Condensate Piping
2. Pipe Hangers and Supports
3. Sleeves
4. Pipe Expansion Joints, Guides and Anchors
5. Valves; Low Temperature Heating
6. Refrigerant Valves and Accessories

7. Cold Water Connections (From valve after backflow preventer to equipment only)
8. Expansion Tank
9. Air Separator Tank
10. Heat Exchangers
11. Freeze Protection
12. Pressure Gauges, Thermometers, Strainers, Accessories
13. Electric Motors and Starters
14. Pumps (Water systems)
15. Radiators and Convectors
16. Boiler/Burner Units
17. Louvers
18. Air Cooled Chillers
19. Hot Water Treatment Systems
20. Packaged Roof Top Units (RTUs)
21. Air Handling Units (AHUs)
22. Make-Up Air Units (MAU)
23. Energy Recovery Units (ERUs)
24. Chilled Beams (CB)
25. Vibration Isolation
26. Ductwork
27. Sound Attenuation Equipment
28. Diffusers, Registers and Grilles
29. Fans
30. Unit Heaters (Hot Water)
31. Fintube Radiation (Hot Water)
32. Fan coil Units (FCUs)
33. Variable Air Volume Terminal Units including hot water heating coil (VAV)
34. Insulation of All Piping, Ductwork and Equipment
35. Metal Chimneys and Flues
36. Roof Curbs
37. HVAC Control Systems
38. All cutting, core drilling and channeling for HVAC work to be installed under this contract for holes five (5) inches in diameter or less.

39. Fire stopping and smoke stopping of penetrations made by/for this subcontractor.

40. Furnish and maintain safe and adequate conditions, all staging and scaffolding that are required for the work of this section.

41. Hoisting and rigging for equipment and materials specified herein.

42. The Commissioning process requires the participation of Section 230001, Building Automation Systems, to ensure that all systems fulfill the functional and pre-functional requirements set forth in these construction documents. The general commissioning requirements and coordination are detailed in Section 019113 General Commissioning. Section 230001, Building Automation Systems, shall fulfill commissioning responsibilities assigned to division 25 in accordance with Section 019113 General Commissioning.

43. LEED v4-S Requirements

    a. The work of this Section includes material and submittal requirements for fulfillment of Project LEEDv4-S Certification.

    b. LEEDv4-S Certification is an Owner Requirement that is critical to secure project funding from the Massachusetts School Building Authority.

    c. LEEDv4-S requirements for the work of this Section are details herein, and additionally in DIVISION 1 of this Project Manual.

44. Install smoke detectors furnished by Electrical Sub-Contractor.

45. Perform differential pressure test (pre and final tests) for all duct smoke detectors with Electrical Subcontractor, as per the requirements of NFPA-72 chapter 14.

B. Provide any other component or related system (whether or not listed) which is part of the overall design and basic equipment and deemed necessary for its completion, thoroughness and readiness for operation in perfect condition.

C. List of Drawings: The work to be completed by the Trade Subcontractor for the work of this Section is shown on the drawings (refer to Drawing Index). The Subcontractor shall carefully inspect all the listed drawings, not just those pertaining particularly to this sub-trade unless specifically called out otherwise, regardless of where among the drawings it appears. Examine all drawings and all other sections of the specifications for requirements therein affecting the work of this Section.

D. Major System Summary:

1. Air cooled chiller plant with variable flow primary pumping and variable flow secondary pumping, with inhibitor type PG of concentration indicated on drawings; if not indicated, default concentrations shall be 30% for chilled water system and 40% for hot water system. A tertiary loop is dedicated to the induction system with three-way modulating mixing valve designed to maximize use of chilled water return. The chiller shall have capability to operate continuously at 10% load; and below 10% load the chiller shall cycle to maintain set point without requiring manual reset. The chiller shall have low ambient controls down to 0F outside, able to continuously operate down to outside condition of 0F at all load conditions, and be able to restart at outside conditions down to 0F.

2. Gas fired high efficiency condensing boiler plant with variable flow primary pumping and variable flow secondary pumping, with 40% PG. Low water temperature is used to optimize efficiency as well as to serve induction units without having to create a separate loop.

3. Heating coils serving kitchen makeup air unit shall have freeze protection pump.

4. Water piping running outdoors and/or unheated spaces, excluding AHU/ERU external pipe chases, shall have self- regulating electric heat trace.

5. Classrooms are served by four-pipe type induction units (aka active chilled beam) with modulating control valve. BMS shall continuously calculate the space dew point based on combination temperature/relative humidity sensor in the space. If the space dew point climbs to that of the induction circuit chilled water supply temperature, the BMS shall shut off chilled water flow to induction coil to prevent condensation, and alarm status registered. Its primary air is provided by Energy Recovery Units (ERUs) complete with heat wheel, VAV supply fan, VAV exhaust fan, reheat coil, chilled water coil, bypass section to allow recirculation, and filtration.

6. Administration Offices is served by a packaged electric DX rooftop unit with zone controls by VAV boxes with hot water reheat coils.

7. Gym is served by a single-zone 4-pipe VAV air handling unit with hot water heating coil, chilled water coil, VAV supply fan, VAV return fan, and air filtration.

8. Media Center and Cafeteria are served by 4-pipe VAV HVAC air handling units with hot water heating coil, chilled water cooling coil, VAV supply fan, VAV return fan, and air filtration.

9. Kitchen- Provide kitchen VAV kitchen exhaust fan and corresponding make up air unit which shall have 40% PG heating coil and a 30% PG cooling coil (located downstream of the heating coil), VAV supply fan, and air filtration. This unit's heating coil is also provided with freeze protection pump. Provide a demand control ventilation system based on dual sensors (temperature and smoke) to modulate both exhaust and makeup from 100% down to 30% to match the cooking duty.

10. Miscellaneous equipment and special spaces are cooled by ductless AC units with low ambient controls down to -20F outside.

11. Selected spaces to also have hot water fintube radiation.

12. Corridors, vestibule, stairwell and utility spaces are heated and cooled by fan coil units.

13. Provide ventilation and heating for utility spaces.

14. DDC based BAS system.

15. Full service contract, in addition to one-year guarantee, during same period.

16. Piping, equipment and ductwork labeling.

17. Critical equipment including all of ATC is fed by emergency power. Refer to schedule, and coordinate with electrical.

18. Air and water balancing.

19. Commissioning assistance.

1.04 RELATED WORK

A. Examine all other sections of the Specifications and all drawings for the relationship of the work under this Section and the work of other trades. Cooperate with all trades and coordinate all work under this section therewith.

B. The following related items are included under sections listed below:

1. Concrete bases and thrust blocks, housekeeping pads and filling inertia pads for HVAC equipment. SECTION 033000 – CAST IN PLACE CONCRETE.

2. Cutting shall be the responsibility of this Trades Subcontractor and patching shall be performed by the respective trades. Refer to the respective sections.

3. Fuel, water and electricity for all tests and temporary operation of HVAC equipment – SECTION 015000-TEMPORARY FACILITIES AND CONTROLS.

4. Temporary heat, SECTION 015000 – TEMPORARY FACILITIES AND CONTROLS.

5. Openings for Air Intake Devices. In APPLICABLE SECTIONS, in which they occur.

6. Undercut doors and door louvers. SECTION 081113, HOLLOW METAL WORK AND SECTION 081416, WOOD AND PLASTIC DOORS.

7. Woodgrounds (blocking) for fastening air devices and radiation. Refer to Architectural drawings and SECTION 061000, ROUGH CARPENTRY to determine if these items are provided. Secure to woodgrounds if provided or directly to wall or ceiling surface if not provided. Provide expansion bolts for masonry- concrete-block wall mounting.

8. Flashing of ductwork curbs and roof curbs for HVAC equipment. SECTION 070002, ROOFING AND FLASHING.

9. Painting of all exposed ductwork and other mechanical equipment not having enameled, surfaces, stainless steel or chromed finishes, SECTION 090007, PAINTING.

10. City water piping and fittings including insulation and backflow prevention on plumbing piping systems connecting to HVAC equipment. SECTION 220001 PLUMBING.

11. In general, all wiring required for equipment provided by the HVAC Subcontractor that requires Automatic Controls and all interlock wiring for this HVAC equipment that is not shown or indicated on the Electrical Drawings of SECTION 260001 ELECTRICAL, shall be provided under SECTION 230001, HVAC.

12. Food Service Equipment. SECTION 114000, FOOD SERVICE EQUIPMENT

C. Section 01 91 13 – General Commissioning.

1.05 PRODUCTS FURNISHED, BUT NOT INSTALLED UNDER THIS SECTION

A. Furnish pipe sleeves for placement into formwork by this Trades Subcontractor.

B. Furnish access doors and panels to be installed by the applicable sections.

1. Furnish access panels for installation in walls, ceiling and floors at locations to permit access for adjustment, removal, replacement and servicing of all concealed equipment, valves and materials installed under this Section of the specifications.

2. Access panels shall be installed under the Section of the related trades of the finished surfaces in which they are located.

3. Access panels shall be located in closets, storage rooms and/or other non-public areas if possible; positioned so that the equipment can be easily reached, and the size shall be sufficient for this purpose (min. 16 in. x 16 in.). When access panels are required in corridors, lobby or other habitable areas, they shall be located as directed by the Owner's Representative.

4. Access panels shall be primer painted, keyed alike and provided with cylinder lock and two keys for each panel. Units shall be manufactured by Milcor, Inland Steel, Miami Carie or approved equal. Required fire resistance of walls and ceilings shall be maintained.

C. Furnish motor starters for installation by SECTION 260001 - ELECTRICAL.

1.06 PRODUCTS INSTALLED, BUT NOT FURNISHED UNDER THIS SECTION

A. Install duct-mounted smoke detectors, which shall be furnished by the Electrical subcontractor. The HVAC Subcontractor shall wire the appropriate fan to shut down upon detection of smoke. The Electrical Subcontractor shall power wire and wire the smoke detector to the fire alarm panel. Perform differential pressure test (pre and final tests) for all duct smoke detectors with Electrical Subcontractor, as per the requirements of NFPA-72 chapter 14

1.07 REFERENCES

A. For products or workmanship specified by association, trade, or federal standards, comply with the requirements of the standard, except when more rigid requirements are herein specified or are required by applicable codes.

B. The date of the standard is that in effect at the Bid date.

C. Schedule of References:

1. AABC Associated Air Balance Council
   1518 K Street, N.W.
   Washington, DC 20005

2. ABMA American Boiler Manufacturers Association
   950 N. Glebe Road
   Suite 160
   Arlington, VA 22203

3. ADC Air Diffusion Council
   11 South LaSalle Street, Suite 1400
   Chicago, IL 60603

4. AMCA Air Movement and Control Association
   30 West University Drive
   Arlington Heights, IL 60004

5. API American Petroleum Institute
   1220 L Street, N.W.
   Washington, DC 20005

6. ARI Air-Conditioning and Refrigeration Institute
   4301 North Fairfax Drive, Suite 425
   Arlington, VA 22203

7. ASHRAE American Society of Heating, Refrigeration and Air Conditioning
   Engineers, Inc.
   1791 Tullie Circle N.E.
   Atlanta, GA 30329

8. AWS American Welding Society, Inc.
   P.O. Box 351040
   550 NW LeJeune Road
   Miami, FL 33135

9. CDA Copper Development Association
260 Madison Avenue
New York, NY 10016

10. EJMA Expansion Joint Manufacturers Association, Inc.
25 North Broadway
Tarytown, NY 10591

11. FM Factory Mutual System
1151 Boston-Providence Turnpike
Norwood, MA 02062

12. HI The Hydronics Institute
35 Russo Pl.
PO Box 218
Berkeley Heights, NJ 07922

13. MSS Manufacturer's Standardization Society of the Valve & Fitting Industry
127 Park Street, N.E.
Vienna, VA 22180

14. NAIMA North American Insulation Manufacturer's Association
44 Canal Center Plaza, Suite 310
Alexandria, VA 22314

15. NEBB National Environmental Balancing Bureau
8575 Grovemont Circle
Gaithersburg, MD 20877

16. NEMA National Electrical Manufacturer's Association
2101 L Street, N.W., Suite 300
Washington, DC 20037

17. SMACNA Sheet Metal and Air Conditioning Contractor's National Association, Inc.
4201 Lafayette Center Drive
Chantilly, VA 22021

18. TIMA Thermal Insulation Manufacturer's Associates, Inc.
8341 Sangre De Cristo Road, Suite 3
Littleton, CO 80127

1.08 DEFINITIONS

A. As used in this Section, the following terms shall be understood to have the following meaning:

1. Work: all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.

2. Concealed: hidden from sight in chases, furred in spaces, shafts, embedded in construction, in a crawl space, and above hung ceilings.

3. Exposed: not installed underground or concealed as defined above.

4. "Furnish" shall mean purchase and deliver to the project site, complete with every necessary appearance and support.

5. "Install" shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting, proper location and operation in the project.

6. "Provide" shall mean furnish and install.

7. "Piping" shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

8. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the general contract and connected to the systems covered by this Section of the specifications by this trade subcontractor.

9. "Coordinate" shall mean all work provided under this Section of the specification shall be in compliance with work of other trades.

10. "HVAC Subcontractor," "Subcontractor," "Mechanical Subcontractor", or "Installing Contractor" shall be the Subcontractor responsible for the Work of this Section of the Specifications, and shall be responsible for coordination of the Work of this Section of the Specifications with the Work of Paragraph 2.57-Automatic Temperature Controls, where applicable.

11. "ATC" shall mean Automatic Temperature Controls, and shall be interchangeable with HVAC Control Systems.

1.09 CODES, ORDINANCES AND PERMITS

A. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform to the latest governing edition of the following standards, codes, specifications, requirements, and regulations, but not limited to:

1. All Applicable NFPA Standards

2. State and Local Building Mechanical and Energy Codes

3. American Society of Mechanical Engineers

4. American Society of Testing and Materials

5. American National Standards Institute

6. Underwriters' Laboratories, Inc.

7. Occupational Safety and Health Administration

B. Any other local codes or authorities having jurisdiction including any other standards specifically indicated in other paragraphs of this specification.

C. All pressure vessels shall conform to ASME and Massachusetts codes and regulations.

D. All equipment shall meet the more efficient requirement:

1. As shown on bid documents, or

2. Minimum efficiencies stated in the Massachusetts 780 CMR 13 energy code.

E. This Subcontractor shall give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by Architect, inspectors, and authorities having jurisdiction. Replace unacceptable work to conform to requirements, satisfactory to Architect, and without extra cost to the Owner. If work is covered before inspection and approval, this Subcontractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.10 SUBMITTALS

A. Conform to the requirements of Section 013300-Submittals, for schedule and form of all submittals. Coordinate this submittal with submittals for all other finishes.

B. Shop drawings and design layouts shall be prepared by licensed installing subcontractors and shall note the name(s), license number(s) and license expiration date(s) of the subcontractor(s) installing the heating, piping and refrigeration systems.

C. Material List: Before purchasing materials for the work, submit to the Architect a complete list showing (1) the materials specified, and (2) the equivalent materials proposed for use, including description of product, if the Subcontractor desires to use materials other than those specified.

1. All materials shall be approved by the Architect before commitment for materials is made. Intention of using specified materials shall not relieve the Subcontractor from submitting the above list.

D. Product Data: Submit complete manufacturer's product description and technical information including:

1. Piping and Fittings (all types)

a. Hot Water Heating and Chilled Water Piping

b. Refrigerant Piping

c. Makeup water Piping

d. Condensate Piping

2. Pipe Hangers and Supports

3. Sleeves

4. Pipe Expansion calculations; Joints, Guides and Anchors, with locations indicated on plans

5. Valves; Low Temperature Heating

6. Refrigerant Valves and Accessories
7. Cold Water Connections
8. Expansion Tank
9. Air Separator Tank
10. Heat Exchangers
11. Freeze Protection
12. Pressure Gauges, Thermometers, Strainers, Accessories
13. Electric Motors and Starters
14. Pumps (Water systems)
15. Radiators and Convectors
16. Boiler/Burner Units
17. Air Cooled Chiller
18. Hot Water Treatment Systems
19. Packaged Roof Top Units
20. Air Handling Units
21. Make-Up Air Unit
22. Energy Recovery Units
23. Chilled Beams
24. VAV Terminals
25. Vibration Isolation
26. Ductwork
27. Sound Attenuation Equipment
28. Diffusers, Registers and Grilles
29. Fans
30. Variable Speed Drives (VFD)
31. Unit Heaters (Hot Water)
32. Fan coil units
33. Insulation
34. Metal Chimneys and Flues
35. Roof Curbs
36. HVAC Control Systems

E. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.

1. Access panel shop drawings shall be submitted to the Architect for approval.

2. Do not submit multiple product information in a single bound manual.

3. Three-ring binders shall not be accepted.

F. In the event that the Subcontractor fails to provide Shop Drawings for any of the products specified herein:

1. Subcontractor shall furnish and install all materials and equipment herein specified in complete accordance with these Specifications.

2. Subcontractor furnishes and installs material and/or equipment which is not in complete accordance with these Specifications, he shall be responsible for the removal of this material and/or equipment from the Work, and shall be responsible for the replacement of this material and/or equipment with material and/or equipment which is in complete accordance with these Specifications, at the direction of the Owner's Representative.

3. Removal and replacement of materials and/or equipment which are not in complete compliance with these Specifications shall be executed by the Subcontractor at no extra cost to the Owner.

4. Removal and replacement of materials and/or equipment which are not in complete compliance with these Specifications shall not be allowed as a basis for a claim of delay of completion of the Work.

G. Mark dimensions and values in units to match those specified.

H. Submit Material Safety Data Sheets (MSD) on each product with submittal.

I. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable Victaulic style or series number.

J. LEED for Schools Submittals (Refer to SECTION 013300-SUBMITTALS)

1. Relevant supporting documentation, as required by LEED for Schools v4 and as detailed in Section 018113-Sustainable Design Requirements.

2. A completed LEED MATERIALS REPORTING FORM, per SECTION 013113-Sustainable Design Requirements.

3. Product substitution requests are subject to additional LEEDv4-S submittal requirements. Refer to SECTION 012500-SUBSTITUTION PROCEDURES.

1.11 OPERATION AND MAINTENANCE (O&M) DATA

A. Refer to SECTION 017700 – PROJECT CLOSEOUT and SECTION 017823 – OPERATION AND MAINTENANCE DATA.

B. Prepare and submit Operating and Maintenance manuals at least one (1) month prior to the date of Substantial Completion of the Project. Submit six complete sets of operation and maintenance data complete with at least the following.

C. Table of Contents:

1. Introduction:

   a. Explanation of Manual and its use

2. Plant Operation:

   a. Heating/Cooling Plant Instructions

   b. Operating Instructions for all Pumps, Air Handling Apparatus, Terminal Units, Boilers, Split System A/C Units, Fans, and other specified equipment.

3. Maintenance

   a. Maintenance and Lubricating Chart: furnish three sets of charts indicating equipment tag number, location of equipment, equipment service, greasing and lubricating requirements, lubricants and intervals of lubrication. One chart shall be framed under glass and mounted where directed by the Architect.

   b. Valve and System Chart: correspond to valve tags, refer to Paragraph 3.05.

   c. Recommended List of Spare Parts: furnish two typed sets of instructions for ordering spare parts with sectional views of the fittings or equipment showing parts numbered or labeled to facilitate ordering replacements. Each set shall include a list with itemized prices of those parts recommended to be kept on hand as spares, as well as the name and address of where they may be obtained.

4. Manufacturer's Literature:

   a. Piping and Fittings (all types)

      1) Hot Water Heating Piping

      2) Chilled Water Piping

      3) Refrigerant Piping

      4) Makeup water Piping

      5) Condensate Piping

   b. Pipe Hangers and Supports

   c. Sleeves

   d. Pipe Expansion Joints, Guides and Anchors

   e. Valves; Low Temperature Heating

   f. Refrigerant Valves and Accessories

   g. Cold Water Connections

   h. Expansion Tank (ET)

i. Air Separator Tank (AS)

j. Heat Exchangers

k. Freeze Protection

l. Pressure Gauges, Thermometers, Strainers, Accessories

m. Electric Motors and Starters

n. Pumps (P)

o. Boiler/Burner Units (B)

p. Air Cooled Chiller (CH)

q. Water Treatment Systems

r. Packaged Roof Top Units (RTU)

s. Vibration Isolation

t. Ductwork

u. Sound Attenuation Equipment

v. Diffusers, Registers and Grilles

w. Fans (F, EF, SF, KEF)

x. Variable Speed Drives (VFD)

y. Air Handling Units (AHU)

z. Energy Recovery Units

aa. Chilled Beams

bb. Unit Heaters, Hot Water

cc. Cabinet Unit Heaters

dd. Insulation

ee. Metal Chimneys and Flues

ff. Roof Curbs

gg. HVAC Control Systems (ATC)

5. Manufacturer's Nameplate

a. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent shall not be acceptable.

1.12 MATERIAL AND EQUIPMENT STANDARD

A. Where equipment or materials are specified with the name of a manufacturer, such specification shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Architect.

B. Substitutions may be offered for review provided the material, equipment or process offered for consideration is equal in every respect to that indicated or specified. The Request for each substitution must be accompanied by complete specifications together with drawings or samples to properly appraise the materials, equipment or process.

C. If a substitution of materials or equipment in whole or in part is made, this HVAC Subcontractor shall bear the cost of any changes necessitated by any other trade as a result of said substitution.

D. All materials, equipment and accessories provided under this Section shall be new and unused products of recognized manufacturers as approved.

1.13 ELECTRICAL WORK

A. All electrical apparatus and controls furnished as a part of the work of this Section, but which are not integral with the equipment served, shall be mounted by the Electrical Subcontractor and all wiring shall be done under SECTION 260001 ELECTRICAL .

B. Except for electrical apparatus specifically called for as part of this Section, all switches and controllers required shall be provided under Section 260001-Electrical.

C. All electrical apparatus and controls furnished as a part of the HVAC work shall conform to applicable requirements under SECTION 260001-ELECTRICAL.

1.14 RECORD DRAWINGS

A. Refer SECTION 017839 – PROJECT RECORD DOCUMENTS.

B. All costs for Record Drawings shall be borne by the HVAC Subcontractor.

C. Maintain at the job site at all times, a complete set of black line prints of the HVAC Drawings. As the work progresses, mark all changes made, whether resulting from addenda, formal change orders or other instructions issued by the Architect. Color in the various ductwork, piping, equipment, apparatus and associated appurtenances exactly as they are erected.

D. The accurate location, depth, size and type of all concealed items shall be recorded before concealment to ensure accurate and direct future access doors and panels. Show inverts of all services at key points within the building, or buried items, and entering and leaving the building. Show dimensions from building grid lines.

E. The record drawings to be reviewed at regular intervals by the Architect and to be taken into consideration when reviewing the monthly applications for payment submitted by the HVAC Subcontractor.

F. When this procedure has been accomplished, the Record Drawing information shall be transferred by this Subcontractor to the CAD files, and a CAD disc and one set of reproducible Mylar plots shall be submitted to the Architect, as directed in SECTION 017700, PROJECT CLOSEOUT and SECTION 017839 – PROJECT RECORD DOCUMENTS.

1.15 WARRANTIES

A. Submit manufacturer's standard replacement warranties for material and equipment furnished under this Section. Such warranties shall be in addition to and not in lieu of all liabilities, which the manufacturer and the HVAC Subcontractor may have by law or by provisions of the Contract Documents. All refrigeration compressors shall have the manufacturer's extended replacement warranty for a total of five years.

B. All materials, equipment and work furnished under this Section shall be guaranteed against all defects in materials and workmanship for a minimum period of one-year commencing with the Date of Substantial Completion. Any failure due to defective material, equipment or workmanship which may develop, shall be corrected at no expense to the Owner including all damage to areas, materials and other systems resulting from such failures.

C. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Drawings.

D. Upon receipt of notice from the Owner of the failure of any part of the systems during the guarantee period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

1.16 COORDINATION

A. The work shall be so performed that the progress of the entire building construction, including all other trades, shall not be delayed nor interfered with. Materials and apparatus shall be installed as fast as conditions of the building permit and must be installed promptly when and as required.

B. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other Sections. Any conflicts shall be referred immediately to the Architect for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Architect's satisfaction at no expense to the Owner.

C. Where work of this Section is to be installed in close proximity to work of other sections or where there is evidence that the work of this section may interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8-inch scale or larger working drawings and sections, clearly showing how the work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.

D. Keep fully informed as to the shape, size and position of all openings required for all apparatus, piping, ductwork, and the like., and give information in advance to build openings into the work. Furnish all sleeves, pockets, supports and incidentals, and coordinate with the General Contractor for the proper setting of same.

E. All distribution systems, which require pitch or slope such as condensate drains and water piping, shall have the right of way over those, which do not.

F. Ductwork shop drawings at ¼"=1'-0" scale shall be prepared and sepia transparencies of these Drawings shall be used to work out the coordination of all work of all Trades as specified in each applicable Section. Fire protection, Plumbing, Electrical and any other systems shall be shown and coordinated on these transparencies in the order listed by the respective subcontractors.

G. The HVAC Subcontractor shall, with the approval of the Architect and without extra charge, make reasonable modifications in his work as required by normal structural interferences, or by interference with work of other trades, or for proper execution of the work.

H. Keep fully informed as to the size, shape and location of all openings required for the work of this Section and give full information to all Subcontractors and the General Contractor.

1.17 COORDINATION DRAWINGS

A. Refer to SECTION 013300 –SUBMITTALS and SECTION 017700 PROJECT CLOSEOUT for coordination drawings submittal requirements and use of project CADD Files.

B. Indicate clearances and advise other trades of clearance requirements for operation, repair, removal and testing of mechanical equipment.

C. Indicate aisle ways and access ways required on coordinated shop drawings for mechanical equipment rooms, electrical rooms, computer rooms, and kitchens.

1.18 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. It is the intention of the Specifications and Drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the Drawings, but mentioned in the Specifications or vice versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided by the HVAC Subcontractor or his/her Sub-subcontractors, without additional expense to the Owner.

B. The Drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the site and shall have the approval of the Architect before being installed. The HVAC Subcontractor shall follow Drawings, including shop drawings, in laying out work and shall check the Drawings of other trades to verify spaces in which work is to be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Architect before proceeding with the installation. The HVAC Subcontractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Refer to the Architectural, Structural, Fire Protection, Plumbing and Electrical Drawings and coordinate location and requirements of all HVAC equipment.

D. Sizes of ducts and pipes and routing are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the intent and purpose of the Drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge.

1.19 SURVEY AND MEASUREMENTS

A. Base all required measurements, horizontal and vertical, from referenced points established by the HVAC Subcontractor and be responsible for correctly laying out the Work required under this Section of the Specification.

B. In the event of discrepancy between actual measurements and those indicated, notify the General Contractor in writing and do not proceed with the related work until instructions have been issued.

1.20 DELIVERY, STORAGE AND HANDLING

A. No materials shall be delivered or stored on site until Shop Drawings have been approved.

B. All manufactured materials shall deliver to the site in original packages or containers bearing the manufacturer's labels and product identification.

C. Protect materials against dampness. Store off floors, under cover, and adequately protected from damage.

1.21 PROTECTION OF WORK AND PROPERTY

A. This HVAC Subcontractor shall be responsible for the care and protection of all work included under this Section until the completion and final acceptance of this Contract.

B. Protect all equipment and materials from damage from all causes including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.

C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this Section and make good damage thus caused.

D. Damaged materials are to be removed from the site; no site storage of damaged materials shall be allowed.

1.22 SUPERVISION

A. Provide a Construction Supervisor with a minimum of 5 years of experience in HVAC Construction Supervision who shall be responsible for the installation of the Work of this Section of the Specifications, and in accordance with this Section of the Specifications and with the Contract Drawings.

1.23 SAFETY PRECAUTIONS

A. Life safety shall be a primary consideration. Provide all required and prudent material, labor and equipment to comply with applicable safety regulations. Further, Provide all material, labor and equipment to comply with reasonable or generally accepted safety precautions as directed by the Owner or the Architect.

B. Comply with all of the safety requirements of OSHA throughout the entire construction period of the project.

C. Furnish, place and maintain proper guards for prevention of accidents and any other necessary construction required to secure safety of life and property.

D. Perform work only in areas of the building as approved by the Owner or his representative. Personnel and equipment access to the site, lay down areas, parking areas and areas of work shall only be as designated and allowed by the Owner.

1.24 WELDING QUALIFICATIONS

A. Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Owner shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with SECTION 051200-STRUCTURAL STEEL.

B. A fire watchman with an approved fire extinguisher shall be posted at the site of the welding work, during that work, and for a minimum of 30 minutes after the work is completed, to see that sparks or drops of hot metal do not start fires.

1.25 SCHEDULE

A. Construct work in sequence under provisions of SECTION 010000 – SUMMARY OF WORK.

1.26 SPARE PARTS

A. The HVAC Subcontractor shall furnish spare-parts data for each different item of equipment furnished. The data shall include a complete list of parts and supplies, with current unit prices and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified hereinafter to be furnished as part of the contract; and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 180 days at the particular installation. The foregoing shall not relieve the HVAC Subcontractor of any responsibilities under the guarantees specified herein.

B. The HVAC Subcontractor shall furnish a minimum of 4 additional complete sets of filters for all air handling equipment using filters. In addition to the filters furnished with each piece of equipment from the manufacturer, the HVAC Subcontractor shall provide two complete sets of filters to be used during the construction and then the testing and balancing period. Additionally, a complete new set of filters shall be installed after the testing and balancing period. Finally, a complete new set of filters shall be installed upon substantial completion of the project, prior to final acceptance by the Owner.

1.27 MAINTENANCE ACCESSORIES AND TOOLS

A. All special tools necessary as recommended by the equipment manufacturer(s) for the operation and maintenance of boilers, pumps, fans, and other equipment shall be furnished. Small hand tools shall be furnished with a suitable lockable cabinet, mounted where directed.

B. Smoke Pipe Cleaner

1. Smoke pipe cleaner shall be provided to clean the breeching and smoke connections. Cleaner shall have jointed handle long enough to clean breeching and smoke connections without dismantling the system.

C. Special Wrenches

1. Special wrenches shall be provided as required for opening boiler manholes, hand holes, and cleanouts.

1.28 TEMPORARY SERVICES

A. Refer to SECTION 015000 – TEMPORARY FACILITIES AND CONTROLS.

B. Operations necessary for checking testing and balancing shall be done after written approval is given to start up systems. Before then, ensure that care is taken to protect equipment from damage, and to prevent distribution of dust through duct systems. Cap and seal ducts and cap pipes as required to prevent construction debris from entering.

C. Permanent heating or air conditioning systems shall not be used for temporary heating, except with written permission of the Architect. It is intended that the HVAC Subcontractor shall schedule his work so as to be able to utilize the permanent heating system for temporary heat when the building is totally enclosed. When the permanent heating system is utilized for temporary heat, the boiler plant shall be operated as designed with all accessory equipment and systems operative. Upon completion of the temporary heating phases, the equipment shall be inspected and cleaned as required to bring it to as new condition. Under no circumstances shall the boilers, air handlers, or any permanent equipment be operated without feed water and chemical treatment and air filters.

1.29 SLEEVES, INSERTS AND ANCHOR BOLTS

A. Coordinate with other trades the location of and maintaining in proper positions, sleeves, inserts and anchor bolts to be supplied and/or set in place under this Section of the specifications. In the event of incorrectly located preset sleeves, inserts and anchor bolts, and the like, all required cutting and patching of finished work shall be done under this Section of the specifications.

B. Unless otherwise specified herein, all pipes passing through floors, walls, ceilings or partitions shall be provided with sleeves and rating shall be maintained by installation of fire stopping by this subcontractor.

C. Field drilling (core drilling), when required, shall be performed under this Section of the specifications, after receipt of approval by the General Contractor.

1. When coring cannot be avoided, provide ¼-inch pilot hole prior to coring. When coring through floor or slab, verify location of core on floor below and protect and piping, ductwork, wiring, personnel, and the like, below the location of the core.

1.30 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

A. Provide all supplementary steel, factory fabricated channels and supports required for proper installation, mounting and support of all equipment and systems provided under this Section of the specification.

B. Supplementary steel and factory fabricated channels shall be firmly connected to building construction in a manner approved by the General Contractor, as shown on the drawings, or hereinafter specified.

C. The type and size of the supporting channels and supplementary steel provided under this Section of the specifications shall accommodate all deflections in conformance with the manufacturer's requirements for the specific loading on the system installed therein.

D. All supplementary steel and factory fabricated channels shall be installed in a neat and workmanlike manner parallel to the walls, floors and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.

E. All supplementary steel including factory fabricated channels, supports and fittings shall be UL approved, shall be galvanized steel where exposed or subject to rust producing atmosphere and shall be manufactured by Unistrut, H-strut, Powerstrut or an approved equal.

1.31 ACCESSIBILITY

A. All work provided under this Section of the Specification shall be installed so that parts requiring periodic inspection, maintenance and repair are readily accessible. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the designer.

1.32 TESTING AND BALANCING

A. General Requirements

The subcontractor shall select AABC MN-1, NEBB-01, SMACNA-07 or ASHRAE 111 as the standard for providing testing, adjusting and balancing of air and water systems. The selected standard shall be used throughout the project. Testing, adjusting, and balancing shall be accomplished by a firm certified for testing and balancing by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). Prior to testing, adjusting, and balancing, the subcontractor shall verify that the systems have been installed and are operating as specified. Approved detail drawings and all other data required for each system and/or component to be tested shall be made available at the job site during the entire testing, adjusting and balancing effort. The subcontractor shall verify that all balancing devices are properly installed to permit testing, adjusting and balancing and that all duct leakage tests have been completed prior to testing, adjusting and balancing. The Owner's Representative shall be notified in writing of all equipment, components, or balancing devices, that are damaged, incorrectly installed, or missing, as well as any design deficiencies that prevent proper testing, adjusting, and balancing. Testing, adjusting, and balancing shall not commence until approved by the Owner's Representative. Instrumentation accuracy shall be in accordance with the standard selected in this paragraph. Sound level measuring equipment shall be rated in accordance with ANSI S1.4 and ANSI S1.11.

B. Instrument Accuracy Requirements

All instrumentation shall be checked for accuracy before beginning testing, adjusting and balancing procedures. Instrument accuracy shall be in accordance with the standard selected in Paragraph A. General Requirements, immediately above. Checks may be carried out against similar equipment maintained specifically for checking purposes or by the manufacturer or a recognized testing facility. All instrumentation used for testing shall be calibrated within 6 months of use. Pitot tubes and U-tube manometers do not require checking. In no case shall the instrumentation accuracy be less than specified by the instrument manufacturer. Any instrument falling out of calibration during the process of balancing and testing shall be recalibrated or removed from the site and replaced by a properly calibrated instrument. No instruments shall be allowed to remain on-site that are not in calibration.

C. Submittals

1. List the minimum data to be included in the final balance report.

The following shall be submitted in accordance with Section 013300-Submittals.

2. Reports:

Testing and Balancing; 6 copies of a preliminary report, 30 days before balancing commences. The report shall be organized by specific systems and shall clearly identify each item of equipment to be tested, adjusted, and balanced. The appropriate test procedures and measurements to be taken for each item of equipment shall be listed. Instrument calibration records shall be provided on forms shown in AABC MN-1 or SMACNA-07. Manufacturer's specified accuracy shall be shown. The report shall include floor plan drawings showing all dimensions of ductwork, piping and their related measurement locations and types of measurements to be made. All related data necessary for testing, balancing, and adjusting, including fan curves and pump curves, shall be included. A system readiness checklist, similar to that shown in SMACNA-07, shall be included. The report shall contain a listing of the deficiencies of all systems to be tested, adjusted and balanced and the corrective action taken. The report shall contain a schedule for the testing and balancing. Six copies of the final report on forms shown in AABC MN-1 or SMACNA-07, 30 days after completion of the test and balance operation. Data shall be in a hard bound cover identifying the project name, location, date of submittal, name of subcontractor, and a general title indicating the specific area and type of work, and shall be signed by a registered professional engineer, employed by the test and balance firm, who has a minimum of 2 years experience in testing, adjusting and balancing work. The final report shall include a summary describing test methods, test results, and major corrective actions taken. The report shall include as-tested floor plans showing all measurement locations and types of measurements made. The air handling unit data shall include a static pressure profile diagram, and pitot tube traverses where possible. The VAV terminal data shall include maximum and minimum air flows, for design and actual conditions, and shall be supported with summaries which show the air outlet totals for each VAV terminal and the VAV terminal totals for each air handling unit. Air distribution data shall include coded drawings, which show the exact location of each air outlet. Pump data shall include pump efficiency. Data for heating and cooling coils shall include heat balance calculations.

All instruments that are recalibrated and brought back onto the job site after being found to be out of calibration shall have recalibration records submitted on forms shown in AABC MN-1 or SMACNA-07.

3. Certificates

Qualification: Qualification data, 90 days prior to testing and balancing operations. The test and balance firm shall be certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB). The lead balancing technician shall be qualified by AABC or NEBB and his qualification data shall include past experience on at least five similar projects.

1.33 CERTIFICATES OF INSPECTION/APPROVAL

A. Furnish upon completion of all work, certificates of inspections from the manufacturers stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be in satisfactory operating conditions.

1.34 HVAC SYSTEM COMMISSIONING

A. At completion of the HVAC system installation, testing and balancing and start up, the mechanical subcontractor shall demonstrate to the owner and to the engineer the proper operation of all major HVAC systems. This shall include but not be limited to temperature controls, chillers, air handlers, boilers, rooftop units, kitchen make up and exhaust systems, fan systems and pumps. Allow minimum of 9 full days (72 Hours) for this demonstration.

B. Provide owner and engineer at least one weeks' notice before demonstration is to begin. Mechanical contractor shall ensure the presence of personnel from local manufacturer's representative for the specific pieces of equipment involved as well as for the automatic temperature controls subcontractor who shall be present throughout the entire procedure.

C. If a piece of equipment has an occupied/unoccupied cycle or otherwise has two speed operation all control cycles and speeds are to be demonstrated.

D. If any piece of equipment or control cycle does not operate as specified then this subcontractor shall remedy the deficiency and repeat the demonstration in the owner's and engineer's presence.

E. A factory-trained field representative shall provide on-site training for subcontractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Subcontractor shall remove and replace any improperly installed products.

F. Refer to Section 019113 – Building Commissioning Requirements for additional requirements.

PART 2 - PRODUCTS

2.00 PIPING AND FITTINGS

A. General Requirements for Pipe

1. Pipe material shall be indicated in the Schedule of Pipe and Fittings for each type of service.

2. Steel pipe shall conform to ASTM A53 Grade B or ASTM A106 Grade B (for systems with temperatures that could go over 750 degrees F) black steel. Pipe thickness (schedule) shall be as specified for the service.

3. Copper tubing shall conform to ASTM B75 or ASTM B88. Thickness (type) shall be as required for the service with a minimum safety factor of 4:1. Tubing for compressed air tubing shall conform to ASTM B251.

B. General Requirements for Fittings

1. Pipe fittings shall be indicated in the Schedule of Pipe and Fittings for each type of service. Fittings shall be rated to match the larger of the pipe pressure rating in the Schedule or the valve rating listed in the valve tables in the Part 2 Valve and Strainer section of this specification.

2. All fittings shall be installed per code requirements and the manufacturer's best recommendations.

3. Steel pipe fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer. For 90° elbows, provide long radius fitting unless they do not physically fit, in which case short radius may be used. Flanges shall be flat faced weld neck up to Class 125 and raised face weld neck type for Class 150 and above.

4. The steel pipe joining methods below are only allowed when they are specifically listed in the Schedule of Pipe and Fittings:

a. Type S1: Welded fittings shall conform to ASTM A234 with WPA marking. Butt-welded fittings shall conform to ASME B16.9, and socket welded fittings shall conform to ASME B16.11. Make fusion welded joints as required by ANSI/ASME B31.1.

b. Type S2: Steel flanged fittings including flanges, bolts, nuts, bolt patterns, and similar items shall be in accordance with ASME B16.5 for the class required (Class 150 minimum). Flange material shall conform to ASTM A53 Grade B. Blind flange material shall conform to ASTM A516 for cold service and ASTM A515 for hot service. Bolts shall be high strength or intermediate (Class 150 only) strength with material conforming to ASTM A193.

c. Type S3: Cast Iron (CI) flanged fittings shall be of malleable cast iron conforming to ASTM A47, Grade 32510. Bolts shall be high strength or intermediate (Class 125 only) strength with material conforming to ASTM A193. Class 125 iron flanges shall be limited to 175 psig / 230°F (up to 12 in.) and 125 psig / 230°F (14–24 in.). Class 250 iron flanges shall be limited to 400 psig / 250°F (up to 12") and 250 psig / 250°F (14 –24 in.).

d. Type S5: Threaded joints: For use up to 2 in. pipe size. Pipe threads shall conform to ASME B1.20.1. Nipples shall conform to ASTM A733 or ASTM B687. Class 125 iron threaded fittings shall be limited to 150 psig / 250°F or 125 psi at 350°F. Class 250 iron threaded fittings shall be limited to 340 psig / 250°F. Class 150 ductile iron threaded fittings shall be limited to 185 psig / 250°F or 150 psig / 300°F (maximum temperature). Class 300 ductile iron threaded fittings shall be limited to 1200 psig / 250°F or 600 psig / 450°F (maximum temperature).

e. Type S7: For use over 2 in. pipe size. Standard grooved mechanical pipe joints shall conform to ANSI/AWWA C606. Use is limited to low temperature water systems below 210°F and 250 psig in easily accessible locations. Couplings shall be designed for not less than 250 psi service and shall provide a water-tight joint. Victaulic, VGS, Gruvlok, or specifically approved equal.

    1) Grooved mechanical joint fittings shall be full flow factory manufactured forged or fabricated steel fittings or cast ductile iron fittings. Mechanical pipe couplings shall be of the bolted type and shall consist of a housing fabricated in two parts, a synthetic rubber gasket, and nuts and bolts to secure unit together. Housings shall be of ductile iron conforming to ASTM A536, Grade 65-45-12. Coupling nuts and bolts shall be of heat treated carbon steel, zinc electroplated to ASTM B-633 and conform to ASTM A-183 and A-449, minimum 110,000 PSI tensile strength. Gaskets shall be of molded synthetic rubber, Type EPDM (for water service) with central cavity, pressure responsive configuration, rated for a temperature range of -30°F to +230°F, and shall conform to ASTM D-2000 (Gaskets shall be verified as suitable for the intended service prior to installation).

2) Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact of housings upon installation to insure positive rigid clamping of the pipe. Rigid grooved pipe couplings shall be used with grooved end pipes, fittings, valves and strainers. Rigid segmentally welded elbows shall not be used. Standard rigid coupling (2-12 in.) housings shall be Victaulic Style 107, 07, or Grinnell Style 772, (over 12 in. shall be 2 piece housings equal to Victaulic AGS) and shall provide system rigidity equal to welded steel with supports and hanging requirements corresponding to ANSI B-31.1 Power Piping and ANSI B-31.9 Building Services Codes (same spacing as steel pipe).

3) Flexible grooved joints shall not be permitted, except as vibration isolators adjacent to mechanical equipment other than pumps.

4) Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations. The Owner's Representative shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and verify the groove dimensions in accordance with the coupling manufacturer's specifications.

5. Fittings for copper tubing shall be wrought copper and bronze fittings conforming to ASME B16.22 and ASTM B75 or cast copper alloy fittings conforming to ASME B16.18. Copper may be used up to 2 in. tubing size. Adapters may be used for connecting tubing to flanges and threaded ends of valves and equipment. The copper tubing/pipe joining methods below are only allowed when they are specifically listed in the Schedule of Pipe and Fittings:

   a. Type C1: Soldered copper fittings shall use either 95/5 or silver solder (for systems up to 250 degrees F and 175 psi), or shall be brazed (for higher temperature/pressure systems – subcontractor shall submit brazing material and pressure/temperature rating of joint). Solder shall conform to ASTM B32. Solder and flux shall be lead free. Silver solder shall conform to FS QQ-B-654. Brazing alloys shall be B-Ag alloy (or equivalent strength alloy) having a melting point above 1000 degrees F.

b. Type C2: Permanent push-to-connect fittings may be used (in exposed, accessible areas only) and shall use ASME B16.22 wrought copper alloy or ASME B16.18 cast copper alloy fittings with push-to-connect ends designed for direct insertion of copper tube. Push-to-connect ends shall be complete with EPDM engineered seal and 301 stainless steel internal components. EPDM engineered seal suitable for, and limited to, water systems with operating temperatures up to 210ºF and maximum pressure rating up to 200 psig. Seal shall be ANSI/NSF 61 certified for potable water service.

c. Type C3: Copper and copper alloy press fittings may be used (in exposed, accessible areas only) and shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer and shall be suitable for, and limited to, water systems with operating temperatures up to 210ºF and maximum pressure rating up to 200 psig. Press ends shall have a design feature to assure leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

d. Type C4: Grooved joints (copper tube sized) fittings (rated and limited for systems up to +210 degrees F and maximum pressure rating of 300 psi) equal to Victaulic Style 607 may be used for water systems (in exposed, accessible areas only).

6. Type SC1: Vic-Press 304™ fittings and couplings or ProPress® Stainless joints with Schedule 5 stainless steel pipe may be used for up to 2 in. water piping (in exposed, accessible areas only) in lieu of other copper or steel joining methods to a maximum operating temperature of +210 degrees F and maximum pressure rating of 200 psi. Pipe shall be ASTM A312 Schedule 5, stainless steel. Fittings shall be stainless steel with EPDM O-ring seals.

   a. Do <u>not</u> use on steam systems or hot water systems that use steam heat exchangers. Exception: Press fitting joints may be used on hot water systems below 210º generated by low pressure steam <u>providing</u> the steam control valves fail closed, the hot water piping has minimum 3 foot thermal traps at the heat exchanger (both supply and return), <u>and</u> the first grooved joint is a minimum of 25 feet away from the heat exchanger's thermal pipes.

7. Composition gaskets for flanges shall conform to ASME B16.21. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. Gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). NBR binder shall be used for hydrocarbon service. Gaskets shall be suitable for pressure and temperatures of piping system.

8. Unions shall conform to FS WW-U-531 or FS WW-U-516, type to match adjacent piping.

9. Adapters for copper tubing shall be brass or bronze for soldered and brazed fittings.

10. Dielectric Waterway fittings shall be used where dissimilar pipe materials (such as steel and copper) in any water or glycol system are joined. Fittings shall conform to the tensile strength and dimensional requirements specified in FS WW-U-531. Waterways shall have metal connections on both ends to match adjacent piping. Metal parts of dielectric Waterways shall be fully separated by NSF/FDA listed thermoplastic lining so that the electrical current is well below 1 percent of the galvanic current that would exist upon metal-to-metal contact. Fittings shall be rated for 300 psig and 225°F. Galvanized pipe, dielectric unions, or insulated couplings shall not be used.

11. Flexible pipe connectors shall be as specified in Vibration Isolation paragraph.

C. Schedules of Pipe and Fittings

1. As used in the pipe and fitting schedule tables, closed loop systems have expansion tanks and are not open to the atmosphere, examples are chilled, hot, dual temperature and closed heat pump condenser water systems. Open loop systems are open to the atmosphere with open condenser water system being the most common.

2. Relief valve piping shall have the same pressure/temperature ratings as the fluid being relieved. Exposed outdoor piping shall be stainless steel.

WATER AND GLYCOL SERVICES UP TO 230 PSIG AT 250ºF OR 275 PSIG AT 100ºF (Some joint types or materials may have lower pressure and/or temperature limits and contractor shall ensure they are only used where those limits shall NOT be exceeded.)				
Service	**Pipe Material & Schedule or Type**	**Joint Types Allowed**	**Fitting Material**	**Min. Pressure Class (psig) & / or Schedule**
Closed loop piping up to 2 in.	Copper / Type L	C1, C2, C3, C4, or SC1	Copper, Bronze	150
Closed loop piping up to 2 in.	Steel / Schedule 40	S5, S6, or SC1	CI, DI	250 / Standard Weight
Closed loop piping 2.5-24 in.	Steel / Standard Weight	S1, S2, S3, S4, or S7	Steel, CI, DI	150 / Standard Weight
Condensate gravity drain	Copper / Type DWV	C1, C2, C3, C4, or SC1	Copper, Bronze	125
Cold water make-up	Copper / Type L	C1 (silver soldered or brazed only), C2, C3, C4, or SC1	Copper, Bronze	150

D. Refrigerant Piping:

1. Refrigerant gas relief piping shall be ASTM A53 Schedule 40, black steel. Fittings for pipe sizes 2 inches and below shall be threaded 300 pound malleable iron or 2000 pound forged steel. Joints shall be welded for pipe sizes 2-1/2 inches and above, threaded for pipe sizes 2 inches and below. Unions for use with steel piping shall be 300 pound malleable iron, ground joint, or 2000 pound forged steel. Cast iron fittings must not be used on refrigerant systems.

2. Dimensions and material requirements for refrigerant (and other fluids/gasses that can be below 35 degrees F) pipe, pipe fittings and components shall conform to ASHRAE 15 and ASME/ANSI B31.5 and shall be compatible with fluids used and capable of withstanding the pressures and temperatures of the service. Pipe, tubing, and components used for refrigerant service shall be cleaned, sealed, capped, or plugged prior to shipment from the manufacturer's plant.

a. Copper pipe and fittings shall be seamless copper tubing, soft drawn, Type K for underground use (all underground piping shall be pre-insulated with no joints), Type ACR for all other uses (unless otherwise noted), ASTM B 88M (ASTM B 88). Fittings for copper tubing shall be wrought copper, brazed joint type (type C1), ASME/ANSI B16.22. Brazing alloys shall be B-Ag alloy (or equivalent strength alloy) having a melting point above 1000 degrees F. Flared-tube joint fittings conforming to ASME B16.26 and ASTM B62 (where operating pressures allow) may be used with soft copper tubing (annealed ASTM B280) only in nominal sizes smaller than one inch for connection to equipment and no larger than 1 3/8 inches outside diameter for other connections. Flanges shall be bronze, ANSI B16.24.

b. Where copper pipe size or pressure rating is too small, refrigerant piping shall be ASTM A53 Schedule 40, black steel. All joints shall be welded. Unions for use with steel piping shall be 300 pound malleable iron, ground joint, or 2000 pound forged steel.

E. Radon Exhaust Piping

1. Under-slab portion up to 6” above slab shall be solvent welded schedule-40 PVC piping.

2. From 6” above slab up to 12” above roof level shall be medium pressure galvanized ductwork. PVC to Sheetmetal connection shall be made with minimum 1” overlap, Sheetmetal screws, and all seams shall be sealed.

3. Top of exhaust duct on roof shall be capped weather tight.

4. Exhaust fan and pressure gauge to be installed in future by owner.

5. Refer to details on drawings.

2.01 MATERIALS AND ACCESSORIES

A. Iron and Steel Sheets

1. Galvanized Iron and Steel: Galvanized iron and steel shall conform to ASTM A 527, ASTM A 528, or ASTM A 642, with general requirements conforming to ASTM A 525. Gauge numbers specified are Manufacturer's Standard Gauge.

2. Uncoated (Black) Steel: Uncoated (black) steel shall conform to ASTM A 366 or ASTM A 569, composition, condition, and finish best suited to the intended use. Gauge numbers specified refer to Manufacturer's Standard Gauge.

B. Solder: Solder shall conform to ASTM B 32. Solder and flux shall be lead free.

C. Solder, Silver: Silver solder shall conform to FS QQ-B-654.

D. Gaskets for Flanges: Composition gaskets shall conform to ASME B16.21. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16-inch thickness, full face or self-centering flat ring type. Gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). NBR binder shall be used for hydrocarbon service. Gaskets shall be suitable for pressure and temperatures of piping system.

E. Bellows-Type Joints: Joints shall be flexible, guided expansion joints. Expansion element shall be of stainless steel. Bellows-type expansion joints shall be in accordance with the applicable requirements of EJMA-01 and ASME B31.1 with internal liners.

F. Expansion Joints: Expansion joints shall provide for either single or double slip of connected pipes, as required or indicated, and for not less than the traverse indicated. Joints shall be designed for hot water working pressure not less than 300psig and shall be in accordance with applicable requirements of EJMA-01 and ASME B31.1. Joints shall be designed for packing injection under full line pressure. End connections shall be flanged or beveled for welding as indicated. Joints shall be provided with anchor base where required or indicated. Where adjoining pipe is carbon steel, the sliding slip shall be seamless steel plated with a minimum of 2 mils of hard chrome conforming to ASTM B 650. Joint components shall be fabricated from material equivalent to that of the pipeline. Initial settings shall be made in accordance with manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by joint manufacturer, but in any case shall not be more than 5 feet from expansion joint except for lines 4-inches or smaller, guides shall be installed not more than 2 feet from the joint. Service outlets shall be provided where indicated.

G. Grooved End Steel Pipe Expansion Joints: In-line expansion joints installed in water piping systems up to 230 deg F.

1. 2 in. through 6 in. Sizes: Packless, gasketed, slip-type expansion joint with grooved end telescoping body for installation with Style07 rigid couplings providing up to 3 in. axial end movement, designed for working pressures up to 350 psi. Victaulic Style 150 Mover®.

2. ¾ in. and Larger Sizes: Combination of grooved end short nipples and Style 75 or 77 flexible couplings joined in tandem to provide increased expansion. Joint movement and expansion capabilities determined by number of couplings/nipples used in the joint. Pressure rating dependent on size and style of flexible couplings used. Victaulic Style 155.

2.02 PIPE HANGERS AND SUPPORTS

A. As manufactured by Carpenter & Patterson, Inc., Grinnell Corporation, B-Line Systems or approved equal. Hangers shall transmit the load exclusively to the structure of the building. All hangers and supports to conform to MSS standards SP-58 and SP-69 and ANSI B 31.1.

B. Hangers for all piping 4 -inches and above shall be adjustable roll type. Hangers for piping below 4-inches shall be clevis type. Hangers for piping in tunnels on strut support frames shall be roller type, similar to Figure B379 by B-Line Systems. Additionally, the first five pipe hangers on both sides of all pump piping (suction and discharge) to be precompressed spring and double-deflection neoprene style, with 30o hanging rod swing capability, similar and equal in all respects to Mason Industries Model PC 30N, selected by manufacturer for anticipated loading and deflection.

C. Provide all additional structural steel required for proper installation of hangers, anchors, guides and supports; hangers shall be arranged to maintain the required grading and pitch of piping, to prevent vibration and to provide for expansion and contraction.

D. Maximum spacing of hangers and supports for steel pipe:

Pipe Size (inches)	Max Spacing (feet)
Up to 1	6
1¼-2½	9
3-6	12

E. Reduce Steel pipe spacing to a maximum of 10', regardless of pipe, as necessary for fittings, valves, and other concentrated loads.

F. Horizontal copper tubing shall have a maximum hanger spacing of 5 ft. for tubing up to 1-1/4¼ in. and 10 ft. for 1½ in. and larger. Maximum spacing for PVC pipe hangers shall be 4'.

G. Branch piping and run-outs of over 5 feet shall have at least one hanger or support.

H. At all copper piping, provide pipe supports with copper finish to eliminate the possibility of galvanic action.

I. Furnish additional hangers or supports at vertical or horizontal changes of direction and at locations of concentrated loads due to valves, fittings, strainers, and accessories.

J. Hangers and supports shall provide for 2 in. of vertical adjustments.

K. Hanger rods shall be steel, threaded and furnished with two removable nuts at each end of positioning rod and hanger and locking each in place.

L. Except as otherwise noted, hanger rods shall be of the following sizes:

SCHEDULE OF PIPE HANGER ROD SIZES		
Pipe sizes (inches)	Single rod diameter (inches)	Double rod diameter (inches)
½-2	3/8	3/8
2½-3	½	3/8
4 & 5	5/8	½
6	3/4	5/8

M. Pipe covering protection saddles shall not be loaded to more than 80% of maximum loading as rated by the manufacturer.

N. Insulated piping insulation shields:

1. Up to 3 in. pipe size: 18-gauge galvanized steel, located outside the vapor barrier, minimum 180° arc, 12 in. long, or pipe covering protection saddles.

2. 4 in. pipe size and larger: pipe covering protection saddles.

O. Vertical support shall be by means of riser clamps (anchors with split ring type allowable up to 2 in. size only) and adjustable pipe support with flange anchored to floor.

P. Rods, clamps and hangers shall be electro-galvanized coated.

Q. All clamps, hangers and rods in the wastewater treatment plant shall be PVC coated.

R. Valve and piping supports, from the floor, shall be equal to Carpenter & Paterson, Inc. Figure 101, adjustable pipe support and complete with pipe standard and flange, anchored to floor.

1. Supports shall be installed at each control valve, riser, tee or elbow and where any unsupported section exceeds 4'-0" in length measured along piping centerline.

S. Upper Attachments to Building Structure:

1. Reinforced Concrete Construction: Upper attachment welded or clamped to steel clip angles which are expansion-bolted to the concrete. Expansion bolting shall be located so that piping loads place bolts in shear. Submit details for approval.

2. Structural Steel Framing: Upper attachments welded or clamped to structural steel members. Additional steel members may be necessary in some support locations where piping locations differ from that known on contract drawings. Submit details for approval.

3. Expansion Fasteners and Power Set Fasteners: In concrete slab construction, expansion fasteners may be used for hanger loads up to one-third the manufacturer's rated strength of the expansion fastener. Power set fasteners may be used for loads up to one-fourth of rated load. When greater hanger loads are encountered, additional fasteners may be used and interconnected with steel members combining to support the hanger.

T. All hangers and shields exposed to the exterior shall be galvanized steel and PVC coated to manufacturer's standard thickness.

U. Victaulic Style 107H, 07, and W07 rigid couplings may be used with IPS steel piping systems, which meet the support and hanging requirements of ASME B31.1 and B31.9. An adequate number of Victaulic Style 177, 77 and W77 flexible couplings shall also be used to compensate for thermal expansion/contraction of the pipe.

2.03 FIRE STOPPING

A. Seal openings of fire rated construction with a material or product that has been tested at an independent testing laboratory, such as UL, FM. Fire stopping shall conform to ASTM E-814 and UL 1479, with fire ratings equal to or exceeding the fire rating of the construction involved. Fire stopping shall be UL classified, and shall be similar to the 3M brand Fire Barrier Penetration Sealing Systems, GE Silicones, Calpico Inc or approved equivalent. Fire stopping of this type shall also be utilized for openings through smoke rated construction.

B. If desired by the Contractor and approved by local codes, the “Pro-Set” piping penetration system also may be utilized. Penetration system shall be UL certified and shall be the “Pro-Set” System A. Firestop coupling (sleeve) shall be filled with ceramic fiber material to provide insulation and fire stopping. System shall be capable of maintaining a 3-hour fire rating. Penetration system shall be secure, waterproofed, fire rated and smoke proof and shall allow for pipe expansion and contraction

C. Smoke proof and Seal all pipe penetration in wall regardless it is rated or unrated wall construction.

2.04 SLEEVES

A. Size sleeves to provide a minimum of 1-inch clearance around piping and ductwork, and to allow continuous runs of insulation where specified. Ensure that insulated piping and ductwork do not touch sleeves.

B. Pack clearance spaces with fire stopping. Caulk with fire-resistant, resilient waterproof compound. Ensure that fire ratings of floors and walls are maintained.

C. Piping sleeves shall be according to the following:

1. Through interior non-masonry walls, use 18-gauge rolled and tack welded galvanized steel sleeves, set flush with finished surfaces on both sides.

2. Through interior masonry walls, exterior walls above grade and roofs, use machine cut and reamed standard weight steel piping, set flush with finished surfaces on inside and to suit flashing on outside.

3. For floors in mechanical equipment rooms, and similar areas where a water dam is required, use machine cut and reamed standard weight steel piping set flush to underside of structure and extending 6-inches above finished floor.

4. For other floors, use 18-gauge rolled and tack welded galvanized steel, or machine cut and reamed plastic pipe or standard weight steel piping set flush to both finished surfaces. Refer to Room Finish Schedule.

5. Cover pipe sleeves in walls and ceilings of finished areas other than equipment rooms with satin finish stainless steel, or satin finish chrome or nickel-plated brass escutcheons, with non-ferrous setscrews. Do not use stamped steel split plates. Split cast plates with screw locks may be used.

6. In non-rated walls, escutcheon plates shall be of adequate size to allow for piping with full insulation to pass through the wall uninterrupted. The interior diameter of the plate shall fit snugly around the outside diameter of the insulation.

D. Duct sleeves shall be minimum 18-gauge galvanized steel. Provide adequate bracing for support of sleeves during concrete and masonry work. For fire rated floors and walls, build fire dampers into structure to attain fire rated construction, in a manner acceptable to the local and state authorities.

E. Cover exposed duct sleeves in finished areas with 18-gauge galvanized steel plates in the form of duct collars. Fix in position with non-ferrous metal screws.

2.05 ESCUTCHEON PLATES

A. Provide one piece or hinged type wall and ceiling expansion-type plates with round head set screws or integral pipe clips. Provide recessed type for floors. For copper lines and in finished rooms provide minimum 18-gage spun brass, chrome plated over nickel plates. For all other areas, provide 18-gage enameled cast-iron or steel plates.

2.06 PIPE EXPANSION JOINTS, GUIDES AND ANCHORS

A. Furnish and install where shown on the drawings, and/or where required, a system of expansion joints, main anchors and pipe guides to control the expansion of the new water distribution piping. Temperature fluctuation shall be between 40°F and 240°F.

B. Pipe guides shall be 4-finger spider-and-sleeve type to insure multiple guiding and to allow for complete insulation of piping. Spider and sleeve shall be formed of two halves to facilitate installation of spider on pipe and mounting of guide to structure. Guides shall be provided in accordance with "Standards of the Expansion Joint Manufacturer's Association", latest edition. Guides shall provide up to 6 in. of axial pipe movement. Assembly to be fabricated of carbon steel and finished with one coat of rust inhibitive paint.

C. Expansion joints shall be multi-ply 321 stainless steel bellows type (ASTM A240-T321), rated for 150-psig @ 600°F, axial movement, forged flange ends (ASTM A105), minimum 3-inch axial movement, 1-inch lateral movement and 50 degree angular movement; as scheduled on the drawings. Hyspan Precision Products, Metraflex, Proco Products, or an approved equal.

D. Grooved End Steel Pipe Expansion Joints: In-line expansion joints shall be installed in water piping systems up to 230 deg F. Victaulic, VGS, or Gruvlock, or an approved equal.

1. 2 in. through 6 in. Sizes: Packless, gasketed, slip-type expansion joint with grooved end telescoping body for installation with Style 07 rigid couplings providing up to 3 in. axial end movement, designed for working pressures up to 350 psi. Victaulic Style 150 Mover®.

2. ¾ in. and Larger Sizes: Combination of grooved end short nipples and Style 75 or 77 flexible couplings joined in tandem to provide increased expansion. Joint movement and expansion capabilities determined by number of couplings/nipples used in the joint. Pressure rating dependent on size and style of flexible couplings used. Victaulic Style 155.

2.07 VALVES AND STRAINERS

A. General:

1. Valves and strainers shall be constructed of the materials shown in the tables for each system and be rated by the manufacturer for the appropriate pressure class required for the listed pressure and temperature limits and for the fluid used and per the valve tables.

2. The manufacturers and model numbers indicated below are to be used as a means of identifying the type, quality, materials and workmanship required. Note that some of the manufacturers listed for a type of valve do not make valves for all pressure/temperature limits and/or all sizes. All valves of each type (400 psig ball, 150 psig globe, and other similar items) for the project shall be by the same manufacturer.

3. All valves shall be located and oriented as to valve stem direction to permit proper and easy operation, and access to valve for maintenance of packing, seat and disc. Valve stems shall not be tilted down unless approved by the manufacturer. Where valves are more than seven feet above the floor, stems shall be horizontal and all valves 2-1/2 in. and above shall have chain wheel and "endless link" style chain for operation from floor; where impact wheel is required, it shall be provided. Packing and gaskets shall not contain asbestos. Provide unions adjacent to equipment end of all threaded and soldered or permanent push-to-connect end valves. Provide grooved joint couplings adjacent to equipment end of all grooved end valves.

B. Service:

1. Shutoff or Isolation Valves shall be provided in all branch connections to mains and where shown on piping diagrams.

   a. In general, for 2½ in. and larger piping use flanged valves or grooved-ended valves in grooved water systems; butterfly valves for water and glycol systems.

   b. In general, for piping smaller than 2½ in. use threaded, sweat, permanent push-to-connect or press/crimped water system connections; ball valves for water and glycol systems.

2. Balancing Valves

   a. No balancing valves are required where Pressure Independent Automatic Control Valves (PIACV) are used for a single coil. Where multiple coils are served by a single PIACV, each coil shall have a combination balancing and shut-off valve to provide proportional balancing. When non-PIACVs are used, provide automatic flow limiting valves or combination balancing and shut-off valves as shown on drawings and details for water and glycol systems. Triple duty valves (balancing with flow measurement, shut-off, and check valve) or equivalent tri-service assemblies (in grooved piping systems) can be used where shown on the drawings and allowed in the tables on pump discharges.

3. Check Valves

   a. For pump discharge use silent check valves (where allowed in the tables and where triple duty valves are not used). All others shall be swing-check type.

4. Drain Valves and Manual Vent Valves

   a. Globe with plug-type disc or ball valves (as shown on drawings).

C. Swing Check Valves: Bronze valves shall conform to MSS SP-80, of the type required for the pressure class and body connection type listed in the tables. Iron valves shall conform to MSS SP-71, of the type required for the pressure class and body connection type listed in the tables. Steel valves shall conform to ASME B16.34, of the type required for the pressure class and body connection type listed in the tables. Valves shall be as manufactured by Stockham, Milwaukee, Crane, Nibco, Victaulic (grooved), Grinnell (grooved), or Hammond.

D. Silent Check Valves: Silent check valves for use on pump discharge shall be of the materials and pressure/temperature ratings shown in the tables. Minimum open area through valve shall be at least 100% of the pipe area. Valves shall be as manufactured by Mueller, Nibco, Metraflex, APCO, Victaulic (grooved), Grinnell (grooved), or SF Equipment.

E. Ball Valves: Valves shall meet FS WW-V-35C, Type II, and have the appropriate trim to meet the required pressure/temperature ratings listed in the tables. Valves shall have locking handles to allow servicing and removal of piping or equipment. Valves on insulated piping shall have stem extension assemblies equal to the insulation thickness. Valves shall have 100% tight shut-off (no seat leakage). Valves shall be as manufactured by Conbraco Industries (Apollo), Watts, Stockham, Nibco, Hammond, or Milwaukee. Ball valves for modulating control service shall have characterized disc to provide equal percentage flow characteristics and extended rangeability. Modulating ball valves shall be Bray VCB series or Belimo B series.

F. Butterfly Valves: Provide butterfly valves of the type and materials listed in the tables. Valve necks shall allow a minimum of 2 in. insulation. Valves shall have the trim required to meet the listed pressures and temperatures listed in the tables. Valves shall have visual position indication. Valve seats shall have zero or near zero (bubble-tight) bi-directional seat leakage. Valves 6 in. and larger and all steam valves shall be gear operated. Non-steam valves under 6 in. shall be lever operated with balance stops.

1. General Service: Standard lug or grooved (in grooved systems) type with ductile iron body, resilient EPDM seats, bronze, nickel, PPS (Polyphenylene Sulfide), Nylon 11 or EPDM coated ductile iron disc and 416 stainless steel stem. Valves shall comply with MSS SP-25, MSS SP-67, and API-609. Valves shall be as manufactured by Mueller, Centerline, DeZurik, Milwaukee, Nibco, Hammond, Keystone, Bray Model 31H, Victaulic Masterseal (grooved), Grinnell Model B302 (grooved), or SF Equipment.

2. High Performance: Valves shall have lug-style carbon steel body, 316 stainless steel eccentric disc, offset 17-4 PH stainless steel shaft, and filled PTFE soft seat. Valves shall comply with ANSI B16.5, ANSI B16.34, MSS SP-25, MSS SP-61 (zero leakage), MSS SP-58, and API-609. Valves shall be as manufactured by Flowseal (Crane), Neles-Jamesbury, DeZurik, Posi-Seal, Milwaukee, Hammond or Bray/McCannalok.

G. Triple Duty Pump Discharge Valves- shall <u>not</u> be permitted.

H. Automatic Flow Limiting Valves: Valves shall be pressure flow limiting independent type with spring loading to provide the required opening to maintain constant flow across the entire control pressure range. Valve flow selection shall be adjustable on the valve assembly. Valves whose flow rate can't be field selected with at least a 20% range of design flow shall be provided with replacement flow cartridges as required by the balancing subcontractor or engineer. The valves shall be provided with a permanent nameplate or tag carrying a record of the factory-determined flow rate, flow range and flow control pressure ranges. Valves shall be certified to control the flow within 5 percent of the flow set per the tag's listed flow and control pressure range. Unless shown otherwise, the minimum control pressure range shall be 2 to 32 psi. Valves shall be of materials suitable for the maximum operating pressure and temperature listed in the table for the intended service. Valves up to 2 in. shall be threaded or solder-end. Valves over 2 in. shall be flanged. Each valve shall have a pressure fitting with quick disconnect valve located on both sides of the valve. Provide deluxe meter kit in carrying case. Provide molded insulation kit. Valves shall be as manufactured by Griswold, Flow Design/Auto flow, Macon, Hays or Nexus.

I. Pressure Independent Control Valves: The intent is for PIACVs to be used for all modulating 2-way control valves on all water systems (including glycol). Each pressure independent (PI) automatic control valve (ACV) is a two-section valve referred to herein as a PIACV. These valves shall be self balancing (pressure independent) over a minimum operating range across both sections of the valve assembly of 6 to 45 psid (or up to 58 psid where the associated pump head is over 130 feet) with the mechanical PI section limiting the differential pressure over the ACV section to provide very stable and accurate control. Electronic PI sections are <u>not</u> allowed as they require the ACV section to absorb the entire pressure drop at the maximum psid. Control valves leakage shall be no more than that allowed by ANSI seat leakage Class IV (0.01% of full open valve capacity). See SECTION 250001-BUILDING AUTOMATION SYSTEM of the specifications for further information on these valves.

J. Strainers

1. Strainer-body connections shall be the same size as the pipe lines in which the connections are installed. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with a tapped blow down opening. Provide full size nipple and appropriate type of valve for blow down. The basket shall be of stainless steel with small perforations of sufficient number to provide a net free area through the basket of at least 5 times that of the entering pipe. The flow shall be into the basket and out through the perforations. Bronze strainers shall conform to MSS SP-80, of the type required for the pressure class and body connection type listed in the tables. Iron strainers shall conform to MSS SP-71, of the type required for the pressure class and body connection type listed in the tables. Steel strainers shall conform to ASME B16.34, of the type required for the pressure class and body connection type listed in the tables. Y-type strainers are listed in the tables, provide basket type strainers of

same construction where shown on drawings. Strainers shall be as manufactured by Mueller, Sarco, Watts, Armstrong, Keckley, or Yarway.

2. Strainers for grooved end piping systems shall be of the same size as the pipe lines in which the connections are installed. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with a tapped blow down opening:

   a. Y-pattern, 2 in. through 12 in. sizes, 300 psi maximum pressure rating. Suitable for services up to 210°F, ductile iron body, Type 304 stainless steel perforated metal removable baskets, blow down port with pipe plug and grooved ends.

   b. T-pattern, 2 in. through 12 in. sizes, 300 psi maximum pressure rating. Suitable for services up to 210°F, ductile iron body, Type 304 stainless steel frame and mesh removable basket, removable access coupling/cap for strainer maintenance, and grooved ends.

   c. T-pattern, 14 in. through 24 in. sizes, 300 psi maximum pressure rating. Suitable for services up to 210°F, carbon steel body, Type 304 stainless steel frame and mesh removable basket, carbon steel T-bolt hinged closure/cap for strainer maintenance, and grooved ends.

K. Suction Diffusers

1. Where shown furnish pump inlet suction diffusers as manufactured by Mueller, Bell & Gossett, Armstrong, Taco, or Paco. Units shall consist of an angle type body with inlet vanes and a combination diffuser/strainer and straightening vanes for use on pump inlet. The body or bottom opening shall be equipped with a tapped blow down opening. Provide full size nipple and appropriate type of valve for blow down. The basket shall be of stainless steel with small perforations of sufficient number to provide a net free area through the basket of at least 5 times that of the entering pipe. Unit shall be equipped with a disposable fine mesh start up strainer that shall be removed after system flushing. The body shall be full line size, non-reducing type. Provide reducer as required to fit the pump. Units shall be provided with adjustable support feet to relieve piping strains from the pump suction. Provide valved gauge connections with gauges at diffuser inlet and pump suction to indicate when cleaning is required. Iron strainers shall conform to MSS SP-71, of the type required for the pressure class and body connection type listed in the tables. Steel strainers shall conform to ASME B16.34, of the type required for the pressure class and body connection type listed in the tables.

2. Where shown furnish pump inlet suction diffusers as manufactured by Victaulic or Grinnell on grooved installations. Unit shall be full line size, non-reducing type with flanged outlet and grooved inlet connections, ductile iron body, angle-type, 304 stainless steel frame and perforated sheet diffuser. Removable 20 mesh stainless steel startup pre-filter, outlets for pressure/temperature drain connection and base support boss, 250 psig working pressure rating and 210°F maximum operating temperature.

L. Water Pressure Reducing and Back-pressure Valves

1. Valves shall be as manufactured by Bell and Gossett, Armstrong, Taco, Spence, Sarco, Leslie, Kay & MacDonald, Cashco, or Watts.

2. Provide pressure reducing and back-pressure regulating valves where shown on the drawings. Valves shall be constructed for the applicable temperature and pressure limits in the table for the service intended.

3. Make-up water PRVs shall be provided with integral low inlet-pressure check valves and inlet strainers. The strainers shall be easily removable without system shutdown. The valve seat, strainer and stem shall be removable and of non-corrosive material. The body shall be brass. The valve shall be full line sized as shown on the Drawings. Pressure setting to be minimum system operating pressure (static head plus approximately 5 psi).

M. Pressure Relief Valves and Accessories

1. Pressure relief valves shall be provided where shown on the drawings in accordance with ASME BPV VIII Div 1. Relief valves shall be constructed for the maximum pressure the system can operate at. The aggregate relieving capacity of the relief valves shall be not less than that required by the above code. Provide at least one relief valve for each closed loop piping system. Discharge from water relief valves shall be to indirect drain. Pipe chiller refrigerant relief and steam relief valves to a safe location outdoors. Valves shall be as manufactured by Watts, Kunkle, Lonergan, or Lunkenheimer.

2. For steam relief valves that are piped outdoors, provide steam exhaust heads where shown on drawings. Exhaust heads shall be low pressure drop cyclone design with drains as manufactured by Bryan Steam HEH Series (rated at 7,000 fpn) or an approved equal by, Crane (Cochrane), Penn Separator, Watson McDaniel, Anderson or Hayward (Wright-Austin). Pipe drains as required. Exhaust heads shall remove at least 99% of liquids and solids larger than 10 microns and be fabricated of cast iron or carbon steel (with high heat and rust resistant aluminum paint) with stainless steel separating elements. Subcontractor shall verify that the exhaust head's steam capacity is equal to or greater than the associated relief valves capacity and provide any required pipe increases

N. Air Vents: Provide air vents at all high points in the piping systems meeting the pressure and temperature limits shown on the table for each system.

1. Automatic: Normal Capacity – Float operated with bronze or steel body and stainless steel internals, ball-check valve type with materials as required for the pressure/temperature listed in the table for the system. Provide each vent with safe drainage piping for venting air/water to drain.

2. Manual: For low pressure/temperature water and glycol systems, provide 1/8-in. brass body, chrome plated with two-detachable keys. For higher pressure/ temperature systems, provide globe valves with plug-type disc or ball valves with materials, as required and allowed in the table for the system.

O. Drain Valves: Drain valves shall be one of the type listed for isolation in the table for each piping system. Provide drain connections at all equipment and all low points in the piping systems to allow for complete drainage. Drain connections shall have full size threaded hose end connections with cap/plug. For piping up to 4 in., provide minimum ¾ in. valves. For piping between 4 in. and 10 in., provide minimum 1½ in. valves. For piping larger than 10 in., provide minimum 2 in. valves. Provide 50' of premium grade hose for each size drain.

Valve Lubrication: Furnish a lubrication gun in the mechanical equipment room with extra lubricant sticks sufficient to repack each valve. Guns shall be extra heavy, lever type hydraulic hand type with automatic shutoff, 1500 psi gauge and 12 in. long connecting hose. Lubricant shall be as required by valve manufacturer for the service intended. **WATER AND FUEL OIL SERVICES**
Maximum 250°F and 150 psig (up to 12 in.)/ 125 psig (over 12 in.)

Valve Type	**Size (in.)**	**Type**	**Application**	**Body/Trim Body/Seat**	**Type of Connection**	**Minimum Pressure Rating/Class**
Ball	½ – 2	2 or 3 piece	Isolation or ATC Modulation (with characterized disc)	Brass or Bronze/RTFE	Sweat or Threaded	400 psig WOG (Water, Oil or Gas) or ANSI Class 250
PIACV	½ – 2	Control & Balancing	ATC Modulation for Water & Glycol Systems	Brass or Bronze/RTFE	Sweat or Threaded	400 psig WOG (Water, Oil or Gas) or ANSI Class 250
PIACV	2 ½ – 16	Control and Balancing	ATC Modulation for Water & Glycol Systems	Ductile Iron/EPDM	Flanged (ANSI 125/150)	ANSI Class 150
Butterfly	2½-12	General Service	Isolation or ATC 2-Position	Iron/EPDM	Flanged (ANSI 125/150)	175 psig CWP (Cold Water Pressure), Bi-directional, 150 psig dead end service.
Butterfly	14 - 48	General Service	Isolation or ATC 2-Position	Iron/EPDM	Flanged (ANSI 125/150)	150 psig CWP (Cold Water Pressure), Bi-directional.
Butterfly	2½ - 24	High Performance	ATC Modulation (C_v at 2/3 open)	Steel/Filled PTFE	Flanged (ANSI 125/150)	ANSI Class 150
Globe	½ – 2	Control	ATC Modulation	Bronze/Brass	Threaded	ANSI Class 125
Balancing/ Shutoff	½ – 2	Flow Indication	Isolation and balancing	Brass or Bronze/Brass	Sweat or Threaded	ANSI Class 125
Balancing/ Shutoff	2½ - 12	Flow Indication	Isolation and balancing	Iron/Brass	Flanged	ANSI Class 125
Check	To 1½	Silent Wafer	Pump discharge	Iron/Bronze or Brass	Flanged	ANSI Class 125
Check	2 - 24	Silent Globe	Pump discharge	Iron/Bronze or Brass	Flanged	ANSI Class 125
Check	½ - 2	Swing	Piping	Bronze/Bronze	Sweat or Threaded	ANSI Class 125

Check	2½ - 24	Swing	Piping	Iron/Bronze or Iron	Flanged	ANSI Class 125
Strainer	½ - 2	Y-type	ACVs, P&F HXs	Bronze or Iron/Stainless 1/16 in. screen	Sweat or Threaded	ANSI Class 125
Strainer	2½ – 4	Y-type	ACVs, P&F HXs	Iron/Stainless 1/16 in. screen	Flanged	ANSI Class 125
Strainer	5 – 24	Y-type	ACVs, P&F HXs	Iron/Stainless 1/8 in. screen	Flanged	ANSI Class 125
Strainer	2 – 16	Suction Diffuser	Pump Inlet (non-reducing)	Iron/Stainless 5/32 in. screen with 20 mesh start-up sleeve	Flanged	175 psig Working Pressure or ANSI Class 125

ALTERNATE PIPING METHOD (GROOVED JOINT)
WATER SERVICES
Maximum Service Rating of 230F; with pressure as required for the systems (see standard valve tables)

Valve Type	Size (in.)	Type	Application	Body/Trim Body/Seat	Type of Connection	Pressure Rating/Maximum System Rating
Ball	1½-6	2-piece	Isolation or ATC 2-Position	DI (ASTM A-536)/Cr.-plated stem, ball TFE seats	Grooved	800 PSI/600 PSI
Ball	2	1-piece	Diverting (3-port) or ATC 2-Position	DI (ASTM A-395)/SS TFE	Grooved	600 PSI/450 PSI
Butterfly	2-12	General Service	Isolation or ATC 2-Position	DI (ASTM A-536 or 395) DI/EPDM	Grooved	300 PSI (dead-end to full rating of valve)/250 PSI
Butterfly, 3-way	2-12	General Service	Diverting	DI (ASTM A-536 or 395)/ DI/EPDM	Grooved	300 PSI (dead-end to full rating of valve)/250 PSI
Butterfly	14-24	General Service	Isolation	DI (ASTM A-395) SS/EPDM	Grooved	175 PSI (dead-end to full rating of valve)/150 PSI
Butterfly	14-24	General Service	Isolation	DI (ASTM A-395 or 536) DI/EPDM	Grooved	300 PSI (dead-end to full rating of valve)/250 PSI
Balancing/ Shutoff	½-2	Flow Indication	Isolation and balancing	Ametal® Brass-Copper Alloy/EPDM	Sweat or Threaded	300 PSI/250 PSI

Balancing/ Shutoff	2½-12	Flow Indication	Isolation and balancing	DI (ASTM A-536)/EPDM	Flanged or Grooved	300 PSI/250 PSI
Check	2½-12	Silent	Pump Discharge, Piping	DI (ASTM A-395 or 536) DI/EPDM	Grooved	300 PSI/250 PSI
Check	4-12	Silent	Pump Discharge, Piping	DI (ASTM A-395 or 536) DI/EPDM	Grooved	300 PSI/250 PSI
Check	2-4	Swing	Piping (Horizontal)	DI (ASTM A-536) SS/EPDM	Grooved	300 PSI/250 PSI
Check	14-24	Spring-Assist/Dual Check	Pump Discharge, Piping	DI (ASTM A-395) SS/EPDM	Grooved	230 PSI/200 PSI
Strainer	2-12	Y-Type	ACV's, P&F HXs	DI (ASTM A-395 or 536) /EPDM SS 1/16 in. or 1/8 in. screen	Grooved	300 PSI/250 PSI
Strainer	1½-12	T-Type	ACV's, P&F HXs	DI (ASTM A-395 or 536) /EPDM SS 1/8 in. screen	Grooved	400 PSI/350 PSI
Strainer	14-24	T-Type	ACV's, P&F HXs	DI (ASTM A-395 or 536) /EPDM SS 1/8 in. screen	Grooved	300 PSI/250 PSI
Strainer	3-12	Suction Diffuser	Pump Inlet (non-reducing)	DI (ASTM A-395)/EPDM SS 3/16 in. screen with 20 mesh start-up sleeve	Grooved System x ANSI Class 150 Pump Flange	300 PSI/250 PSI
Strainer	14-24	Suction Diffuser	Pump Inlet (non-reducing)	DI (ASTM A-395)/EPDM SS 3/16 in. screen with 20 mesh start-up sleeve	Grooved System x ANSI Class 150 Pump Flange	300 PSI/250 PSI

2.08 PRESSURE BYPASS REGULATING VALVE

A. Furnish and install a pressure bypass regulating valve where indicated on the drawings and as detailed herein. Valve shall be operated by the automatic temperature control system.

B. Valve operation to be such that valve opens on a rising differential pressure in the system. Valve shall be selected at normal system operating pressure; bypassed flow rate to be equivalent to flow through all two-way control valves in each system served. Valve to be normally closed.

C. Body to be 150 lb. carbon steel; trim to be 303 SS; seat to be SS sliding plate with nuclear grade graphite; spring housing to be ductile iron; diaphragm to be Viton, suitable for service ranges of up to 230-psi at 300 degrees F.

D. Provide all required piping to connect downstream sensing line into piping. Line to be Schedule 40 black steel.

E. Final sizing and valve selection to be by valve manufacturer.

2.09 COLD WATER CONNECTIONS

A. Connections shall be provided which include consecutively in line a strainer, backflow prevention device, and water pressure regulator. The backflow prevention device shall be provided as indicated and in compliance with SECTION 220001-PLUMBING.

B. Strainers: Basket or Y-type strainers shall be the same size as the pipelines in which they are installed. Strainer bodies shall be rated for 250 pound service, with bottoms drilled and plugged. Bodies shall have arrows cast on the sides to indicate the direction of flow. Each strainer shall be equipped with a removable cover and sediment basket. Basket shall not be less than 22-gauge and shall have perforations to provide a net free area through the basket of at least four times that of the entering pipe.

C. Pressure Regulating Valve: Valve shall be a type that shall not stick nor allow pressure to build up on the low side. Valve shall be set to maintain a terminal pressure approximately 5-psi in excess of the static head on the system and shall operate within a 20-psi variation regardless of initial pressure and without objectionable noise under any condition of operation.

2.10 GLYCOL FEED UNIT

A. Unit, providing it meets all requirements of the plans and specifications, shall be as manufactured by Advantage Controls Inc., J.L. Wingert Co., Neptune Chemical Pump Co., Pulsafeeder Inc. (Unit of IDEX Corp.), or approved equal.

B. Provide minimum 50-gallon polyethylene storage tank with hinged cover. Tank shall be mounted on a welded enamel coated steel frame/stand.

C. Provide positive displacement type 1/2 hp pump rated at a minimum of 3.3 gpm at a pressure of 100 psi. Pump shall be mounted on steel frame below tank.

D. Provide pre-piped pump strainer, shut off valves, check valve, pressure gauge, relief valve to prevent system over pressurization (piped from discharge into storage tank), and other accessories as shown on drawings. Pipe and fittings shall be 3/4 in. schedule 80 PVC or type L copper (1/2 in. is allowed for the relief piping to the tank). Provide flexible piping for the pump inlet and discharge. Provide unit with minimum 8' long grounded power cord suitable for plugging into a dedicated receptacle (115 VAC, 60 Hz, 20 Amps).

E. Provide pre-wired magnetic starter with HOA switch and "on" indicator light. Provide pre-wired adjustable pressure switch and controls to start pump on low glycol system pressure and stop pump after a 10 psi (adj.) differential. Initial set point to start pump shall be 5 psi (adj.) above the minimum pressure scheduled for the expansion tank (typically between 20 and 80 psig). Controller and pressure sensor shall be solid state electronic type in NEMA 4X electrical enclosure. Provide storage tank liquid level sensor with low level switch at 10% (adj.) level, pre-wired to prevent pump operation, activate a unit mounted audio alarm (with silence switch), and activate a dry contact for the building's DDC system. All wiring shall be in conduit.

2.11 EXPANSION TANK

A. Expansion Tanks (ET)

1. Diaphragm type: TACO, Bell & Gossett, Armstrong, Amtrol, Grundfos or approved equal.

   a. Shell: fabricated steel designed and constructed per ASME Section VIII, Division 1.

   b. Bladder: heavy-duty butyl, replaceable.

   c. Suitable for a working pressure of 150-psig.

   d. Operating temperature: 300°F.

2. Pressurization system shall include a replaceable diaphragm-type captive air expansion tank which shall accommodate the expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. Sizes shall be as indicated. Expansion tank shall be welded steel, pre-charged to the minimum operating pressure. Tank air chamber shall be fitted with an air-charging valve. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations.

2.12 AIR/DIRT SEPARATOR

A. Line size, ASME Construction, suitable for 125-psig pressure; centrifugal, low velocity vortex type, as manufactured by Spirotherm, TACO, Bell & Gossett, Armstrong, Amtrol, Spirax Sarco, or approved equal. Provide with 3/4-inch hose end drain valve. Unit shall be capable of both air and dirt separation. Unit shall have removable base for easy access to strainer, and shall be provided with valves to allow for the strainer services.

2.13 PRESSURE GAUGES, THERMOMETERS AND ACCESSORIES

A. Pressure Gauges

Gauges shall be provided for equipment and piping as indicated. A thermometer and pressure gauge shall be provided on the low temperature water supply and return mains.

1. Up to 7 feet above finished floor: 4½ in. diameter; over 7 feet above finished floor: 6 in. diameter, oriented for ease of reading.
2. Provide gauges having one percent of scale range accuracy, brass pipe and fittings, phosphor bronze bourdon tubes, beryllium copper bellows, 1/4-in. NPT male connection, stainless steel rack and pinion movement, micro adjustment for calibration, white dial and black figures, plastic lens, and threaded ring case. Provide minimum 2-inch long brass nipples, test cock, snubbers and shutoff-cock for each gauge.
3. Gauge ranges to be selected so that normal operating range for a particular gauge shall occur at approximately the midpoint of the total range, and so that under minimum and maximum conditions, damage to gauge shall not occur. Provide compound gauges at suction side of pumps.
4. Gauge Schedule: Provide at locations indicated on drawings. Shop drawing submittal package to include location, size of gauge and range.
5. Manufacturers: Ashcroft, U.S. Gage, Marsh or an approved equal.
6. Gauges on piping in all mechanical rooms shall be so placed as to be easily read from the floor without parallax.

B. Compound Gauge (based on Trerice No. 600C Series, 4-1/2 in. size)

1. Provide compound pressure gauge with cast aluminum case, black finish.
2. Ring shall be friction type, stainless steel, clear glass window, with white dial with black figures and gradations.
3. Pointer shall be adjustable, red tipped.
4. Bourdon tube shall be phosphor bronze soldered to socket and tip, socket shall be brass, ¼-inch NPT.
5. Accuracy shall be ANSI B.40.1, Grade A, 1% of full scale over middle half of range, 2% of full scale over first and last quarter of range.

C. Thermometers and Wells

1. Separable well type, industrial thermometers as manufactured by Taylor Instrument Co., U.S. Gage, Mueller Instrument Co., or approved equal.

2. Provide thermometers having brass, cast aluminum-bronze or cast aluminum case with red reading mercury and glass windows or dial type bimetal reading unit with stainless steel case, glass window and external adjustment. Provide 3-inch diameter white dials or 9-inch scales with black numbers and adjustable angle stem, stainless steel separable wells with extended neck to suit insulation thickness. Provide stems and wells to extend approximately to center of the pipe or maximum length of 12-inch for large pipe. Provide 1-percent accuracy at mid-range.

3. Scale: Heating Hot Water, 40 to 240°F/Chilled Water: 0-100°F.

D. Drains

1. A drain connection with ¾-inch hose bib shall be installed at the lowest point in the low temperature water return main near the heat exchanger. In addition, threaded drain connections with threaded cap/plug and drain shall be installed wherever required for thorough draining of the low temperature water system.

E. Strainers

1. Basket or Y-type strainer-body connections shall be the same size as the pipelines in which the connections are installed. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with nipple and gate valve for blow down. The flow shall be into the basket and out through the perforations. Provide blow-down valve; full size of tapping.

F. Grooved End Strainers:

1. Y-Pattern, 2 in. through 18 in.: 300 psi CWP, ductile iron body, with Type 304 stainless steel metal removable basket with 0.125 in. diameter perforations, blow-down port fitted with pipe plug. Victaulic Series 732 and W732.

2. T-Pattern, 2 in. through 24 in.: Up to 750 psi CWP, ductile iron or carbon steel body with Type 304 stainless steel frame and mesh removable basket with No. 6-mesh sizes, removable coupling and end cap or T-bolt hinged closure/cap, for strainer maintenance. Victaulic Series 730 and W730.

G. Suction Diffusers

1. Furnish at each end suction pump, a suction diffuser (Bell & Gossett, Mueller, Armstrong or approved equal). Units shall consist of an angle type body with inlet vanes and a combination diffuser/strainer with 1/8-inch diameter openings for pump protection. (Unit shall be equipped with a disposable fine mesh start up strainer, which shall be removed after system flushing). Flow direction shall be from inside the strainer to outside. The body shall be full line size. Provide reducer as required to fit the pump. On suction diffusers used with floor mounted pumps, unit shall be provided with an adjustable support foot to relieve piping strains from the pump suction. Provide valved gauge connections with gauges at diffuser inlet and pump suction to indicate when cleaning is required. Provide blow-down valve; full size of tapping.

2. Furnish at each suction pump with grooved end connections up to 12 in. a suction diffuser (Victaulic Series 731-D or approved equal) with grooved inlet and straight, single, or double reduction flanged outlet, rated to the working pressure of the mating flange. Unit shall consist of an oversized ductile iron body, Type 304 stainless steel frame and perforated sheet diffuser with 5/32 in. diameter holes, 20-mesh stainless steel startup pre-filter, and NPT tapped bosses on either side for pressure measurement, and drain plug.

3. Furnish at each suction pump with grooved end connections 14 in. through 24 in. a suction diffuser (Victaulic Series W731-I) with AGS grooved inlet and Class 150 flanged outlet, rated to 300 psig. Unit shall consist of a ductile iron or segmentally welded fabricated steel body and end cap, Type 304 stainless steel frame and perforated sheet diffuser with 5/32 in. diameter holes, 20-mesh stainless steel startup pre-filter, and NPS tapped bosses on either side for pressure measurements, and drain plug.

H. Pressure-reducing Valves

1. Bell & Gossett, Armstrong, Taco or an approved equal.

2. Diaphragm operated pressure-reducing valve with low inlet pressure check valve and inlet strainer. The strainer shall be easily removable without system shutdown. The valve seat, strainer and stem shall be removable and of non-corrosive material. The body shall be brass. The valve shall be full line sized as shown on the Drawings. Pressure setting to be minimum system operating pressure.

I. Multi-Purpose Pump Discharge Valves (furnish at the discharge of all hydronic heating pumps)

1. Bell & Gossett, Armstrong or approved equal

2. Valves to be designed to permit tight system shutoff and then return to original balance point after shutdown, to perform as a spring-loaded non-slam check valve and to perform as a plug-type flow control valve. Valve

to be able to be repacked under full pressure. Valve to be suitable for use in heating systems with working temperatures up to 230°F.

3. Valve to have flanged, ductile-iron body, bronze disc and seat, stainless steel stem and spring. Valve body to be furnished with calibrated position indicator and two 1/4-inch plugged drain tappings.

4. Valves shall be equipped with schrader valve metering connections to facilitate differential pressure readings across the valve orifice for accurate system balancing. Provide flow versus valve position and differential pressure charts.

5. Each valve to be furnished with a pre-formed removable PVC insulation jacket with high-density fiberglass insulation suitable for temperatures up to 230°F continuous.

J. Tri-Service Valve Assembly: shall not be allowed. Install separate non-slam check valve and shut off valves. Furnish at the discharge of all hydronic heating pumps in lieu of multi-purpose pump discharge valves.

K. Differential pressure transmitter stations on hydronic systems shall include separate taps with isolation valves for the balancer to plug in and calibrate transmitters.

2.14 HYDRONIC SPECIALTIES

A. Air vent valves on all main piping systems shall be 1/4-inch manual gate valves Powell Fig. 507, Lunkenheimer, Crane, or approved equal.

B. Vent valves on coils shall be Bell & Gossett No. 4V, Armstrong, Taco or approved equal.

C. Relief valve shall be Bell & Gossett No. 790-50, Armstrong, Taco or approved equal, set at 50-psi, 3/4-inch inlet, 3/4-inch outlet.

2.15 MOTORS, DRIVES AND STARTERS

A. All equipment shall be provided complete with motors, drives, and starters, unless otherwise indicated.

B. Motors shall be Premium Efficiency (as available by size/horsepower) and shall conform to NEMA Standards and shall be suitable for load, duty service and location. Motors shall have nameplates giving manufacturer's name, serial number, horsepower, efficiency, speed and current characteristics. Motors shall be General Electric, Westinghouse, Reliance, Allis-Chalmers, Gould, Baldor, or approved equal.

C. Motors shall be tested in accordance with the standards of ANSI C50 and conform therewith for insulation resistance and electric strength. Minimum efficiency levels shall be as established by the Energy Policy and Conservation Act of 1992 for motors sold after October 1997. All motors shall be tested in accordance with IEEE Standard 112, Test Method B.

D. Motors for use with variable frequency drives shall be rated for that service and have a minimum Class F insulation. Bearing grease shall be non-conductive, provide on nameplate the type of grease to use.

E. Motors ½ HP and larger shall be squirrel cage induction, ball or roller bearings with pressure grease lubrication, specifically wound for 460 V/3PH/60HZ alternating current, unless otherwise noted.

F. Motors less than ½ HP shall be capacitor start of split phase type, specifically wound for 120V/1PH/60HZ alternating current, unless otherwise noted.

G. Motors greater than 15 HP shall be part-wind start.

H. Motors shall be furnished complete with conduit terminal box of size adequate to accommodate conduits and wires as sized on the Electrical Drawings or specified under this Section.

I. Motor capacity shall be sufficient to operate associated driven devices under conditions of operation and load and with overload and at least the horsepower indicated or specified. All motors shall be of the premium efficiency, high power factor, low energy consuming type most suitable for the application and installed environment. Any motor replacement necessary for compliance to the application shall be at no additional cost to the Owner.

J. Motors shall be suitable for continuous duty at rated horsepower with temperature rise not to exceed 40°C for drip proof motors, 50°C for splash proof motors, 55°C for totally enclosed or explosion proof motors. All motors shall be capable of 25% overload without overheating and suitable for operation for the ambient conditions of its specific location.

K. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except fractional HP motors, which shall have slotted mounting holes.

L. Drives for belted motors shall be as manufactured by Dodge Manufacturing Company, Browning Manufacturing Company, T.B. Woods Company or an approved equal with adjustable motor sheaves and adjustable slide bases. The drive belts shall be as short as practicable. All fans and fan units shall be furnished with cogged-type triple V-belt drives, each sized for 150% of the design drive capacity. All multiple belt drives shall have matched sets of belts.

M. Motor controllers shall be equipped with all poles, auxiliary contacts and other devices necessary to permit the interlocking and control sequences required. Controller operating coils shall be generally designed for 120-volt operation, and 3 phase motors shall be provided with thermal overload protection in all phases.

N. This Subcontractor shall furnish all magnetic starters for each and every motor furnished under this Section of the specification. The Electric Subcontractor shall install, and wire the starter.

O. All electrical apparatus furnished under this Section shall be approved by UL and shall be labeled or listed where such is applicable. Where custom-built equipment is specified and the UL label or listing is not applicable to the completed product, all components used in the construction of such equipment shall be labeled or listed by UL where such is applicable to the component.

P. Provide shaft grounding rings on all inverter duty motors.

2.16 PUMPS (WATER SYSTEMS)

A. In-Line Mounted Centrifugal Pump: Provide pumps with capacities as shown on the Drawings. Pumps shall be in-line type, close-coupled, single stage design, for installation in vertical or horizontal piping. Pump must be capable of being serviced without disturbing piping connections.

1. Pumps shall be as manufactured by Grundfos, Taco, Bell & Gossett, Armstrong or approved equal.

2. Pump volute shall be cast iron, bronze or S.S. and impeller shall be synthetic (up to 2 in. flanges), bronze/brass S.S. or cadmium plated steel, enclosed type dynamically balanced, keyed to the shaft and secured by locking cap screw or nut.

3. Pumps shall be rated 125 psi minimum (up to 4 in. flanges) and a minimum of 175 psi working pressure (for larger pumps), with gauge ports at nozzles, and with vent and drain ports.

4. Pump shall be suitable for continuous operation between 35 and 225 degrees F.

5. Bearings shall be non lubricated bronze type with S.S. shafts. Seal shall be mechanical type.

6. Motor shall be non-overloading throughout pump curve, premium efficiency, VFD rated, meet NEMA specifications and shall be size, voltage and enclosure called for on the Drawings and the MOTOR Section of these specifications. It shall have heavy-duty grease lubricated ball bearings.

7. Each pump over 2 HP shall be fitted with a factory installed flush line. Supply, for field installation in the flush line to the mechanical seal, a 50 micron cartridge filter and floating ball type sight flow indicator suitable for the working pressure encountered. The HVAC Subcontractor shall change the filters after the system has been flushed and on a regular basis until the pumps are turned over to the Owner.

8. Each pump shall be factory tested and painted with at least one coat of high-grade machinery enamel prior to shipment.

B. End Suction Pumps

Provide pumps with capacities as shown on the Drawings. Pumps shall be base-mounted, single stage, end suction design. Pump must be capable of being serviced without disturbing piping connections.

1. Pumps shall be as manufactured by Grundfos, Taco, Bell & Gossett, Armstrong, or approved equal.

2. Pump volute shall be Class 30 cast iron with integrally cast pedestal support. The impeller shall be cast bronze, enclosed type, dynamically balanced to ANSI Grade G6.3, keyed to the shaft and secured by locking cap screw or nut.

3. Pumps shall be rated for a maximum of 175-psi working pressure, with gauge ports at nozzles, and with vent and drain ports.

4. Pump shall be suitable for continuous operation at 225 degrees F.

5. Motor shall be non-overloading throughout pump curve, premium efficiency, meet NEMA specifications and shall be size, voltage and enclosure called for on the Drawings.

6. Pump bearing housing assembly shall have heavy-duty regreaseable ball bearings, replaceable without disturbing piping connections.

7. Base plate shall be structural steel or fabricated steel channel configuration fully enclosed at sides and ends. A flexible type coupler, capable of absorbing torsional vibration, shall be employed between the pump and the motor.

8. See Vibration Isolation Section.

2.17 HYDRONIC HEATERS

A. Finned Tube Radiation

1. Furnish and install a complete system of baseboard radiation where shown on the drawings. Size, type, capacity and performance to be as scheduled on the drawings. Fin tube radiation to be similar and equal in all respects to Sterling Versaline. Alternate manufacturer's, providing they are equal to the specified model are, Slant Fin, Vulcan, Trane, Ritting, Dunham-Bush or an approved equal.

2. In general, the system shall have full backplate, sloping-top enclosure, ball bearing cradle type element hangers, roller bearing type supply and return pipe hangers, access doors at all valves, end covers, wall sleeves, inside corners and outside corners. Enclosure shall be continuous between walls or shall be furnished with end covers.

3. Enclosure shall be of the sloped-type. Material to be minimum 16 gauge cold rolled steel. Enclosure shall be reinforced with welded gussets across the louvered area. Joining of enclosure sections shall be by slip joints to provide rigidity. Brackets shall be die formed for rigidity, and must be designed to support the full backplate at the top as well as at the front skirt of the enclosure. Brackets shall incorporate a security lock for fastening the enclosure, and to prevent removal of enclosure without tools. All enclosures and accessories shall be chemically phosphatized before priming with baked-on primer. Final coat shall be baked-on enamel. Color to be selected by the Architect. All accessories shall be die formed minimum 18 gauge cold rolled steel with beaded or flanged edges. Access doors with hex head camlock operator shall be provided at all valves. No sheet metal screws, or other fastenings or joining devices shall be visible when enclosure is installed.

4. Heating elements shall be copper tube/aluminum fins or steel tube/steel fins as scheduled. Element shall be rated at 240 PSI at temperatures up to 300° F.

5. Backplate shall be full dimension style, die formed of minimum 18 gauge cold rolled steel. It shall allow for removal of enclosure without damaging the wall. Install with high temperature open cell polyurethane dirt seal gasket along entire length of backplate.

6. Hangers for heating elements shall be, die formed, 14 gauge galvannealled steel with channel type wiped edge for rigidity Nickel-chromium plated ball bearings inserted into a nylon isolator insert shall be used in conjunction with a 18 gauge die-formed element support cradle to provide friction free lengthwise movement of element during expansion and contraction as well as aligning element to prevent contact with bracket, wall or enclosure. Hangers shall also provide for vertical adjustment.

7. Dampers shall have rolled edges for rigidity with tamper resistant operator.

8. Hangers for supply and return piping within the enclosure shall be of the roller bearing type to allow for noiseless expansion.

9. Bare element for custom enclosure shall comply with all of above performance and specification requirements. Provide brackets, hangers, guides, and appurtenances required for a complete noise, vibration-free operation.

B. Baseboard Radiation (Runtal Style)

1. Radiators shall be manufactured of cold rolled low carbon steel, fully welded and consisting of header pipes at each end, connected by flat oval water tubes.

2. Tubes shall have a minimum wall thickness of 0.058 in. (85 psig).

3. Radiator header pipes shall be square 0.109 in. minimum wall thickness and include all necessary supply, return, and air vent connections. Internal baffling shall be provided as required.

4. Piping connections shall be minimum ½ in. NPT taper threaded sockets, located in either side, or vertical positions, with locations coordinated by the subcontractor. Air vent connections shall be 1/8 in. NPT taper threaded sockets. Maximum pressure drop for entire assembly shall not exceed 3 feet.

5. Radiators shall have steel corrugated fins welded to the rear side of the water tubes to increase the convective output. There shall be no less than 32 fins per foot. Fins shall start within 1 in. of the headers, and shall be spot-welded three times per tube.

6. Radiators shall include integral heavy gauge (0.09 in. minimum) all-welded perforated top grilles (for curved radiators the grilles shall be omitted).

7. Working pressure shall be minimum 85 psig (tested at 110 psig).

8. Radiator expansion shall not exceed 0.016 inch per linear foot at 215°F.

9. Radiators shall be cleaned and phosphatized in preparation for the powder coat finish.

10. Radiators shall be painted with a gloss powder coat finish, for a total paint thickness of 2 to 3 mils (0.002-0.003 in.).

11. Color of the finish paint shall be selected by the architect from available standard or optional colors prior to ordering.

12. Wall mounting brackets shall be provided with radiators. Provide full trim pieces for a continuous appearance from wall to wall where shown. Radiators shall be provided with perforated panel across top of radiator.

13. Provide appropriate piping connections to connect multiple pieces of radiation in series (where shown). Flexible connectors shall be used where appropriate to provide expansion compensation for the radiators.

14. Radiators shall be provided by Runtal or approved equal for the sizes, capacities, and quantities as shown on the plans and schedules.

C. Radiant Ceiling Panels

1. Armstrong Metalworks Airtite ARX radiant ceiling system, or as manufactured by Vulcan, Airtex, or approved equal.

2. Extruded aluminum panel of single or double tube design, of circuiting, and panel sizes as indicated and as required to meet the scheduled performance.

3. Soft drawn copper tubes physically secured to panel for secure fitting and maximum heat transfer.

4. Integral expansion loops and insulation.

5. Provide complete factory assembled panels to fit into selected space specific ceiling system.

6. Provide installation appurtenances required to make the system complete and operable.

7. Refer to drawings.

8. Color selection by architect.

2.18 BOILERS

A. Boiler acceptable manufacturers: Lochinvar, Aerco, Fulton or approved equal.

B. Boilers shall be suitable for firing with natural gas utilizing a forced draft combustion system. Boilers shall be ASME rated for 50 psi working pressure.

C. The boiler shall have a full three pass fire tube design to allow complete combustion of the fuel in the main combustion chamber. All flue side surfaces, including the main combustion chamber, second and third flue passages shall be constructed of 316 stainless steel designed to maximize the condensate formation. All flue passages shall be fully water-backed to minimize thermal stresses on the boiler vessel.

D. Boiler shall be suitable to operate under any return water temperature, any boiler water flow rate and without any restrictions on temperature rise through the boiler vessel. Boiler shall be able to operate at efficiencies up to 98% at suitably low return water temperatures. Boiler minimum thermal efficiency shall be at least 94.5%.

E. The condensing secondary and tertiary fire tube flue passages shall be fabricated from 316 stainless steel with a reduced cross section in the direction of flue products flow to maintain a near constant velocity of combustion products and to enhance micro turbulences for maximum heat transfer.

F. Boiler shall have an internal water baffle plate separating return water between second and third flue passages for maximum efficiency.

G. Boiler shall be fully serviceable from the front by means of a reversible swing burner door and removable access cover.

H. The boiler vessel shall be wrapped with a full 4 in. thermal insulation blanket for minimal stand-by loss.

I. The boilers shall include a natural gas modulating burner (shipped loose) to include the gas train (field assembled) with the appropriate components to meet the Mass Plumbing Code and insurance regulations.

J. The boiler/burners shall be provided with the required software to allow control to be done by the ATC subcontractor.

K. Hot water system shall utilize 40% propylene glycol fluid.

L. Boiler manufacturer shall provide flue and draft control system.

M. Boiler manufacturer shall size the combustion intake system.

2.19 AIR COOLED CHILLER

A. Acceptable Manufacturers:

1. Daikin
2. Trane
3. JCI/York
4. Carrier

B. General: Install and commission, as shown on the schedules and plans, factory assembled, charged, and tested air cooled chiller(s) as specified herein. Chiller shall be designed, selected, and constructed using a refrigerant with Flammability rating of “1”, as defined by ANSI/ASHRAE STANDARD - 34 Number Designation and Safety Classification of Refrigerants. Chiller shall include, but is not limited to: variable speed rotary screw compressors, a complete system with two independent refrigerant circuit, direct expansion type evaporator, air-cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls including capacity controller, control center, motor starting components, and special features as specified herein or required for safe, automatic operation.

C. Chilled water system shall utilize 30% propylene glycol fluid.

D. Cabinet: External structural members shall be constructed of heavy gage, galvanized steel coated with baked on powder paint which, when subjected to ASTM B117, 1000 hour 5% salt spray test, yields minimum ASTM 1654 rating of "6".

E. Service Isolation valves: Service discharge (ball type) isolation valves are added to unit per system. This option also includes a system high-pressure relief valve in compliance with ASHRAE15. (Factory-mounted.)

F. Pressure Transducers and Readout Capability

1. Discharge Pressure Transducers: Permits unit to sense and display discharge pressure.

2. Suction Pressure Transducers: Permits unit to sense and display suction pressure.

G. Compressors & Drives

1. Compressors: Shall be semi-hermetic or hermetic; rotary screw, 3D scroll or centrifugal type, including:

   a. Compliant design for all wearable part sealing

   b. Refrigerant flow through the compressor with 100% suction cooled motor.

   c. Large suction side free volume and oil sump to provide liquid handling capability.

   d. Compressor crankcase heaters to provide extra liquid migration protection.

   e. Discharge check valve and reverse vent assembly to provide low-pressure drop, silent shutdown and reverse rotation protection.

   f. Suction and discharge service valves.

   g. Initial and operating oil charge.

   h. Oil Level and moisture indicator sight glass.

   i. Vibration isolator mounts for compressors.

   j. Brazed-type connections for fully hermetic refrigerant circuits.

   k. Permanent magnet variable speed motors.

   l. Compressor Motor overloads capable of monitoring compressor motor current. Provides extra protection against compressor reverse rotation, phase-loss and phase imbalance.

   m. Oil separator & filter.

2. Variable compressor motor drive shall have integral factory installed cooling system based on refrigerant system, but shall be separated from the main refrigerant circuit by a plate & frame heat exchanger.

H. Refrigerant Circuit Components

1. Chillers shall have minimum of two independent refrigerant circuits.

2. Each refrigerant circuit shall include: liquid line shutoff valve with charging port, low side pressure relief device, filter-drier, solenoid valve, sight glass with moisture indicator, thermostatic expansion valves, and flexible, closed-cell foam insulated suction line and suction pressure transducer.

I. Heat Exchangers

1. Evaporator:

a. Shell and tube type, direct expansion type with refrigerant inside high efficiency copper tubes, chilled liquid forced over the tubes by galvanized steel baffles.

b. Constructed, tested, and stamped in accordance with applicable sections of ASME pressure vessel code for minimum 450 psig (3103 kPa)refrigerant side design working pressure and150 PSIG (1034 kPa) water side design working pressure.

c. Shell covered with ¾ in. (19mm), flexible, closed cell insulation, thermal conductivity of 0.26k ([BTU/HR-Ft2-oF]/in.) maximum. Water nozzles with grooves for mechanical couplings, and insulated by Contactor after pipe installation.

d. Provide vent and drain fittings, and thermostatically controlled heaters to protect to -20F (29C) ambient in off-cycle.

J. Air Cooled Condenser:

1. Coils: Condenser coils shall be copper tube/ aluminum fin construction. Coils and headers are brazed as one piece. Integral sub cooling is included. The design working pressure of the coil is 650 PSIG (45 bar). Condenser coils must be cleanable with the use of a standard (up to 1500 psi) pressure washer.

2. Condenser Coils must be protected from debris (i.e. Hail Stone) by a protective panel to ensure longer equipment life and better unit performance.

3. Low Sound Fans Shall be dynamically and statically balanced, direct drive, 700 RPM, corrosion resistant glass fiber reinforced composite blades molded into a low noise, full-airfoil cross section, providing vertical air discharge and low sound. Each fan in its own compartment to prevent cross-flow during fan cycling. Guards of heavy gauge, PVC (polyvinylchloride) coated or galvanized steel.

4. Fan Motors: High efficiency, direct drive, ultra-low noise fan blades, low speed, rigid mounted, with double sealed, permanently lubricated, ball bearings, ECM motors to achieve the low speed.

K. Controls

1. General: Automatic start, stop, operating, and protection sequences across the range of scheduled conditions and transients.

2. Microprocessor Enclosure: Rain and dust tight NEMA 3R/12 (IP55) powder painted steel cabinet with hinged, latched, and gasket sealed door.

3. Microprocessor Control Center:

   a. Automatic control of compressor start/stop, anti-coincidence and anti-recycle timers, automatic pumpdown shutdown, condenser fans, evaporator pump, evaporator heater, unit alarm contacts, and chiller operation from 0°F to 125°F (-18°C to 52°C) ambient. Automatic reset to normal chiller operation after power failure.

   b. Software stored in non-volatile memory, with programmed set points retained in lithium battery backed real time clock (RTC) memory for minimum 5 years.

   c. Forty character liquid crystal display, descriptions in English (or Spanish, French, Italian, or German), numeric data in English (or Metric) units. Sealed keypad with sections for Set points, Display/Print, Entry, Unit Options & clock, and On/Off Switch.

   d. Programmable Set points (within Manufacturer limits): display language; chilled liquid temperature set point and range, remote reset temperature range, set daily schedule/holiday for start/stop, manual override for servicing, low and high ambient cutouts, number of compressors, low liquid temperature cutout, low suction pressure cutout, high discharge pressure cutout, anti-recycle timer (compressor start cycle time), and anti-coincident timer (delay compressor starts).

   e. Display Data: Return and leaving liquid temperatures, low leaving liquid temperature cutout setting, low ambient temperature cutout setting, outdoor air temperature, English or metric data, suction pressure cutout setting, each system suction pressure, discharge pressure, anti-recycle timer status for each compressor, anti-coincident system start timer condition, compressor run status, no cooling load condition, day, date and time, daily start/stop times, holiday status, automatic or manual system lead/lag control, lead system definition, compressor starts/operating hours (each), status of hot gas valves, evaporator heater and fan operation, run permissive status, number of compressors running, liquid solenoid valve status, load & unload timer status, water pump status.

f. System Safeties: Shall cause individual compressor systems to perform auto shut down; manual reset required after the third trip in 90 minutes. Includes: high discharge pressure, low suction pressure, high pressure switch, and motor protector. Compressor motor protector shall protect against damage due to high input current or thermal overload of windings.

g. Unit Safeties: Shall be automatic reset and cause compressors to shut down if low ambient, low leaving chilled liquid temperature, under voltage, and flow switch operation. Subcontractor shall provide flow switch and wiring per chiller manufacturer requirements.

h. Alarm Contacts: Low ambient, low leaving chilled liquid temperature, low voltage, low battery, and (per compressor circuit): high discharge pressure, and low suction pressure.

4. Manufacturer shall provide any controls not listed above, necessary for automatic chiller operation. Subcontractor shall provide field control wiring necessary to interface sensors to the chiller control system.

5. Provide BACnet interface card, or as specifically approved to achieve over MSTP or over IP integration. Submit complete list of available points each with its specific functions, with the shop drawing submission.

L. Power Connection and Distribution

1. Power Panels:

a. NEMA 3R/12 (IP55) rain/dust tight, powder painted steel cabinets with hinged, latched, and gasket sealed outer doors. Provide main power connection(s), control power connections, compressor and fan motor start contactors, current overloads, and factory wiring.

b. Power supply shall enter unit at a single location, be 3 phase of scheduled voltage, and connect to individual terminal blocks per compressor. Separate disconnecting means and/or external branch circuit protection (by Subcontractor) required per applicable local or national codes.

2. Compressor, control and fan motor power wiring shall be located in and enclosed panel or routed through liquid tight conduit.

M. Accessories and Options

1. The following accessories/options shall be furnished, above and beyond standard features noted above:

a. Microprocessor controlled, Factory installed Across the-Line type compressor motor starters.

b. Outdoor Ambient Temperature Control

1) Low Ambient Control (Factory mounted):

2) Permits unit operation to 0°F ambient. Standard unit controls to 25°F ambient.

3) High Ambient Control (Factory Mounted):

4) Permits unit operation above 115°F ambient.

c. Power Supply Connections:

1) Single Point Non Fused Disconnect: Single point Non-Fused Disconnect(s) and lockable external handle (in compliance with Article 440-14 of N.E.C.) can be supplied to isolate the unit power voltage for servicing. Separate external fusing must be supplied, by others, in the in-coming power wiring, which must comply with the National Electric Code and/or local codes.

d. Control Power Transformer:

1) Converts unit power voltage to 120-1-60 (500 VA capacity). Factory-mounting includes primary and secondary wiring between the transformer and the control panel.

e. Protective Chiller Panels (Factory Mounted)

1) Architectural Louvers/Wire Panels: Manufacturer shall provide factory installed architectural louvered panels around entire condenser coils to protect against hail or other damage. Louvers shall be painted as per remainder of unit cabinet. Lower section of chiller (around compressors and evaporator, and the like) shall be covered with heavy gauge, welded wire-mesh, coated to resist corrosion, around base of machine to restrict unauthorized access. If these panels are not factory installed, then subcontractor shall be responsible for purchasing them and installing in the field.

f. Flow Switch (Field-mounted): Vapor proof SPDT, NEMA 4X switch, rated for 150 PSIG, -20°F to 250°F.

g. Service Isolation valves: Service suction and discharge (ball type) isolation valves are added to unit per system. This option also includes a system high pressure relief valve in compliance with ASHRAE15. (Factory-mounted.)

h. Hot Gas By-Pass: Shall be required on lead stage, unless the chiller is equipped with variable speed compressor capable of providing 10% of the full capacity on continuous basis at all operating conditions. Hot gas bypass permits continuous, stable operation at capacities below the minimum step of unloading to as low as 5% capacity by introducing an artificial load on the cooler. Hot gas by-pass shall be factory installed on only one refrigerant circuit.

i. Vibration Isolation (Field-mounted): Elastomeric Seismic Isolators: Level adjustable, restrained mounts in rugged welded steel housing with vertical and horizontal limit stops. Housings shall be designed to withstand a minimum 1.0g accelerated force in all directions to 2 inches.

j. Sound Reduction (Factory-mounted):

1) Trane InvisiSound Ultimate option, or approved equal by Daikin, Carrier or Johnson Controls (York).

2) Provide the following options as required to meet scheduled sound performance data at all load points.

a) Ultra-low Sound fans, Low speed, reduced noise (Factory-mounted).

b) Acoustical compressor wrap.

3) Refer to maximum allowable sound power level table on drawings.

2.20 WATER TREATMENT SYSTEMS AND EQUIPMENT

A. General

1. Provide the necessary apparatus to provide water treatment and complete water treatment services for the hot water systems in the building.

2. A contract agreement satisfactory in form and substance to the Owner shall be executed between the HVAC Subcontractor and the Water Treatment Sub-Subcontractor through its authorized agents binding the Water Treatment Sub-subcontractor to provide supervisory service to assure the use of proper chemical treatment to and for the various systems involved for a period of one year from the date of the initial system start and treatment thereof, as hereinafter described in these Specifications. The contract shall be assigned to the Owner on the Date of Substantial Completion so that water treatment shall continue uninterrupted during the one-year life of the contract. The Water Treatment Sub-subcontractor shall perform the following consulting analysis service.

3. Supervise the cleaning and flushing out of all systems.

a. After completing the installation or modification of each system, it shall be properly flushed out prior to start up. Flush out chemicals and procedures shall be furnished by the Water Treatment Sub-subcontractor.

b. Tests shall be made following the flush out and refilling procedure and a written report submitted to the Architect, Owner and General Contractor stating that the flushing out has been completed satisfactorily. Residual chemical levels shall be limited as follows:

1) Phosphate: zero

2) Alkalinity: to 100 mg/L maximum

3) Suspended solids: zero

4) pH value: 8.4 or less

5) Percent by weight of inhibitor type propylene glycol (30% for chilled water & 40% for hot water)

c. All side loops and low points shall be drained and flushed.

d. Systems shall then be refilled as specified and treated chemically in accordance with recommendation of the Water Treatment Sub-subcontractor. HVAC Subcontractor shall notify the Water Treatment Sub subcontractor at least 48 hours in advance of the initial system fill.

e. It shall be the responsibility of the HVAC Sub-contractor to secure an agreement between the pump manufacturer and the Water Treatment Sub-subcontractor as to the proper level of treatment to be maintained in such systems to avoid damage to pumps and pump seals. A letter stating such understanding shall be submitted to the Architect before approval of the pumps and the water treatment program.

4. Supervise and instruct the Owner's operating personnel in the following:

a. Initial introduction of water treatment to all systems and the control thereof.

b. Chemical product literature, identification for use and application procedure.

c. Testing procedure and interpretation of test results and proper control limits for each constituent, and

d. Log sheets with instructions in correct entry procedure.

5. Provide service calls at frequency of not less than one call per month thereafter.

6. Furnish all required chemicals for proper treatment of all systems hereinafter described for the one-year period together with the necessary control testing kit or apparatus and reagents for field analysis of the water during the aforementioned one-year period.

7. Provide written reports of water analysis results with recommendations.

8. Provide a quarterly review of conditions with the Owner.

9. The subcontractor shall assume responsibility for the field-testing and control and the regular addition of chemical treatment.

B. Qualifications of the Water Treatment Sub-subcontractor:

1. The Water Treatment Sub-subcontractor shall have a minimum of five years experience in the water treatment business, have laboratory facilities and staff capable of performing all necessary analyses relating to this job. All treatment programs shall be performed under the direction of a graduate chemist or licensed professional engineer.

C. Cleaning and Flushing:

1. Exercise every precaution to avoid introducing foreign matter such as welding beads and slag or dirt into the piping system. All completed welds shall be hammered to loosen debris. All piping, valves and fittings shall be internally cleaned of oil, grease or dirt, prior to assembly into system by use of wire brush and swab.

2. All cleaning and flushing work shall be coordinated with and supervised by the water treatment company for chemicals and procedures to be followed.

3. Following the successful testing of the piping systems, they shall be cleaned under the supervision of the water treatment company.

4. Before submitting piping systems for acceptance, all strainers shall be inspected and thoroughly cleaned.

5. Cleaning shall be started only after all piping has been hydrostatically tested and all systems have been completely connected up.

6. Operate pumps and circulate water throughout system for period of three 8-hour days. At the end of each day of circulation, remove and clean all strainer baskets and blow off all low points.

D. Closed recirculation systems

1. Each closed recirculation system shall have a minimum 25-gallon capacity bypass feeder complete with valves, funnel, drain, and fittings. The piping system shall be thoroughly flushed and cleaned with Dearborn BC-45 Cleaner, Dow, Barclay or an approved equal, and charged with Dearborn B-329 Nitrite Corrosion Inhibitor, Dow, Barclay or an approved equal, after cleaning. Control limits of 800-1000 mg/L shall be maintained. The bypass shall be piped across the suction and discharge pipes of the system.

E. Repeat the process for the systems upon completion of each phase.

F. Test Kits

All required test kits and reagents for determining the proper water conditions shall be provided.

2.21 VIBRATION ISOLATION

A. General

1. All vibration isolators shall be the product of a single approved manufacturer or as manufactured by an individual mechanical equipment manufacturer.

2. Model numbers hereinafter specified are from Mason Industries. Other equivalent units by Consolidated Kinetics, Vibration Mountings and Controls or an approved equal are acceptable.

3. Victaulic Style 177, 77 or W77 flexible couplings may be used for vibration isolation and noise reduction at equipment connections. A minimum of three (3) couplings shall be placed in close proximity to the source of vibration.

B. Fan Coil Units, Exhaust Fans, Supply Fans, Return Fans, Transfer Fans, Unit Heaters, and the like:

1. Steel spring and 0.3-inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

2. Mason Model DNHS, 1-inch deflection.

C. Mechanical Room Piping and Pumps

1. Steel spring and double deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection, Mason style 30N, with minimum 1-inch deflection.

2. The first five (5) pipe hanger locations on both sides (suction and discharge) of each pump, 30□ swing spring and double deflection neoprene hangers, precompressed to the rated deflection, Mason style PC30N, with minimum 1-inch deflection.

3. For floor mounted pumps, provide concrete inertia bases with minimum 1 in. deflection springs. Minimum clearance under base shall be 1 in.. Base size shall be large enough to include support of pump and associated vertical piping.

D. Ductwork

1. The first five hanger locations on the discharge side of each AHU and HV unit shall be provided with double deflection neoprene hangers.

2. Mason Model HD or WHD.

E. Pump Flexible Connectors

1. Double sphere neoprene connector with floating ASA drilling flanges (Class type to match adjacent pump and piping flanges.): Mason Model MFTNC. (Flexible connectors to be installed where shown on drawings.)

2. Victaulic Style 177, 77, or W77 flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment connections. Three (3) couplings, for each connector, shall be placed in close proximity to the source of vibration.

F. Air Cooled Condensing Units

1. Resilient cross-ribbed neoprene elastomer pad bonded to a steel plate. Furnish with molded-in isolation washer and hole in center of steel plate to correspond to OD of bolts used to fasten mechanical equipment to structural steel. Minimum isolation efficiency to be 90%. Pads to be located at each mounting point. Pads to be selected for anticipated loading (in pounds per square inch).

2. All vibration isolators shall be selected in accordance with the weight distribution of the equipment to be served so as to produce a uniform deflection. Deflections shall be as hereinbefore specified.

3. Submittals shall include all spring deflections, spring diameters, scale drawings, attachment details, and rated capacity indicating adequacy for each piece of equipment served.

G. All vibration isolators shall be selected in accordance with the weight distribution of the equipment to be served so as to produce a uniform deflection. Deflections shall be as herein before specified.

H. Submittals shall include all spring deflections, spring diameters, scale drawings, attachment details, and rated capacity indicating adequacy for each piece of equipment served.

I. Boilers

1. Boilers shall be mounted on a concrete pad and neoprene pads, similar to Mason Industries Model Super W.

J. Air Cooled Chiller

1. Chiller shall be mounted on 1 ½ in. deflection spring isolators.

K. Roof mounted ERU, RTU's, AHU's, and MUA.

1. Provide vibration isolation curbs, similar to model RSC by Mason Industries, selected to achieve 1.5 in. static deflection under load.

L. Fan Boxes

1. Provide vibration isolation curbs, similar to model 30N by Mason Industries, selected to achieve.75 in. static deflection load.

2.22 DUCTWORK

A. Metal Ductwork

1. All aspects of metal ductwork construction, including all fittings and components, shall comply with THE SMACNA HVAC DUCT CONSTRUCTION STANDARDS, 3RD ED., unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits or unless noted otherwise. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class ½ and 1-inch WG ductwork shall meet the requirements of Seal Class C. Class 2-inch WG ductwork shall meet the requirements of Seal Class B. Class 3 through 10-inch WG shall meet the requirements of Seal Class A. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in THE SMACNA HVAC DUCT CONSTRUCTION STANDARDS, 3RD ED. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer is to be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 2-inch band width covering all screw heads and joint gap. Dents in the male portion of the slip-fitting collar shall not be acceptable. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

2. Rectangular ductwork schedules:

SCHEDULE OF RECTANGULAR DUCTWORK CONSTRUCTION (UP TO 2-inch WG)

Duct Dimension (inches)	Metal gages		Transverse joint construction	Reinforcement spacing	Transverse joint Reinforcement
	Galvanized steel	B & S aluminum			
<=12	24	0.040 in.	1 in. pocket lock	---	None
13-18	24	0.040 in.	Standing "S" slip	8 ft.-0 in.	1 in.x26 gauge
19-26	22	0.050 in.	Standing "S" slip	8 ft.-0 in.	1 in.x26 gauge
27-30	20	0.064 in.	Standing "S" slip	8 ft.-0 in.	1 in.x24 gauge
31-42	22	0.050 in.	Standing "S" slip	5 ft.-0 in.	1-1/8 in.x20 gauge

SCHEDULE OF RECTANGULAR DUCTWORK CONSTRUCTION (UP TO 2-inch WG)					
Duct Dimension (inches)	Metal gages		Transverse joint construction	Reinforcement spacing	Transverse joint Reinforcement
	Galvanized steel	B & S aluminum			
43-60	20	0.064 in.	Standing "S" slip with tie rod	4 ft.-0 in.	1-5/8 in.x18 gauge w/ 3/8" tie rod
61-96	20	0.064 in.	Standing "S" slip angle reinforced with tie rod	2 ft.-6 in.	2 in.x20 gauge with 2 in.x2 in.x3/16 in. angle and 3/8 in. tie rod
97+	18	0.071 in.	Welded flange reinforced with tie rods	2 ft.-0 in.	1½ in. welded flange w/ 2 in.x2 in.x1/8 in. angle and 3/8 in. tie rods spaced 60 in. O/C max.

3. Round:

   a. Round ductwork shall be furnished where shown or called for on the drawings, and may be substituted for rectangular, as an option to the Sheet Metal Sub-subcontractor when approved by the engineer, and shall be provided where shown on the Drawings.

   b. Round duct and fittings shall be of spiral lock seam construction and shall be fabricated from G-60 galvanized steel or 316 stainless steel. Galvanized steel shall meet ASTM A525 & A527 standards and stainless steel shall meet ASTM A240 and shall be fabricated in accordance with the following table.

SCHEDULE OF ROUND DUCTWORK CONSTRUCTION						
Duct Diameter (inches)	0.0 in. to +10.0 in. WG		0.0 in. to -10.0 in. WG (Class B)			
	Galvanized		Galvanized		316 Stainless Steel	
	Ductwork	Fittings	Ductwork	Fittings	Ductwork	Fittings
3-8	26	22	24	20	24	20
9-14	26	22	22	18	22	18
15-26	24	22	20	16	20	16
27-36	22	20	18	14	18	14

SCHEDULE OF ROUND DUCTWORK CONSTRUCTION						
Duct Diameter (inches)	0.0 in. to +10.0 in. WG		0.0 in. to -10.0 in. WG (Class B)			
	Galvanized		Galvanized		316 Stainless Steel	
	Ductwork	Fittings	Ductwork	Fittings	Ductwork	Fittings
37-50	20	20	N/A	N/A	N/A	N/A

4. Transitions

   a. Diverging airflow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging airflow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

5. Metallic Flexible Duct

   a. Metallic type duct shall be single-ply galvanized steel. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 1/2 duct diameter. Duct shall conform to UL 181 and shall be rated for positive or negative working pressure of 15-inches water gauge at 350 degrees F when duct is aluminum, and 650 degrees F when duct is galvanized steel or stainless steel.

6. Insulated Nonmetallic Flexible Duct Run outs

   a. Flexible duct run outs shall be used only where indicated. Run out length shall be as shown on the drawings, but shall in no case exceed 4 to 6 feet. Run outs shall be pre-insulated, factory fabricated, and shall comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as run outs. The insulated material and vapor barrier shall conform to the requirements of this specification 230001. The insulation material surface shall not be exposed to the air stream.

7. General Service Duct Connectors

   a. A flexible duct connector approximately 6-inches in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL-01.

8. Ductwork shall have pressure velocity classifications as follow:

DUCT CONSTRUCT-ION CLASS	STATIC PRESSURE RATING	PRESSURE	SMACNA SEAL CLASS	SMACNA LEAKAGE CLASS	VELOCITY
10 in.	10 in.	Pos.*	A	3	2000 fpm or greater
6 in.	6 in.	Pos.*	A	3	2000 fpm or greater
4 in.	4 in.	Pos.*	A	3	4000 fpm or less
3 in.	3 in.	Pos. or Neg.	A	3	4000 fpm or less
2 in.	2 in.	Pos. or Neg.	A	6	2500 fpm or less
1 in.	1 in.	Pos. or Neg.	A	6	2500 fpm or less
½ in.	½ in.	Pos. or Neg.	A	6	2000 fpm or less

*for negative pressures over 3 in. w.g., refer to SMACNA Round and Rectangular Industrial Duct Construction Standards for joint and intermediate reinforcement requirements.

9. Ductwork shall have pressure velocity classifications as follow:

DUCT CONSTRUCT-ION CLASS	STATIC PRESSURE RATING	PRESSURE	SMACNA SEAL CLASS	SMACNA LEAKAGE CLASS	VELOCITY
10 in.	10 in.	Pos.*	A	6	2000 fpm or greater
6 in.	6 in.	Pos.*	A	6	2000 fpm or greater
4 in.	4 in.	Pos.*	A	6	4000 fpm or less
3 in.	3 in.	Pos. or Neg.	A	6	4000 fpm or less
2 in.	2 in.	Pos. or Neg.	B	12	2500 fpm or less
1 in.	1 in.	Pos. or Neg.	B	12	2500 fpm or less
½ in.	½ in.	Pos. or Neg.	B	12	2000 fpm or less

*for negative pressures over 3 in. w.g., refer to SMACNA Round and Rectangular Industrial Duct Construction Standards for joint and intermediate reinforcement requirements.

a. Unless otherwise specified or shown on the drawings, the following pressure classifications shall be used for the types of ductwork listed below:

1) 4 in. Class: All supply ductwork from discharge of air units to inlets of terminal volume boxes.

2) 3 in. Class: All fume hood, kitchen hood and smoke exhaust ductwork.

3) 2 in. Class: All other ductwork.

10. Sealing Requirements for Class A, Leakage Class 3, Galvanized, Non-Welded Aluminum or Non-Welded Stainless Steel Ductwork:

    a. Transverse Joints

        1) During assembly seal all flanged transverse joints with sealing tape of quality equal to Hardcast Inc. 1902-FR. Corners shall be sealed as described by SMACNA and when applicable per manufacturer's published procedures. After sealant has cured, seal entire joint with Hardcast Inc. RTA-50 adhesive on to Hardcast Inc. DT tape or approved equal.

        2) Seal all non-flanged transverse joints with Hardcast Inc. RTA-50 adhesive on to Hardcast Inc. DT tape or approved equal.

    b. Longitudinal Seams

        1) Seal all longitudinal seams during ductwork fabrication with Hardcast Inc. Cold Seal 1001 or approved equal.

    c. Joints and Ductwall Penetrations

        1) Seal all duct joints at takeoffs, access doors, damper bearing penetrations, flexible duct connections, with Hardcast Inc. Versa Grip 102 or approved equal.

        2) Note, access doors and damper rod penetrations shall be equipped with proper hardware for sealing.

11. Sealing Requirements for Class A, Leakage Class 6, Galvanized, Non-Welded Aluminum or Non-Welded Stainless Steel Ductwork.

    a. Transverse Joints

        1) During assembly seal all flanged transverse joints with sealing tape of quality equal to Hardcast Inc. 1902-FR. Corners shall be sealed as described by SMACNA and when applicable per manufacturer's published procedures.

        2) Seal all non-flanged transverse joints with Hardcast Inc. Versa Grip 102 or approved equal.

    b. Longitudinal Seams

        1) Seal all longitudinal seams during ductwork fabrication with Hardcast Inc. Cold Seal 1001 or approved equal.

    c. Joints and Ductwall Penetrations

        1) Seal all duct joints at takeoffs, access doors, damper bearing penetrations, flexible duct connections, with Hardcast Inc. Versa Grip 102 or approved equal.

12. Sealing Requirements for Class B, Leakage Class 12, Galvanized, Non-Welded Aluminum or Non-Welded Stainless Steel, Ductwork.

a. Transverse Joints

1) During assembly seal all flanged transverse joints with sealing tape of quality equal to Hardcast Inc. 1902-FR. Corners shall be sealed as described by SMACNA and when applicable per manufacturer's published procedures.

2) Seal all non-flanged transverse joints with Hardcast Inc. Versa Grip 102 or approved equal.

b. Longitudinal Seams

1) Seal all longitudinal seams during ductwork fabrication with Hardcast Inc. Cold Seal 1001 or approved equal.

B. Duct Leakage Tests

1. Leak testing shall be per SMACNA HVAC Air Duct Leakage Test Manual. Provide orifice assembly including straightening vanes, orifice plate mounted in straight tube with properly located pressure taps, and U tube manometer or other device as specified by SMACNA. Orifice assembly shall be calibrated accurately and shall come with calibration curve. Leakage classes shall be as previously specified. Submit leak test report (per SMACNA format) for Designer review. Drawings of ductwork tested shall also be submitted with report, indicating presence of takeoffs, wall penetrations, joints.

C. Ductwork Accessories

1. Access Doors in ductwork up to 2-inch pressure class.

a. Frame: 24 gage galvanized steel with seal

b. Door: hinged, with 24 gage galvanized steel exterior and interior panels.

c. Locks: doors 16 in. and under, one lock doors over 16 in., two locks

d. Seals: foam gasket

e. Insulation: ½-inch foam board with aluminum foil face, 0.12K at 75°F.

f. Ruskin Model ADH-2, Inland Steel, Miami-Carey or approved equal.

2. Sizes:

SCHEDULE OF DUCTWORK ACCESS DOOR SIZES	
Duct size (inches)	Access door size (inches)
<=12	12 x 8
>12	12 x 14

3. Provide at all fire dampers, air inlets, motorized dampers, smoke detectors, humidifiers, air flow switches and where shown on the drawings.

4. Fire Dampers

   a. Fire dampers shall be 1-1/2 hour fire-rated for use in up to 2 hour rated construction, unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it is to be subjected. Fire dampers shall be approved for the specific application, and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, shall not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies shall be constructed in conformance with UL-05. Fire dampers shall be curtain type with damper blades out of the air stream. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA-05 and in manufacturer's instructions for fire dampers shall be followed. Fire dampers link temperature shall be rated for 165°F.

5. Combination Fire/Smoke Dampers

   a. Complies with all applicable Codes.

   b. 1-1/2 hour UL555 rated.

   c. UL555S Leakage rated.

   d. Installed as per manufacturer’s recommendations and as required by NFPA.

   e. Actuator shall be 120V or 24V, as required by electrical.

   f. Provide access doors.

   g. Ruskin FSD series, or equal by Greenheck or Arrow.

6. Splitters and Manual Volume Dampers

   a. Manual volume dampers shall be provided where shown on the Drawings at every branch take off from the main duct, and elsewhere as required by the Balancing Sub-subcontractor, and shall be single or multiple blade type with sleeve bearings, galvanized steel interlocking blades and a galvanized steel frame. In ducts over 15 in. deep provide multiple opposed blade type, gang operated dampers with a maximum blade width of 8 in.. Damper blades shall be fabricated of 16-gauge steel with hemmed edges, and a maximum length of 48 in.. Damper operating rod shall be full blade length extended through the duct to externally mounted bearing plates. On insulated ductwork, bearing plates shall be installed flush with insulation finish and fastened to the duct. Operating lever shall be of the indicating type with locking quadrant.

7. Back draft Dampers

   a. Back draft dampers shall be provided where indicated and required, and shall consist of a set of externally adjustable counter weighted louvers that open automatically due to excess pressure and prevent reverse flow. The edges of the blades shall be provided with seals to prevent rattling and minimize air leakage. The damper blades shall be supported on metal frames designed for wall mounting as indicated. The dampers shall be rated for operation up to a minimum of 2,500 fpm, standard catalog products of Ruskin, Vent Products, American Warming and Ventilating or approved equal.

8. Motor Operated Dampers

   a. Motor operated dampers shall be furnished by the Automatic Temperature Control Sub-subcontractor and installed by the Sheet Metal Sub-subcontractor unless specified as part of a piece of equipment.

9. Automatic Control Air Dampers:

   a. Furnish and install low leakage automatic control aluminum dampers including necessary linkages, supports, actuators, switches, and similar items.

   b. Damper blades shall not exceed 4 in. width. All blades are to be of 0.080 extruded aluminum construction, Type 6063-T5, located 4-inches o/c. All modulating dampers shall have blades arranged for opposed blade operation.

   c. All damper bearings are to be made of cycoloy 800. Bushings that turn in the bearings are to be oil impregnated sintered metal.

d. Replaceable seals are to be proved with the dampers. Seals are to be vinyl on blade edges, polyurethane foam on jambs. Seals are to be installed along the top, bottom and sides of extruded aluminum frame and along each blade edge. Seals shall provide a tight closing, low leakage damper. Dampers shall be similar and equal in all respects to Ruskin Type CD454, or an approved equal.

10. Damper Actuators:

a. Actuators shall be direct coupled (over the shaft) type, mounted directly to the damper shaft without the need for connecting linkage. Fastening clamp shall use a "V" bolt and "V" shaped, toothed cradle to attach to the damper shaft for maximum holding strength. Single bolt or setscrew type fasteners are not acceptable.

b. Actuators shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. End switches to deactivate the actuator at the end of rotation or magnetic clutch are not acceptable.

c. For power-failure/safety applications, a mechanical, spring return mechanism shall be used. Non-mechanical forms of fail-safe are not acceptable, except for a central, emergency, backup power source.

d. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by changing mounting orientation.

e. Proportional actuators shall accept a 2 to 10 VDC or 4 to 20 MA and provide a 2 to 10 VDC position feedback signal.

f. 24 VAC/DC actuators shall not require more than 12 VA for AC or 8 watts for DC applications.

g. All non-spring return actuators shall have an external manual gear release to aid in installation and allow manual positioning when the actuator is not powered.

h. All actuators shall have an external direction of rotation switch to aid in installation and provide proper control response.

i. Actuators shall be provided with a factory-mounted 3-foot electrical cable and conduit fitting to provide easy hookup to an electrical junction box.

j. The actuators shall be listed under Underwriters' Laboratories Standard 873 and Canadian Standards Association Class 481302. They must be manufactured under ISO 9001.

k. Actuators shall have a 2-year manufacturer's warranty, starting from the date of installation.

l. All actuators shall be sized by the Subontractor and guaranteed to provide the torque and stroke characteristics for the applied duty.

11. Duct Smoke Detectors

    a. Install duct smoke detectors as furnished by the Electrical Subcontractor in strict accordance with NFPA 72, Appendix A, and NFPA 90A.

    b. Smoke detectors shall automatically stop their respective fan(s) upon detecting the presence of smoke. Wiring connection from each smoke detector to its respective fan(s) shall be by the Electrical Subcontractor.

    c. Perform differential pressure test (pre and final tests) for all duct smoke detectors with Electrical Subcontractor, as per the requirements of NFPA-72 chapter 14.

12. Blank off Plates

    a. Any blank off plates or conversions required for mounting control dampers or coils shall be the responsibility of the Sheet Metal Sub-subcontractor.

13. Insulated Metal Panels

    a. Provide 18-gauge, insulated double wall sandwich construction, 1½ in. thick where called for on the Drawings and for blanking off unused portions of wall louvers.

14. Test Openings

    a. Provide instrument test opening enclosures in the ductwork at the discharge of each fan and fan coil, inlet of each fan and fan coil, and where directed by the Balancing Sub-subcontractor. The enclosures shall be installed before the application of the insulation and shall be of the proper height to extend beyond the insulation. The attachment of the test opening enclosure shall be made airtight.

15. Flexible connections shall be 6 in. wide connections constructed of heavy glass fabric double coated with neoprene. Flexible connections shall meet the requirements of the National Board of Fire Underwriters.

16. Duct Clean Out Doors - Provide clean out doors, sixteen feet on center, for all horizontally installed ductwork and at each length of straight duct run less than 16 feet. Provide access door constructed of same material as ductwork served. Access doors shall consist of a double wall inside door with high-density insulation. The inside door shall have a neoprene gasket permanently bonded to it. Provide conical springs over the bolts between the inner and outer door to facilitate opening. The outer door shall be constructed of one gauge heavier material than that of the duct itself. Provide two hand operated plastic knobs with threaded brass inserts for opening and tight sealing of the door. Clean out doors shall be a minimum of: 10 in. x 6 in. for ducts less than 10 in. wide; 12 in.x8 in. for ducts less than 16 in. wide; and 18 in.x14 in. for all ducts greater than 16 in. wide.

D. Duct Sleeves, Framed Prepared Openings, Closure Collars

1. Duct Sleeves

a. Duct sleeves shall be provided for round ducts 15-inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15-inches in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The subcontractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20-gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53, Schedule 20 shall be used. Sleeve shall provide 1-inch clearance between the duct and the sleeve or 1-inch clearance between the insulation and the sleeve for insulated ducts.

2. Framed Prepared Openings

a. Openings shall have 1-inch clearance between the duct and the opening or 1-inch clearance between the insulation and the opening for insulated ducts.

3. Closure Collars

a. Collars shall be fabricated of galvanized sheet metal not less than 4-inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15-inches in diameter or less shall be fabricated from 20-gauge galvanized steel. Collars for round ducts larger than 15-inches and square, and rectangular ducts shall be fabricated from 18-gauge galvanized steel. Collars shall be installed with fasteners on maximum 6-inch centers, except that not less than 4 fasteners shall be used.

E. Kitchen Hood Exhaust Ductwork

1. All Exposed Kitchen Hood Exhaust Ductwork shall be constructed of all welded minimum 18-gauge stainless steel. Kitchen Hood Exhaust Ductwork (concealed) shall be minimum 16 gauge all welded black steel. All external joints and seams shall be welded liquid-tight. Duct connection to the hood shall be welded liquid-tight, or approved mechanical connection. Kitchen hood exhaust ductwork to be fabricated and installed in strict accordance with IMC 2009, UL and all applicable State and Local codes.

2. Provide cleanout panels at base of each vertical rise, at each turn, minimum every 16 feet for grease and residue removal and where shown on the drawings.

3. Provide stainless steel sleeves and blank-off panels where ducts penetrate ceiling grid. Panels shall be 24 in. wide and fit within the grid system and provide a minimum clearance of 6 in. to any acoustical ceiling tile."

4. All kitchen ductwork located indoors shall be wrapped with ceramic fiber type or an approved equal insulation having "zero clearance" rating to combustible materials. Refer to Insulation section for further details.

F. Duct Cleanliness Requirements

1. All ductwork shall be installed in accordance with SMACNA Duct Cleanliness for New Construction Guidelines.

2. Advance level of duct cleanliness shall be achieved and shall include basic and intermediate levels of cleanliness.

a. Basic Level

1) Ductwork leaving the premises of the manufacturer shall include some or all of the following:

a) Internal and/or external self-adhesive labels or marking for part(s) identification.

b) Exposed mastic sealant.

c) Light zinc oxide coating on the metal surface.

d) A light coating of oil on machine formed ductwork.

e) Minor protrusions into the airway of rivets, screws, bolts and other jointing devices.

f) Internal insulation and associated fasteners.

g) Discoloration marks from plasma cutting process.

b. Intermediate

1) The area for storage shall be clean, dry and exposure to dust minimized.

2) The working area should be clean and dry and protected from the elements.

3) The internal surfaces of the uninsulated ductwork shall be wiped to remove excess dust immediately prior to installation.

4) Open ends on completed ductwork and overnight work-in-progress shall be sealed.

c. Advanced Level

1) All self adhesive labels for part identification are to be applied to external surfaces only.

2) To maintain cleanliness during transportation, all ductwork shall be sealed either by blanking or capping duct ends, bagging small fittings, surface wrapping or shrink wrapping.

3) A clean and dry environment where the ductwork is protected from dust, must be provided for the storage of ductwork prior to installation.

4) All sealed ends shall be visually examined, and if damaged, resealed with an appropriate material.

G. Install easy to read warning labels every 20 feet on hazardous exhaust ductwork.

2.23 SOUND ATTENUATION EQUIPMENT

A. Sound attenuators shall be provided where indicated on drawings and in the specifications. The sound attenuators shall be factory fabricated in custom sizes as required. Air and sound performance shall be rated based on laboratory testing per ASTM E477. Dynamic Insertion Loss (DIL) shall be as scheduled, with no more than 2 dB deficit in any octave band. Self generated sound shall not be more than 2 dB above the published data of scheduled model. Attenuators shall be manufactured by Price, IAC, Vibro Acoustics, or approved equal.

B. Factory fabricated sound attenuators shall be constructed of galvanized steel sheets. Outer casing shall be not less than 22 gauge. Sound attenuators shall be constructed to withstand operating at internal static pressure differentials or up to 8 inch water gauge.

C. The subcontractor shall submit for approval certified air and sound performance based on laboratory testing per ASTM E477. Pressure drop shall not exceed the scheduled value at the scheduled air flow.

D. Sound absorbing material shall conform to ASTM C1071, Type I or II. Where scheduled, provide Mylar/Tedlar liner, with stand-off spacer to keep the film clear of the perforated metal. Sound absorbing material shall meet the fire hazard rating requirements for insulation specified elsewhere.

E. Attenuators shall be provided in custom sizes to match the duct sizes shown without transitions.

2.24 DIFFUSERS, REGISTERS AND GRILLES

A. Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum (as scheduled) and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified according to ADC 1062:GRD. Inlets and outlets shall be sound rated and certified according to ADC 1062:GRD. Sound power level shall be as indicated (where level is not indicated, maximum level shall be NC30). Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device shall be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers. Linear slot diffusers shall be provided with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, they shall be protected by a grille or screen according to NFPA 90A.

B. Acceptable manufacturer's: Price, Anemostat, Tuttle and Bailey, Titus or Metalaire.

C. Diffusers: Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL-03 for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

D. Registers and Grilles: Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 6 inches below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 6 inches above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

E. Registers, grilles, and diffusers shall be provided with a factory painted custom color as indicated on the drawings. Refer to drawings for quantities. Custom color shall be chosen by the architect and painted by the factory.

F. Linear Bar Grilles in Millwork

1. Price model LBMH series extruded aluminum type with satin anodized finish.

2. Core only or core complete with frame, without dampers, as detailed on architectural drawings.

3. Provide mounting clips, brackets and all appurtenances required for installation to Designer's approval.

2.25 CEILING MOUNTED CHILLED BEAMS

A. Warranty

1. Units shall be warranted against failures on parts for a period of 12 months from shipment or 18 months from startup, whichever occurs first.

2. In warranty labor shall be the responsibility of the installing subcontractor.

B. Manufacturers

1. Units shall be manufactured by Price, Swegon, Titus or approved equal.

C. General

1. Induction terminal unit shall be constant volume primary air flow units designed to induce a secondary airflow within the conditioned space using the primary conditioned air supply. Units shall be designed for ceiling installation with factory supplied hanging brackets. Hanger rods or other approved hanging system to be field supplied and installed in the field by installing subcontractor.

2. Units shall be equipped with round duct primary air intake, air plenum and air induction nozzle plate, chilled/hot water coil, a supply and a return water piping connection, and a combination supply / return air grille. The grille shall have a removable center core to provide full access to the return air side of the coil. The unit shall be capable of inducing the secondary airflow within the conditioned space using the velocity pressure of the primary airflow. This secondary air must flow directly from the room to the unit and shall not use the ceiling as a return air plenum. Induction units using the ceiling plenum as a return air path are not acceptable.

D. Casing

1. The entire unit shall be constructed of 20-gauge galvanized sheet metal. The primary air plenum and nozzles shall be designed and configured to provide uniform air distribution with low noise operation to all nozzles.

2. Any part of the assembly, without any exception, shall be provided with insulation to prevent any condensation in any conditions due to cold primary air.

E. Induction Nozzles

1. Induction nozzles shall be aerodynamically designed and include a tapered discharge to minimize noise.

2. The unit shall be designed such that a significant (minimum 40% of design induction rate) induction is achieved down to 50% of design primary air flow, and measurable induction rate down to 25% of design primary air flow.

F. Water Coil Assembly

1. Coils shall be of the hot and chilled water type utilizing aluminum fins and copper tubes. Copper tube wall shall be a minimum .033 thickness. Coils shall be factory leak tested at 350 PSI water. Coil connections shall be as indicated on the drawings.

2. Coil must be one continuous assembly to minimize leakage.

3. The water coil assembly shall consist of a two-row copper tube and aluminum fins coil for cooling and one row coil for heating.

G. Quality Assurance

1. All induction terminal units shall be tested by an independent Nationally Recognized Testing Laboratory for performance, throws, and sound levels.

2.26 ENERGY RECOVERY UNITS (ERU), AIR HANDLING UNITS (AHU), MAKE-UP AIR UNITS (MAU)

A. Quality Control

1. Do not operate units for any purpose, temporary or permanent, until is clean , filters are in place, bearings lubricated, and fan has been test run under observation.

2. Products shall be built, tested, and certified in accordance with the following Codes and Standards:

a. AFBMA 9 Load Ratings and Fatigue Life for Ball Bearings.

b. AFMBA 11 Load Ratings and Fatigue Life for Roller Bearings.

c. AMCA 99 Standards Handbook.

d. AMCA 21 0 Laboratory Methods of Testing Fans for Rating Purposes

e. AMCA 300 Test Code for Sound Ratings for Air Moving Devices.

f. AMCA 301 Method of Publishing Sound Ratings for Air Moving Devices

g. AMCA 500 Test Methods for Louver, Dampers, and Shutters.

h. ARI 410 Forced-Circulation Air-Cooling and Air-Heating Coils.

i. ARI 430 Central-Station Air-Handling Units.

j. ARI 435 Application of Central-Station Air-Handling Units.

k. ASHRAE 68 Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.

l. NEMA MG1: Motors and Generators

m. NFPA 70 National Electrical Code.

n. NFPA 90 Installation of Air Conditioning and Ventilation Systems.

o. SMACNA HVAC Duct Construction Standards -Metal and Flexible.

p. Fan ratings shall be based upon test performance in strict accordance with the AMCA Standard 210-74 - ASHRAE Standard 51-75. Each fan shall bear the seal authorized by AMCA indicating that the ratings are certified. Fans not bearing this seal shall not be accepted

q. UL 900 Test Performance of Air Filter Units.

B. Manufacturers

1. Daikin, HAAKON, Semco, JCI/York or approved equal.

2. This project includes acoustic screening furnished and installed by the General Contractor under other sections. Any substitutions of units taller than those named above that require raising the height of the acoustical screening, the additional costs for which shall be borne by this section 230001 subcontractor at no additional cost to the contract.

C. General Construction

1. Arrangement:

a. When the unit is designed to be double height stacked type, bottom of upper level access doors and top of lower level access doors shall have sufficient distance to allow for construction of intermediate platform, for the upper level access.

b. All factory furnished disconnects, starters, drives, and controls shall be accessible in accordance with Electrical Code.

2. Base

a. Construct unit on continuously welded structural steel base. The base shall consist of a perimeter channel and minor cross members to support major unit components, coils, fan, and similar items. Base shall be epoxy coated for corrosion protection.

b. Structural channels shall prevent roof or side panel stresses that could cause excessive deflection, buckling or damage during unit rigging and shipment. The unit base shall prevent sagging or pulsating during unit start-up or operation. Deflection of the base and floor shall not exceed 1/200.

c. The floor of the air handling units shall be constructed from: carbon steel checker plate with a minimum thickness of 14 Ga (0.075 in.). All seams shall be fully welded. The checker plate is to be cleaned and painted with two coats of epoxy based paint.

d. The floor shall be insulated with a minimum of 3 in. thick fiberglass insulation and encapsulated with minimum 20 Ga G90 (Z275) galvanized steel liner. The liner to be stitch welded to base channel and cross members and fully caulked at all seams

e. Each Section / Unit shall be provided with lifting lugs for lifting and installation

f. Provide continuously welded 304 Stainless Steel primary drain pans beneath cooling coils. Pitch drain pans in two planes to prevent standing water and ensure proper drainage to minimum 1.5 in. diameter stainless steel pipe. Drain pipe to be capped.

3. Wall Cabinet / Enclosure

a. The unit exterior is to be constructed such that the quantity of visible fasteners (bolts, screws, rivets) is minimized. Fasteners shall only be permitted at the following locations: doors, removable panels, and louvers which must be fastened to the outside of the unit panel.

b. 2 in. double wall Construction: All panels shall be formed to increase the strength and rigidity of the unit. Construct the outer wall from minimum 18 Ga Satin Coat (ZF75) Galvanized steel, Adjacent Panels shall be sealed with a strip of 1 in. x 1/8 in. butyl tape sealer and fastened internally with #10 self-tapping TEK screws on approx 10 in. centers down the center of the wall panel. All seams shall be caulked with Tremco 830 sealant for air and water tightness

c. Panels shall be load-bearing and capable of forming an integral enclosure without additional structural members

d. The exterior panels shall be fastened to the base through Rain Lip Type Z strip hemmed at the exterior end and installed around base perimeter. The Z strips shall be stitch welded to the base floor with Tremco 440 tape between Z strip and base of panel.

e. Where the inside liner is solid insulate wall panels with minimum 2 in. 3.5 lb/cft mineral wool insulation. Provide erosion resistant matt-faced fiberglass insulation in areas where perforated lines is indicated on the drawings or specified(i.e. fan section, and the like)

f. Insulation shall be completely encapsulated with an inner liner of minimum 20 Ga G90 (Z275) galvanized steel for fresh air sections. Install inner liner in an overlapping fashion to encapsulate the insulation and to prevent exposing any sharp edges. The liner shall be hemmed on all sided prior to installation. All joints to be neatly caulked.

g. AHUs shall have sloping roof with slope of approx ¼ in. per foot sloping away from the door / access side. The roof exterior panel shall have standing seam with screws / fasteners attached to the side . For split sections the seam at the split shall be covered with a C-Cap . There shall be no screws penetrating the exterior skin of roof vertically down

h. Forced convergence of air streams towards the core area of internal equipment shall be accomplished with blank-off plates. Typical equipment requiring blank offs are: coil banks, filters, energy recovery device, electric heating coils, dampers, silencers, and similar items. The blank-offs must be securely fastened to the internal side walls and adjacent internal equipment. The blank off material shall be as specified under the specific modular segment

i. Coils, Side Access Filters, Heat Wheels, and other energy recovery equipment must be fully removable via Access panels and shall be constructed from the same materials and methods as the wall panel. Access panels must be fully removable without the use of specialized tools. Panels shall be completely sealed with neoprene gaskets

4. Access Doors

a. Access shall be provided through large hinged, tightly sealed doors or removable access panels.

b. Access doors shall be constructed of the same materials as the unit casing. Each door shall be provided with two (2) cam type handles and continuous stainless steel piano hinges to achieve maximum sealing. All access doors with top handle higher than 7 ft.-0 in. above base rail shall have a single handle latch mechanism, or device to operate handles located above the 7ft.-0 in. height.

c. Handles shall be internal and external for opening from the inside or outside of the unit. All doors shall open against the air pressure.

5. Paint (for galvanized enclosures, aluminum and stainless shall be unpainted)

a. Surface Cleaning. The exterior surface of the unit shall be thoroughly cleaned to remove dust, dirt, oil to ensure surface is thoroughly cleaned to ensure proper paint adhesion.

b. Base Coat: The exterior of all units shall be painted with two-component epoxy coating. Color Gray.

c. Top Coat (outdoor units): Outdoor units shall be painted with two-component coating. Colour Gray.

D. Fans

1. Plenum Fans

a. Centrifugal, AMCA rated and certified (capacity and sound) airfoil design plenum fans as per the Drawing schedule, designed without a scroll type housing, with fan performance based on tests conducted in accordance with AMCA Standard 210 and AMCA 300, and capable of operating over the minimum pressure class limits as specified in AMCA Standard 2408-09

b. Frame and Inlet Panel: Inlet panels shall be of heavy gauge reinforced steel construction. The inlet panel incorporates a removable spun inlet cone designed for smooth airflow into the accompanying retaining ring of the fan wheel. A square, formed lip suitable for attachment of a boor connector shall surround the unit.

c. Wheel - Non-overloading wheel with backward inclined, die-formed, airfoil design steel blades continuously welded to a spun steel inlet cone, backplate and cast iron hub, statically and dynamically balanced as an assembly, and designed for critical speeds of at least 1.25 times the maximum class speed. All wheels shall be statically and dynamically balanced on precision electronic balancers to Balance Quality grade G6.3 per ANSI/AMCA 204 or better.

d. Fan Shaft and Bearings: AISI 1040 or 1045 hot rolled steel, shaft, accurately turned, ground, polished and ring gauged for accuracy, and sized for a first critical speed of at least 1.43 times the maximum rated speed for the fan, and heavy-duty, grease lubricated, ball or roller, self-aligning pillow block bearing selected for an AFBMA L-10 minimum average bearing life expectancy in excess of 80,000 hours, and equipped with extended lubrication lines terminated in lubrication fittings immediately inside the fan section access

e. Motor & Drive: NEMA Premium Explosion Proof motor conforming to requirements specified in complete with an constant speed V-belt drive selected for minimum 1.5 service factor

f. Fan Support Base: Rigid, welded steel, vibration isolated base with steel cross members, factory cleaned, deburred and finished with epoxy, and complete with stable, color coded spring mounts selected to operate at no greater than 80% of solid load and with neoprene sound pads, spring diameters in accordance with the manufacturer's recommendations to suit the static defection and maximum equipment load, and shipping.

g. Finish: Unless otherwise specified, the entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust preventative primer. After fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant.. Aluminum components shall be unpainted.

2. Manufacturers: Manufacturer shall be Twin City, Greenheck, Cook, or approved equal.

E. Motorized Control Dampers

1. Control dampers meeting the following specifications shall be furnished and installed where shown on plans and/or as described in schedules.

   a. Damper frame shall be 16 ga. galvanized steel formed into a 5 in. x 1 in. structural hat channel. Frame shall be 4-piece construction with 1 ½ in. (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking. Damper blades shall be airfoil shape galvanized steel double skin construction (14 ga. Equivalent) each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper Blade Edge: Blade seals shall be TPE permanently bonded to the appropriate blade edges with flexible stainless steel jamb seal. Bearings synthetic (acetal) sleeve type with Minimum ½ inch dia. plated steel axles.

   b. Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval showing damper suitable for pressures to 4 in. wg (2 kPa), velocities to 4000 fpm (20.3 m/s) and temperatures to 180°F (82ºC). Testing and ratings to be in accordance with AMCA Standard 500-D.

F. Louver

1. Performance Ratings: AMCA licensed.
2. Frame:
   a. Material: Extruded aluminum, Alloy 6063-T5.
   b. Wall Thickness: 0.081 inch (2.1 mm), nominal.
   c. Depth: 4 inches (102 mm).
   d. Downspouts and caulking surfaces.
3. Blades:
   a. Style: Drainable.
   b. Material: Extruded aluminum, Alloy 6063-T5.
   c. Wall Thickness: 0.081 inch (2.1 mm), nominal.
   d. Angle: 37.5& 45 degrees.
   e. Centers: 4 inches (102 mm), nominal.
4. Bird Screen:
   a. Material: Aluminum, expanded.
5. Gutters: Drain gutter in head frame and each blade.

6. Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.

7. Vertical Supports: Hidden vertical supports to allow continuous line appearance up to 120 inches (3,048 mm).

8. Sill: Steeply angled integral sill eliminating areas of standing or trapped moisture where mold or mildew may thrive and effect indoor air quality.

9. Assembly: Factory assemble louver components.

G. Coils: Products

1. Water coils in heating service:

a. 5/8 in. x 0.020 in. Thick OD Copper Tubes brazed to non ferrous headers.

b. 0.0075 in. thick Aluminum Fins

c. Galvanized steel casing and tube supports

d. Factory tested with air under water at 250 psi. Ratings certified by manufacturer to ARI.

e. Refer to schedule sheets in drawings for PG %.

H. Electrical Items

1. Marine Lights: Marine Lights with guard.

2. Switches: Hubbell #CS120W or an approved equal in outdoor weatherproof box with cover.

3. Receptacle: Leviton Smartlock Pro in outdoor weatherproof box with cover.

4. Factory Wiring: Factory installed wiring to include

a. Marine lighting fixtures located where shown, each secured to cast aluminum surface mounted box

b. A switch located where indicated connected with load side wiring to control all lighting fixtures

c. Multiple point power connection for 460/3Ph/60Hz

d. Provide single point power connection for 120/1/60

e. Air handling units to be pre-wired for incoming supply power as required

f. Provide power and control wiring in PVC coated rigid galvanized conduit. Motor connections to be flexible liquid-tight explosion proof

I. Heat Recovery Wheels & Units

1. Heat wheels shall be provided as an integral part of the unit assembly complete with integral capacity, frost, and economizer controls. The controller shall also include jogging algorithm to be activated during economizer cycle to prevent mildew growth from dormant condition.
2. Primary heat wheel shall be total heat enthalpy type.
3. Secondary heat wheel shall be sensible type to serve reheat function. Capacity control can be through wheel speed variation or with bypass damper modulation, but shall be clearly defined in the submission.
4. Heat recovery efficiency, and maximum pressure drop as scheduled. Capacity control can be through wheel speed variation or with bypass damper modulation, but shall be clearly defined in the submission.
5. Full bypass damper to allow for full recirculation during unoccupied periods.
6. Economizer cycle to stop heat recovery for free cooling.
7. Minimum MERV 8 protected on both sides.
8. Frost controls based on leaving air temperature as well as air pressure drop to optimize heat recovery operation. Frost control may be accomplished by heat wheel rotational speed variation or through bypass dampers, but shall be clearly defined in the submission.

J. Acoustics

1. Submit for approval with the original quotation, sound power level data according to AHRI-260 for housing radiated sound as well as supply discharge, return intake, outside air intake, and exhaust air discharge. For outdoor units, the outside air intake and exhaust air discharge sound may be included/combined with the casing radiated sound.
2. For custom units where AHRI-260 data are not available, submit for approval estimated sound power levels as listed in J.(1), above, based on calculations according to the method in the ASHRAE Handbook, current Applications volume, Noise and Vibration Control. These calculations shall be based on fan sound power data according to AMCA 300. Where internal attenuation is provided, the attenuator insertion loss shall be based on testing according to ASTM E477.
3. For all units, submit for approval fan curves and fan sound power (inlet and outlet).

K. Installation

1. Provide custom made air handling units where shown.

2. Subcontractor to rig and hoist each outdoor unit to ground pad in accordance with the manufacturer's instructions and details. Guidance shall be provided during the installation if required. Properly and adequately protect air handling unit on the ground prior to completion of a weather proof assembly.

3. Secure the base mounting unit in place, level and plumb on a concrete housekeeping pad

4. Remove the fan base hold down clamps and all shipping restraints

5. Maintain temporary filter media if necessary in the filter sections until commissioning work and air quality balancing is ready to commence. At time of balancing remove temporary media and vacuum clean the interior of the unit

6. Supply touch-up paint and touch-up all exterior damage when installation is complete.

7. Startup, test and commission each air handling unit in accordance with these specifications.

8. Coordinate with HVAC controls subcontractor to ensure proper tie-in between BMS controllers and any hard wired controls circuiting (VFD, electric heater, dampers)

L. Filtration Requirement:

1. ERU- Provide MERV 8 prefilter on both sides, and additional MERV 14 final filters on supply side with pressure gauges across each filter bank.

2. AHU- MERV 8 prefilters and MERV 14 final filters on supply side with pressure gauges across each filter bank.

3. Maximum possible face area of filters shall be provided, but not exceeding face velocity of 400 fpm.

4. Small section which require blank off plates shall be made to be permanent and shall be sealed.

5. Slide in frames are permitted but seals between the filters shall be provided. Final filters shall also have track seal.

6. Filter edge seals against wall and doors shall be provided.

M. See Vibration Isolation Section.

2.27 FANS

A. Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed, which shall produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

B. Centrifugal Fans

1. Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan blades may be forward curved, backward-inclined or airfoil design in wheel sizes up to 30-inches. Fan blades for wheels over 30-inches in diameter shall be Backward-inclined or airfoil design. Fan wheels over 36-inches in diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 36-inches or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA 9 and ABEMA 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have totally enclosed enclosures. Motor starters shall be across the line magnetic type with watertight enclosure. Remote manual switch with pilot indicating light shall be provided where indicated.

C. In-Line Centrifugal Fans

1. In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing. Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge airflow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA 9 and ABEMA 11. Motors shall have totally enclosed enclosure. Motor starters shall be magnetic with weather-resistant enclosures. Remote manual switch with pilot indicating light shall be provided where indicated.

D. Centrifugal Type Power Roof Ventilators:

1. Fans shall be V-belt driven with backward inclined, non-overloading wheel. Motor compartment housing shall be hinged or removable and weatherproof, constructed of heavy gauge aluminum. Fans shall be provided with bird screen, disconnect switch, motorized dampers, roof curb, and extended base. Motors enclosure shall be drip proof type. Grease-laden kitchen exhaust fans shall be centrifugal type according to UL 705 and fitted with V-belt drive, round hood, and wind band upblast discharge configuration, integral residue trough and collection device, motor and power transmission components located in outside positively air ventilated compartment. Lubricated bearings shall be provided.

2.28 INSULATION

A. Scope: Provide all labor, equipment, materials and accessories, and perform all operations required, for the correct installation of insulation on the following systems and all other necessary items connected into the systems subject to condensation, loss of heat, or personnel protection (above 120 degrees F):

1. Piping insulation (other than pre-insulated underground piping), jackets and accessories (including all valves and fittings with easily removable sections for maintenance of strainers, balance valves, and unions).

2. Equipment and flue gas breeching insulation, and covering (including easily removable sections for maintenance).

3. Ductwork insulation, jackets, and lining (including all fittings).

4. Fire wrap insulation where indicated or required to maintain fire separation.

B. Environmental Requirements: Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

C. Quality Assurance: Insulation materials must be asbestos free, UL listed, and manufactured at facilities certified and registered to conform to ISO 9000 Quality Standard. All insulating products and jackets shall carry a 25/50-flame spread/smoke developed rating as tested in accordance with ASTM E 84.

D. Workmanship: All insulation shall be installed by a licensed applicator and applied in accordance with the manufacturer's recommendations. All work shall comply with all applicable federal, state, and local codes including, but not limited to, OSHA. All work shall conform to industry and trade accepted standards for commercial and industrial insulations. Verify that piping, heat trace, and ductwork has been tested (including applicable pressure/leakage tests) before applying insulation materials. Surfaces to be insulated shall be cleaned free of dirt, scale, moisture, oil and grease. No vapor barrier leaks or insulation voids shall be accepted. Continue insulation vapor barrier through penetrations except where prohibited by code. All fire rated walls and penetrations shall be sealed with fire stopping. Locate insulation and cover seams in least visible locations. Neatly finish insulation at supports, protrusions, and interruptions. For all systems requiring a vapor barrier seal all terminations including fittings, wall penetrations, and supports with vapor barrier mastic such as Foster 30-35 or an approved equal. In addition, in brine or chilled water pipe systems vapor seal pipe terminations every four pipe sections, using Foster 30-35 or an approved equal. Bevel and seal ends of insulation at equipment, flanges, and unions. Where insulation is used over stainless surfaces, the material shall be chlorine free.

E. Delivery and Storage of Materials

1. Deliver all materials to the job site and protect the insulation against dirt, water, chemical and mechanical damage before, during and after installation. Do not install damaged insulation and remove it from the job site.

2. Deliver insulation, coverings, cements, adhesives coatings and all other items to the site in factory-fabricated containers with the manufacturer's stamp or label affixed showing fire hazard ratings of the products, name of manufacturer and brand.

3. Installed insulation that has not been weatherproofed shall be protected from inclement weather by approved waterproof sheeting installed by the subcontractor. Any water-damaged insulation shall be removed and replaced by the subcontractor at no additional cost.

F. Manufacturers: Johns Manville (JM), CertainTeed, Owens-Corning, 3M, Armstrong, Knauf, or approved equal. Note that the listed manufacturers may not be able to supply all the insulation products required for the project. Unless otherwise noted, JM insulation products are listed to provide the minimum standards required for each type of insulation.

G. Pipe Insulation: Provide the following products depending on temperature of each system. Insulation shall be marked to show the locations of all unions, break flanges, strainers, check and balancing valves.

1. For piping with a service temperature between 40°F and 600°F such as chilled water, hot water, glycol chilled water, make-up and feed water, blow-down, all outdoor condenser water piping, condensate drain, provide glass fiber insulation equal to JM Micro-Lok. Insulation shall be rigid molded and noncombustible, meeting ASTM C 547, Type I. K-factor shall be 0.23 at 75°F mean temperature. All purpose vapor retardant jacket shall be JM AP-T PLUS. Jacket shall be white kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples (coated with vapor barrier mastic for all chilled water, dual temperature water and glycol heat recovery systems).

2. For all refrigerant suction and cold chilled water/brine solutions (below 60°F) and all outdoor refrigerant liquid and hot gas piping with a service temperature between -40°F and 200°F, provide elastomeric foam insulation equal to Armacell AP/Armaflex (up to 1 in. thick) or AP/Armaflex/FS (over 1 in. thick). This insulation type may also be used for condensate drain and chilled water piping and fittings that are not heat traced. If used in computer room plenum or over stainless steel pipe or fittings, the material shall be chlorine free equal to Armacell NH/Armaflex. Insulation shall be flexible, cellular elastomeric, meeting ASTM C 534, Type I. K-factor shall be 0.27 at 75°F mean temperature. Insulation shall be rated for no more than 25/50-flame spread/smoke developed rating. Provide waterproof vapor retardant adhesive as needed for installation. Provide 2 coats of waterproof UV protective coating for all outdoor insulation that is not jacketed (allowed up to 1 in. pipe diameter).

H. Minimum pipe insulation thicknesses shall be as shown on the drawings.

I. Field Applied Piping and Fitting Jackets

1. Provide covers for insulation of all pipe fittings (i.e. elbows, tees, end caps, reducers, unions, flanges, mechanical joints), strainers and valves with surface temperatures between –20°F and 150°F (all water, low pressure steam and condensate systems with glass fiber insulation). Provide easily removable sections for cleaning and maintenance of unions, balancing valves, and strainers. Fitting covers shall be 30-mil thick white PVC equal to JM Zeston 2000 molded high impact, UV resistant covers. Attach with water-resistant pressure sensitive color matching vinyl tape to maintain vapor barrier. Insulate all fittings per manufacturer's recommendations to prevent surface temperature from exceeding the 150°F limit.

2. Other than where foam type insulation is used on up to 1 in. outdoor pipe, with 2 coats of UV protection, protect all piping insulation that passes through walls and floors, all outdoor pipe insulation, mechanical room pipe insulation (all within 7 feet of floor) and elsewhere where called for on drawings with 0.016 inch thick smooth or embossed aluminum sheet jacket or 0.01 inch thick smooth or corrugated type 304 stainless steel or 30 mil thick Zeston 2000 perma-weld high impact UV resistant PVC jacket with perma-weld fitting covers. Seams shall be on the bottom half of the pipe arranged to shed water. Provide minimum 2-inch overlap for all longitudinal and transverse joints. All seams of outdoor jacket shall be filled with waterproof adhesive. Provide 1 in. wide draw bands (same material as jacket) on 12 in. centers.

J. Equipment and Flue Gas Breeching Insulation - General:

1. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. As required, secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retardant cement.

3. Provide insulated dual temperature equipment or cold equipment containing fluids below ambient temperature with vapor retardant jackets.

4. Cover fiber glass and calcium silicate insulation on warm or room temperature equipment with 0.016 inch thick (smooth or embossed) aluminum jacket, or with metal mesh and finish with heavy coat of insulating cement or mastic (such as Foster 35-00).

5. For equipment located outdoors, in mechanical equipment rooms (all within 7 feet of floor), or in finished spaces insulated with fiber glass, finish with perma-weld Zeston 2000 jacketing (up to a surface temperature of 150°F) and fitting covers or 0.016 inch thick (smooth or embossed) aluminum jacketing. Outdoor aluminum jacketing seams shall be on the bottom half of the pipe arranged to shed water. Provide minimum 2-inch overlap for all longitudinal and transverse joints. All seams of outdoor jacket shall be filled with waterproof adhesive.

6. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

7. Provide easily removable/replaceable sections (without damage) of insulation for areas that require maintenance, repair, or cleaning, such as pumps (bearings, seals, and impellers), heat exchangers (tube pull), strainers (basket pull), expansion tanks (bladder access), and similar items.

K. Equipment and Flue Gas Breeching Insulation: Provide the following insulation types for the listed equipment.

1. Insulate hot water air separators, heat exchangers, duct coils, storage tanks (board insulation only) and pump casings; with 2 in. thick flexible or rigid fiber glass insulation. Flexible blanket shall be equal to JM type 812 Spin-Glas meeting ASTM C 553, Type III, 1.5 lb/cu ft density, with K-factor of 0.24 at 75°F mean temperature. Flexible board insulation shall be equal to JM 814 Spin-Glas meeting ASTM C 612, Type IA & IB, 3.0 lb/cu ft density, with K-factor of 0.23 at 75°F mean temperature.

2. Insulate higher temperature equipment and flue gas breeching between 600°F and up to 1200°F with 5 in. thick rigid molded hydrous calcium silicate block insulation. Insulation shall be equal to JM Thermo-12/Gold meeting ASTM C 533, non-combustible, asbestos free (color coded throughout material thickness) with K-factor of 0.41 at 300°F mean temperature when tested in accordance with ASTM C 177 and C 518. Insulation shall be securely banded in place, tightly butted, joints staggered and secured with 16 gauge galvanized or stainless steel wire or 1/2 in. x .015 in. galvanized steel bands on 12 in. maximum centers for large areas.

3. Insulate condensate drain pans that are not factory insulated; chilled/water and brine air separators, heat exchangers, expansion tanks, and pump casings; cold surfaces of chillers that are not factory insulated; refrigerant suction accumulators and other cold refrigeration equipment that are not factory insulated with flexible cellular elastomeric foam insulation. Insulation thickness shall be ¾ inch thick for equipment between 40°F and 60°F, 1.5 inch thick for equipment between 0°F and 40°F, and 2 inches thick for equipment between -40°F and 0°F. Insulation shall be equal to Armacell AP/Armaflex (up to 1 in. thick) or AP/Armaflex/FS (over 1 in. thick) meeting ASTM C 534 Type II flexible, cellular elastomeric, roll or sheet with flame spread/smoke developed rating of no more than 25/50 with K-factor of 0.30 at 75°F mean temperature. Provide waterproof vapor retardant adhesive. Outdoor equipment shall have a minimum 50% thicker insulation. Provide additional tapered insulation for outdoor equipment to insure no pooling of water on top of equipment. Provide 2 coats of UV protective coating for outdoor use.

L. Ductwork Insulation – General

1. Provide duct and plenum insulation of type(s) indicated in these specifications. Minimum total R-value for each location and duct system shall be as shown on the drawings.

2. R-values shown on drawings may be obtained by adding the individual R-values of both the lining (where shown or used) and external duct insulation.

M. Ductwork Insulation (External Wrap) - General

1. Where duct is internally lined (coordinate locations with ductwork sub-contractor), exterior insulation is also required unless specifically excluded in the specifications, shown on the plans, or where required to provide the minimum R-value shown on the drawings.

2. Where ducts are insulated or lined, flexible connectors to equipment shall be insulated. Duct flanges and standing seams shall be insulated the same as the duct.

3. Where service access is required, bevel and seal ends of easily removable insulation. Removable sections shall also be provided (and labeled) at all duct test holes.

4. The underside of duct work 24 in. or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18 in. on center. The protruding ends of the fasteners should be cut off flush after the speed clips are installed, and then, when required, sealed with UL listed tapes or vapor-retardant adhesive.

5. For exterior rectangular ductwork, insulation shall be a minimum of 2 inches thick, or to meet IECC 2015, whichever is greater, and shall be wrapped with one layer of roofing membrane matching the architect's material used on the roof. Color shall be as selected by Architect (aluminum, white, gray, or tan). Submit material and color sample to Architect for review and approval. Provide tapered insulation for outdoor ductwork to insure no pooling of water on top of duct. Outdoor round ductwork shall be weatherproofed with the same material, or, alternatively, in the same manner as outdoor piping with a minimum of 2 inch thick, or to meet IECC 2015, whichever is greater, insulation. The roofing membrane shall be installed by a roofing sub-subcontractor (shall comply to requirements set forth in the architect's roofing specifications) to HVAC subcontractor.

N. Ductwork Insulation (External Wrap): Provide the following insulation types for the listed ductwork.

1. Insulate concealed ducts and plenums, depending upon the required R-value (see drawings) for the duct and its location, with 0.75 lb/cu ft dense fiber glass insulation equal to JM Microlite or Owens Corning SOFTR Type 75. Insulation shall meet ASTM C 1290 Type III, flexible blanket with a maximum K-factor of 0.30 at 75°F mean temperature. Operating service temperature range shall be 40°F to 250°F. Vapor barrier jacket shall be FSK aluminum foil reinforced with fiberglass scrim laminated to UL rated kraft paper with maximum permeance of 0.02 perms. Jacket shall be secured with UL listed pressure sensitive tape and/or outward clinched expanded staples (with minimum 2 inch lapped vapor barrier) and vapor barrier mastic as needed. K-factors and R-values listed assume 25% compression during installation. The minimum R-value based on thickness, shall be:

Thickness	R-value
1 ½ in.	4.2
2 in.	5.6
3 in.	8.3

2. Insulate exposed ducts and plenums, depending upon the required R-value (see drawings) for the duct and its location, with 3.0 lb/cu ft dense fiber glass insulation. Insulation shall be equal to JM Type 814 Spin-Glas or Owens Corning Type 703 meeting ASTM C 612, Type 1A & IB; rigid board with a maximum K-factor of 0.23 at 75°F mean temperature. Operating service temperature range shall be 0°F to 450°F. Vapor barrier jacket shall be AP type (kraft paper bonded to aluminum foil, reinforced with fiber glass yarn) with maximum permeance of 0.02 perms. Jacket shall be secured with UL listed pressure sensitive tape and/or outward clinched expanded staples (with minimum 2 inch lapped vapor barrier) and vapor barrier mastic as needed. The minimum R-value, based on thickness, shall be:

Thickness	R-value
1 ½ in.	6.5
2 in.	8.6

O. Acoustic Duct Liner – General:

1. Liner minimum thickness shall be minimum 1 in. (unless otherwise noted on drawings) or as required to provide the minimum R-values shown on the drawings. Ductwork dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness. Do not use liner on kitchen, pool, shower, fume exhaust, hospital operating rooms (and similar areas) or other wet, grease ladened, or potentially hazardous exhaust systems.

2. Liner shall have rugged coating system installed on the air side of liner and all edges. Coating shall be cleanable by dry cleaning methods without damage. Maximum pressure drop of lined ductwork shall not exceed 5% more than unlined ductwork of the same inside dimensions. Liner shall be roll type or board type as required for duct size and to meet specified requirements.

3. Liner shall be rated up to 5,000 ft/min.

4. For all medium and high pressure ductwork (all ductwork above 2 in. pressure class) install a metal nosing at all liner leading edges. A metal nosing shall also be installed at all fan discharges and at any point where lined duct is preceded by unlined duct. Provide exterior insulation over metal nosings (these bridge the insulation and can lead to condensation) on all cooling supply ducts (with below 60°F air) in concealed or unconditioned spaces.

5. Repair liner surface penetrations with manufacturer's approved adhesive meeting ASTM C 919.

P. Duct Liner: Provide flexible duct liner equal to JM Permacote Linacoustic (rectangular duct) or Spiracoustic (round duct) meeting ASTM C 1071 with K-factor shall be 0.25 (1 in. thick) at 75°F mean temperature when tested per ASTM C 518. Liner shall have an air surface coated with acrylic coating treated with EPA register anti-microbial agent proven to resist microbial growth as determine by ASTM G 21 and G 22. Noise reduction coefficient shall be minimum 0.65 for 1 in. thick liner or higher for thicker liner based on type "A" mounting and tested in accordance to ASTM C 423. Install liner with full coverage adhesive meeting ASTM C 919 or JM SuperSeal. Secure liner with galvanized steel pins, welded or mechanically fastened. Weld pins shall not mar the exterior finish or surface of the duct. Liner shall be attached to pin with pressed on washer. Mechanical liner fasteners shall be spaced as indicated by SMACNA, NAIMA, or manufacturer. Pin length should be such as to limit compression of liner. All exposed edges of the liner must be factory or field coated. The minimum R-value, based on thickness, shall be:

Thickness	R-value
1 in.	4.0
1 ½ in.	6.0
2	8.0

Q. Fire Wrap Insulation: For all kitchen grease hood and dryer exhaust, provide fully encapsulated fire rated insulation equal to Unifrax FryeWrap Elite 1.5, Fire Master Fast Wrap XL, or 3M Fire Barrier System 615+. Fire wrap insulation shall be non-asbestos and rated to maintain 2-hour (both T and F - ratings) fire separation with zero clearance to combustibles at all points for the entire duct run.

1. For grease ducts, fire wrap insulation shall pass all requirements of ASTM E2336 and be a minimum of two 1.5-inch thick overlapping layers with minimum 3 in. perimeter and longitudinal overlaps.
2. Insulation for non-grease ducts shall be tested to meet ASTM E84, ASTM D6329, ISO 6944, ISO 834, ASTM E 814, and comply with requirements of NFPA 96, and the International Mechanical Code. Manufacturer may substitute single layer (with overlapped seams) system, providing all the above requirements are met and documented on the submittal.
3. Installation shall be in accordance with manufacturer's instructions to maintain rating with all cut edges sealed with aluminum tape. Insulation shall be held in place with minimum ½ inch wide and 0.015-inch thick stainless steel bands and clips. Provide insulation pins and clips (per manufacturer's recommendations) on the bottom of horizontal ducts to prevent sagging.
4. Seal all fire rated penetrations per manufacturer's details to maintain full 2-hour rating.
5. Provide removable insulation sections for all access and clean-out doors per manufacturer's details to maintain full 2-hour rating. Install easy to read warning labels on insulation every 20 feet and at each clean-out door. Labels shall say "Fire Resistive Enclosure – Do Not Remove".

6. Exposed duct wrap systems shall be protected where subject to physical damage.

2.29 METAL CHIMNEYS AND FLUES

A. For boilers (without draft hoods, gas fired high efficiency condensing type, unless otherwise noted on drawings).

1. Shall be selected, sized, and furnished by flue manufacturer, to be compatible with the selected boilers and to reflect the specific installation.

2. Sizing of flues shall be the responsibility of the contractor based on final routing layout, regardless of the sizes indicated on the plans. No additional cost shall be incurred by the owner for any required changes to flue sizing.

3. Contractor shall provide full flue design based on project specific installation for review, including materials, layout and calculations. Calculations shall be approved by the boiler manufacturer. Boiler manufacturer's approval of the flue calculations shall also be submitted for review.

4. Furnish and install, as shown on the drawings, a positive pressure, dual wall, insulated breeching/stack system.

5. Breeching to be round, double wall, all metal, gas and liquid-tight factory built component system, tested and listed by UL for use with building heating equipment, burning gas, solid or liquid fuels as described in NFPA-85A, B, D and NFPA-211.

6. Breeching inner shell (gas carrying pipe) to be 0.035 in. 304 stainless steel for liquid fuel or 316 stainless steel for solid fuels. Outer shell to be minimum 0.026 in. aluminized or 304 stainless steel. Both inner and outer shell construction to be all welded (tacked joints are unacceptable) and all vertical seams to be full strength 100% penetration square groove weld in accordance with AISC and/or AWS specifications and codes. Inner and outer walls to be connected by "J" clips, which shall allow for unobstructed thermal expansion of inner and outer walls.

7. Insulating barrier to consist of two (2) inches of six (6) pounds per cubic foot density insulation secured to the inner shell with steel straps.

8. Inner shell to be sealed by use of 304 stainless steel bands and high-temperature sealant. The outer shell to be joined together with sealant and one piece 304 stainless steel draw bands. Joint sealant to be supplied by the manufacturer for the anticipated temperature range.

9. System to be complete with elbows, tees, laterals, tapered increasers/reducers, thimbles, support plates, expansion sections, flange adapters, boiler kits, and all necessary hangers, guying and supports. Final system design/layout to be by breeching manufacturer. Submit shop drawings.

10. System to be warranted against defects in materials and workmanship for a period of twelve (12) years from date of original installation.

11. System shall be as manufactured by Schebler, Selkirk Metalbestos, Ampco, Metal-Fab, or approved equal providing they meet the specified requirements. The system shall be sized, selected and approved by the boiler manufacturer.

12. The system shall be by a licensed trade installer.

2.30 ROOF CURBS

A. HVAC shall furnish, assemble and install vibration isolation type curbs.

B. As supplied by equipment manufacturer for roof mounted equipment. Provide pre-fabricated adjustable curbs for duct penetrations through roofs.

C. Provide roof curbs shop-fabricated from 0.064-inch aluminum sheet with heliarc welded joints, integral cants, and flanges, and wood nailer. Sizes as indicated or as required for equipment.

D. Provide insulation liner of 1-1/2-inch minimum thickness glass fiber: NFPA 90A Standards, flame spread rating of 25 or less, smoke rating 50 or less; coated with neoprene or an approved equal as protection from erosion.

E. Provide integral pipe chase for roof mounted air handlers with coils.

F. Provide roof curbs with sound attenuators where indicated and as specified.

G. Provide custom curb with a pathway for return air ductwork through the curb for units that require horizontal ductwork in the curb. Refer to drawings for exact locations.

H. See Vibration Isolation Section for further requirements.

2.31 SPLIT SYSTEM AIR CONDITIONER

A. Acceptable manufacturers: Mitsubishi, Trane, Daikin or approved equal.

B. General:

Furnish and install ductless split system air conditioning system as shown and scheduled on the drawings and as detailed herein. The systems shall consist of a compact wall mounted packaged evaporator section and matching air-cooled outdoor unit. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label. All wiring to be in accordance with the National Electric Code (NEC). The units shall be rated in accordance with ARI Standard 210 and bear the ARI label. A full charge of R-410A shall be provided in the condensing unit. Provide additional refrigerant charge (R-410A), per manufacturer's recommendations, to accommodate additional lengths of piping. A dry nitrogen holding charge shall be provided in the evaporator. System SEER shall meet or exceed 1992 Federal Standards.

C. Indoor Units:

The indoor units shall be completely factory assembled and wired. The casing shall have a white finish. The evaporator fan shall be an assembly of line flow fans direct driven by a single motor. The fans shall be statically and dynamically balanced and run on permanently lubricated bearings. An adjustable guide vane shall be provided with the ability to change the airflow from horizontal to vertical. Return air shall be filtered by means of an easily removable washable filter. The evaporator coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phoscopper or silver alloy. The coil shall be pressure tested at the factory. A condensate pan with drain shall be provided under the coil. The unit electrical power shall be as shown and scheduled on the drawings.

D. Outdoor Units:

The outdoor units shall be completely factory-assembled, piped and wired. The casing shall be fabricated of galvanized steel, bonderized and finished with baked enamel. The units shall be furnished with direct drive, propeller type fans arranged for horizontal discharge. The motors shall have inherent protection, be of the permanently lubricated type, and shall be resiliently mounted for quiet operation. Each fan shall be provided with a raised guard to prevent contact with moving parts. The compressor shall be of the high-performance, rotary type with crankcase heater, accumulator and internal thermal overloads. The compressor shall be mounted so as to avoid the transmission of vibration. The refrigeration system shall be equipped with high pressure switches and have the capability to operate with a maximum height difference and overall refrigerant tubing length as recommended by the unit manufacturer between the indoor and outdoor sections without the need for line size changes, traps or additional oil. Refrigerant flow from the condenser to be controlled by means of a capillary tube. The condenser coils shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The coil shall be protected with an integral metal guard. The unit shall be controlled by the microprocessor located in the matching indoor unit. A built in, low-ambient controller shall allow cooling to 0 degrees F outdoor temperature. The unit's electrical power shall be as shown and scheduled on the drawings. Provide wind shield on all outdoor units.

E. Controls:

1. The control systems shall consist of two (2) microprocessors interconnected by a single non-polar two wire cable as supplied. Wiring shall run from indoor units to controllers direct. Control wiring shall contain NO SPLICES. When running longer lengths or more than one set of remote controller wires together, a double insulated, two wire cable equivalent to that provided, is mandatory or use shielded two wire cable. One microprocessor shall be factory wired and located within the indoor unit. It shall have the capability of sensing return air temperature and indoor coil temperature; receive and process commands from the remote controller; provide emergency operation; and control the outdoor unit. The microprocessor within the remote controller shall provide automatic cooling; display set point and room temperature; control a 24 hour on/off timer so that automatic operation can be set on the timer at one-hour intervals from one to twenty-four hours; have self-diagnostic function display; check mode for memory of most recent problem; control operation of the air sweep louvers; and provide on/off system/mode function switching. Normal operation of the remote controller provides individual system control in which one remote controller and one indoor unit are installed in the same room. Control voltage between the remote controller and the indoor unit shall be 12 volts DC. The control voltage between the indoor unit and the outdoor unit shall be 12 volts DC. 12VDC shall be generated from the indoor unit microprocessor board. The system shall be capable of automatic restart when power is restored after power interruption. System shall include self-diagnostic display including total hours of compressor run time.

F. Warranty:

1. The units shall have a manufacturer's warranty for a period of one (1) year from date of installation. The compressor shall have a warranty of six (6) years from date of installation.

G. Options:

1. Furnish and install optional system program times to provide daily on/off switching and daily setback temperature differentials. The timer shall have a LCD clock; today set switch, weekly timer switch, degree setback switch and daily timer switch. The timer shall mount next to the remote control and be connected by plug-in wire harness.

2. Furnish and install the optional refrigerant piping kits. Kits to include sufficient lengths of preinsulated 3/4 in. refrigerant gas piping and 1/2 in. refrigerant liquid piping to connect indoor units to outdoor units. Piping shall be completely compatible with indoor and outdoor units. (If optional refrigerant piping kit is not used, refrigerant piping shall be Type L hard drawn ACR tubing, conforming to ASTM B280. Fittings shall be wrought copper, conforming to ANSI B16.22. Joints shall be made with silver solder, minimum 45% silver brazing alloy, cadmium free, conforming to ASTM B32. Insulation to be closed-cell polyolefin foam insulation with a heat transfer coefficient not to exceed 0.24 BTU/hr/ft^2/^{o}F per inch of thickness. Density to be 1.5 lbs./cu.ft. Insulation to have pre-slit and pre-glued longitudinal seams with Mylar release liner. Thickness shall be (1) inch. All pipe insulation installed outdoors shall be weatherproofed with Childers, Manville, Ferro Corp., or approved equal, aluminum metal jacketing. The aluminum jacket shall be manufactured from T-3000 aluminum, and shall have a factory attached moisture barrier continuously laminated across the full width of the jacketing. Jacket thickness shall be 0.016 inch. Installation to be in strict accordance with manufacturer's instructions.)

3. Furnish and install minimum 24 in. high adjustable stand, Quick-Sling super stand, RectorSeal stand, Big Foot, or approved equal. Stand shall be constructed of steel tubing cross rails and (4) support feet for bolting to structure. Hardware shall be galvanized and stand shall be factory painted. This contractor shall be responsible for ensuring that stand is designed to withstand weight of equipment.

4. Install piping and pressure test in full accordance with manufacturer’s recommendations.

2.32 AUTOMATIC CONDENSATION REMOVAL UNITS

A. Furnish and install automatic condensation removal units where shown and scheduled on the plans and as detailed herein. Units shall be UL and CSA listed. Units to be similar or an approved equal in all respects to Little Giant Pump Company, Dayton, Aspen, or approved equal.

B. Units shall be furnished with: vertical pump unit, polystyrene tank, ABS motor/tank cover, volute and impeller, stainless steel shaft, snap action switch, 3/8 in. OD barbed discharge connection, check valve, 6-foot power cord, and safety switch. Unit shall engage in 3.56 in. of water and disengage in 2.6 in. of water.

C. Wire safety switches to shut down air-handling units in the event of a failure of the condensation removal unit.

2.33 VARIABLE FREQUENCY DRIVES

A. Reference Standards and Acceptable Manufacturers

1. The variable speed drives (aka VSDs or VFDs) with all options shall be UL and ETL Listed as a complete assembly and shall be built in compliance with the latest standards of ANSI, IEEE, NEMA and the National Electric Code.

2. Acceptable manufacturers, provided they meet the other requirements of this specification shall be Allen Bradley, Siemens, GE or approved equal.

B. Construction

1. The VSD shall be of the Pulse Width Modulated design converting the fixed utility voltage and frequency to a variable voltage and frequency output with 6-pulse IGBT bridge. Efficiency shall exceed 95% at 100% speed and load. Line side displacement power factor shall exceed (0.95) regardless of speed and load.

2. The VSD shall be housed in a NEMA 1 metal enclosure.

3. Standard operating conditions shall be:

a. Incoming three phase 460 volt AC power ± 10%, 60 Hz.

b. Humidity 0 to 95% (noncondensing and noncorrosive).

c. Altitude 0 to 0 to 3,000 feet above sea level, without derating.

d. Ambient temperature 0 to 40°C.

4. VSDs shall include the following system interfaces:

a. Process control speed reference interface to receive an isolated 0-10 volts DC or 4-20 MA DC signal.

b. Run relay with an isolated set of Form C contacts.

c. Dedicated terminal blocks for interface with remote start contact and remote safety trips.

d. 120 volt control to allow VSD to interface with remote contacts at a distance up to 500 feet and with three-wire control.

e. The subcontractor shall be responsible for all control wiring between the terminal strip (and contacts) provided with the VSD, and the automatic temperature control system. Subcontractor shall also be responsible for ensuring that the control output signal (4-20 Ma, 1-10 VDC, and other signals) from the DDC system is compatible with the input signal required by the drive.

5. The VSD shall include the following protective features:

a. Door interlocked padlockable disconnect switch.

b. Electronic instantaneous overcurrent protection.

c. Undervoltage protection.

d. DC bus overvoltage protection.

e. Able to withstand output line-to-line short circuits without component failure.

f. Surge protection from AC line transients.

g. Individual visible status indication of the following protective functions:

1) Logic Error

2) Undervoltage

3) Overcurrent

4) DC Bus Overvoltage

5) Controller Overtemperature

6) Overfrequency

7) Phase Loss.

A single flashing light to indicate a VSD trip is not acceptable.

h. A dry contact output to indicate protective trip-out (open on trip).

i. Provide electronic motor overload protection to protect motor and drive at all frequencies. Electronic overload circuits, which protect motor only at full speed, shall not be acceptable. VSD shall sense load and recalibrate thermal trip curve to insure low speed motor protection.

j. Overload capability shall be 110% of the motor FLA based on the NEC ratings for 60 seconds.

k. Opening of an output disconnect under load shall not result in component damage.

l. VSD shall not require restoring after failure of source voltage. VSD shall automatically restart unit upon restoration of source voltage if start signal is available.

6. The VSD shall include the following additional features:

a. Output contactor to provide electrical output isolation when the VSD is not running.

b. Individual 0-10V or 4-20 mA analog output to frequency and kW.

c. Provide the following in the same enclosure as the variable speed drive:

1) Bypass controller – manual transfer to line power via contactors; including motor thermal overload and fuse protection while in bypass capability.

2) Isolating switch – service switch that provides the ability to service the controller (electrically isolated) while in bypass operation without having to remove power to the motor.

d. Critical frequency avoidance circuit to avoid operation at speeds which cause excessive vibration in the driven equipment. Option board to have at least two field adjustable bands.

e. Adjustable current/torque limit (50-110%) which limits current by lowering the output frequency when excessive current is drawn.

f. Multiple attempt restart, which perform 3 restarts in 10 minutes for all VSD internal trips.

g. AC ammeter.

h. The variable speed drive shall be capable of starting from power interruption into spinning load without stopping motor or creating fault condition. VSD shall speed search motor RPM and synchronize phase rotation to return motor to set speed. All the drives control programming, including all set points, shall be maintained during a power interruption.

i. VSD shall not cog at frequencies greater than 6 Hz. Drive manufacturer shall include a statement to this effect with his submittal. Drive manufacturer shall be fully liable for any damage to pump couplings or other HVAC equipment caused by low frequency clogging.

j. VSD manufacturer shall provide 3% chokes, based on motor horsepower, for each VSD provided. These chokes shall be designed for use with the VSD to smooth current waveforms and lower harmonic disturbance.

7. Standard adjustments shall include minimum speed (5 to 25% of maximum RPM), maximum speed (80 to 100% of maximum RPM), acceleration time (1-3600 seconds), deceleration time (1-3600 seconds), dwell time, voltage boost, and volts/hertz.

8. Door Mounted Operator Controls and status indication shall include:

a. VSD shall have a digital display, keypad and customer connections; regardless of horsepower rating. The keypad is to be used for local control (start/stop, forward/reverse, and speed adjust) for setting all parameters, and for stepping through the displays and menus.

b. The digital display shall be in plain English digital display (code numbers are not acceptable), a 40-character (2 line 16 characters/kine) backlite LCD display. All set up parameters, indications, faults, warnings and other information must be displayed in words to allow the user to understand what is being displayed without the use of a manual or cross reference table. The display must be able to be read without opening cabinet.

c. Pre-wired three position Hand-Off-Auto switch and speed potentiometer located on exterior side of motor control center door. In the “Hand” position, the VSD shall be started and the speed controlled from the speed potentiometer or through a direct keypad command. In the “Off” position the VSD shall be stopped in the “Auto” position, the VSD shall start via an external contact closure and its speed shall be controlled via an external speed reference.

d. The VSD shall have a manual speed potentiometer in addition to using the keypad as a means of controlling speed manually.

e. By-pass/auto/manual speed control selection

f. Manual speed adjustment

g. Frequency meter

h. Elapsed time meter

i. Power on indication

j. Run indication

k. Power (kW) meter

2.34 LOUVERS

A. Furnish and install fixed drainable 6 in. deep aluminum louvers of the sizes and capacities as shown on the Contract Drawings.

B. The fixed wall louvers shall have heads, sills, jambs and mullions of one (1) piece structural members of 6063-T5 alloy, 0.125 inch (3.18 mm) thick with integral caulking slot and retaining beads. Mullions shall be sliding interlock type with double integral internal drains. Drainable blade shall be of the same material and shall be minimum 0.081 inch (2.06 mm) thick with front lip gutter and recessed second gutter designed to catch and direct water to jamb and mullion drains. Closed cell PVC compression gaskets to be provided between bottom of mullion or jamb and top of sill to insure leak tight connections. Structural supports shall be designed to carry a wind load of not less than thirty (30) pounds per square foot. All fasteners shall be stainless steel or aluminum. All louvers shall be furnished with aluminum mesh insect screen. Screening shall be replaceable.

C. Manufacturer to submit AMCA500 test data on a 4 foot x 4 foot unit showing that the louver shall pass 1010 FPM free areas velocity at a pressure drop of less than 0.01 ounces of water per square foot of free area. AMCA data shall also show a 4 foot x 4 foot unit to have a minimum of 8.8 square feet free area.

D. Louvers shall be finished with 2 coats of baked acrylic enamel paint, containing a minimum of 50% Kynar. Louvers shall be painted a custom color, to be selected by the Architect or Engineer.

E. On louvers that call for blank-off panels, the panels shall be a rigid insulation board type minimum of two (2) inch thick with a minimum twenty (20) gauge aluminum protective facing on both sides.

F. Louvers shall be Ruskin Model ELF 6375X, Arrow United Industries Model EA-615-D, American Warming and Ventilating Model LE-31 or an approved equal by Construction Specialties.

G. Installation shall meet all manufacturers' requirements.

2.35 FAN COIL UNITS

A. Provide factory fabricated fan coil units of type and capacity indicated by IEC, Williams, Airtherm, Daikin or approved equal.

B. Fan coil unit shall comprise:

1. Galvanized steel cabinet with baked enamel finish, insulation shall be closed cell foam type.

2. Service panels on the bottom of ceiling mounted equipment which shall be hinged or provided with safety chains to prevent them from falling when opened.

3. Centrifugal forward curved galvanized steel fans, statically and dynamically balanced, permanently lubricated or ball bearing shaft bearings.

4. Provide chilled and/or hot water coils as indicated with aluminum fins mechanically bonded to staggered copper tubes and leak tested at air pressure of 350 psig.

5. Motors shall be ECM with built-in overload protection. Provide integral speed switch (Hi-Medium-Low-Off, or infinitely variable), to be controlled from BAS.

6. Design conditions shall be met with fan at medium speed settings.

7. One inch disposable filters.

8. 18 gauge stainless steel drain pan protecting under entire length of coil, plus auxiliary drain pan under valve kit.

9. Condensate pump as required.

2.36 PACKAGED ROOFTOP AIR CONDITIONING UNITS

A. Acceptable Manufacturers:

1. Daikin

2. Addison

3. JCI/York

B. Summary: Completely factory assembled unitized construction packaged rooftop air conditioning unit including a factory-mounted and wired unit controller and sensors, single point power connection designed for (460V-3Ph-60Hz) power, outdoor air handling section with return and supply openings, discharge plenum, and direct-expansion refrigerant condensing section. Single point power connection to be equipped with an externally lockable disconnect switch. GFCI protected powered convenience outlet, including factory wired control transformer to power the outlet from the single point power connection, shall also be provided (outlet to remain operational when disconnect is open).

C. Unit Construction

1. Base: The base rail shall be constructed of 12 gauge galvanized steel, extending the full perimeter of the unit. All components shall be supported from the base, and the base shall include integral lifting lugs. The unit base rail shall overhang the roof curb for water runoff and shall have a fabricated recess with a continuous flat surface to seat on the roof curb gasket, providing a positive, weather tight seal between the unit and the curb.

2. Casing

a. The unit cabinet shall be double wall construction (on all units 15 tons and larger) to provide both maximum resistance to bacterial growth in the air stream and superior structural integrity. All sheet metal shall be G90 mill galvanized sheet metal, formed and reinforced to provide a rigid assembly. Sheet metal shall be cleaned in an alkaline and zinc phosphate bath, and the exterior surfaces shall be coated with a 1.5 mil powder paint, capable of withstanding 750 salt spray hours in accordance with ASTM B-117. The unit shall be insulated with 1-1/2, in. 1 pound fiberglass insulation between the two sheet metal skins. Insulation shall meet NFPA-90A regulations for smoke and flame spread ratings.

b. The cabinet corner post and the intermediate side supports shall be 16 gauge steel. All access doors shall be 18 gauge on the exterior surfaces, and 20 gauge on the interior. Floor shall be 18 gauge, and 24 gauge.

c. All serviceable sections shall have hinged access doors with latches on both sides of the unit. All access doors shall be constructed of 20 gauge steel on the outside, with 24 gauge on the inside. Each door shall seal against a rubber gasket to prevent air and water leakage.

d. The roof shall be double wall, with 18 gauge on the external surface and 24 gauge on the interior. The roof shall be formed with a 45 degree drip lip overhanging the side walls to prevent precipitation drainage from streaming down the side of the unit. Roof sections shall be connected together via integral channels fastened with screws and sealed with rubber gasketing. Each fastened seam shall be further protected by a sheet metal channel covering the full length of the gasket surface, making a completely water tight seal.

D. Supply Air System – Supply Air Fan – Variable Volume

1. Fans shall be centrifugal type, statically and dynamically balanced in the factory. Fan wheels shall be designed for continuous operation at the maximum rate of fan speed and motor HP.

2. The fan and motor assembly shall be mounted on a common base to allow consistent belt tension with no relative motion between the fan and motor shafts. The entire assembly shall be isolated from the unit base with 1 in. deflection springs (on units 25 tons and larger). The fan discharge shall be connected to the cabinet through a reinforced neoprene flexible connection to eliminate vibration transmission from the fan to the unit casing.

3. Fans shall be double-width, double-inlet with forward curved blades. Fan wheels shall be a minimum of Class II construction.

4. VAV Operation shall be achieved by equipping the supply fan with a Variable Frequency Drive (VFD). Supply fan VFD shall be equipped with a manual bypass. Supply fan speed to be controlled to maintain duct static pressure set point, as measured by pressure transducer, factory installed in unit by rooftop unit manufacturer. Pneumatic tubing to be run from transducer to appropriate place in duct, by mechanical contractor.

E. Bearings and Drives

1. Bearings shall be self-aligning pillow-block re-greasable ball bearings with an average life expectancy of 200,000 hours. Grease fittings shall be accessible through access doors.

2. Fan motors shall be NEMA designed, Premium efficiency, ball bearing type with electrical characteristics and horsepower as specified. Motors shall be 1750 RPM, open drip proof type. The motor shall be located within the unit on an adjustable, heavy steel base.

3. All fan motor drives shall be selected for a minimum service factor of 1.2 and have fixed pitched sheaves.

F. Air Filtering System

1. All filter holding frames shall be of heavy-duty construction designed for industrial applications. All filters shall be side accessible with access doors provided on both sides of the filter section.

2. All filter media shall be Class II listed under UL Standard 900.

3. Rigid filters shall be high performance, expanded area, disposable type filters. Rigid filter sections shall be preceded by a 2 in. MERV-7 throwaway pre-filter assembly. Ratings shall be based on ASHRAE Standard 52-76.

G. Air Inlet System

1. General

a. Outside Air inlet openings shall be covered by a factory installed rain hood permanently attached to the cabinet to prevent windblown precipitation from entering the unit. The rain hoods on the front and back of the unit shall be rotated into the cabinet and secured for shipment so that upon installation they need only be rotated upwards and screwed into place. The outside air hood shall contain a removable and cleanable filter with an efficiency rating of 50% based on ASHRAE 52-76.

b. All damper assemblies shall be of low leak design. Damper blades shall be fabricated from a minimum of 16 gauge, galvanized steel. Blade ends and edges shall be covered with vinyl seals. Damper shafts shall be fabricated from solid steel and mounted in the frame with bronze bearings.

2. Economizer - An economizer shall have outdoor air and return air dampers that are interlocked and positioned by fully modulating, solid state damper actuators. The actuators shall be spring loaded so that the outside air damper closes when power to the unit is interrupted. The operation of the economizer shall be fully integrated into the cooling control system. The economizer shall be available for control via dual enthalpy sensors.

3. Powered Exhaust/Return Air Fans

a. General – Fan(s) shall be installed in the return air plenum for positive power exhaust or VAV return air control, as noted below. Fans shall be on a common shaft, driven by a single motor. The fans, motors and drives shall be of the same quality and design as specified for the Supply Air Fan. Fans shall be capable of exhausting or returning up to 100% of the nominal CFM of the unit.

b. True Return Fans and Exhaust fans with fully Modulating Operation (on units 20 tons and larger) – Unit shall have SWSI plenum return fans in return plenum of unit. Return fans shall be capable of modulating the amount of air from 0% to 100% of nominal CFM. Modulation shall be achieved through use of a Variable Frequency Drive (VFD). VFD shall be of the same manufacturer/construction as the supply fan VFD except without the manual bypass (for protection of unit). VFD shall be controlled by ATC installed programmable DDC controller, based on tracking of supply fan CFM through air flow measuring devices, with the required offset for outside air intake and building pressurization controls. See control section below and sequence of operation for further detail of requirements.

c. Fixed position Operation (on units 10 tons and smaller) – Power exhaust fan shall be on/off control based on economizer position setting on unit. Set point shall be adjustable and set in field by mechanical subcontractor at time of startup, to avoid pressurization issues in space.

H. Refrigeration System - Units shall have multiple independent refrigerant circuits (2 circuits for 6.5 ton – 12.5 ton, and 4 circuits for all units 15 – 40 tons) for maximum load-matching capability. Each refrigerant circuit shall be controlled with a balance-port thermal expansion valve for maximum control at low load conditions.

1. Evaporator Coils

a. Evaporator coils shall be direct expansion type with intertwined circuiting to assure complete coil face activity during part load operation. Coil tubes shall be 3/8” OD copper, with internally enhanced tubes. Fins shall be enhanced aluminum mechanically expanded to bond with the copper tubes. Coil casing shall be fabricated from heavy gauge galvanized steel. All coils shall be pressure tested at a minimum of 450 PSIG.

b. A stainless steel drain pan shall be provided under the entire length and width of the evaporator coil, including all return bends. The main drain pan shall be sloped a total of 1/4” per foot towards the drainage point. Main drain pan shall be easily cleanable in the field. The condensate drain opening shall be flush with the bottom of the drain pan to allow complete drainage. Coils in excess of 48” high shall have an intermediate drain pan, also fabricated of stainless steel extending the entire finned length of the coil to provide better water drainage. Drainage from the intermediate drain pan shall be to the primary drain pan.

2. Compressors

   a. Units shall have one industrial duty hermetic scroll compressor per circuit. Compressors shall have an enlarged liquid carrying capacity to withstand rugged operating conditions. Compressor frame shall be cast iron, with cast iron fixed and orbiting scrolls. Each compressor shall feature a solid-state protection module, designed to protect the compressor from over temperature and overcurrent conditions.

   b. Each compressor shall include the following safety and convenience devices: replaceable suction screen, discharge line check valve, and oil sight glass. Compressors shall be vibration isolated from the unit, and installed in an easily accessible area of the unit.

3. Condenser Coils - Condenser coils shall have 3/8" seamless copper tubes, arranged in staggered rows, mechanically expanded into aluminum fins. Coils shall be protected from hail damage with a V configuration, with individual flat coils rotated 30° from the vertical plane for each condensing circuit. Condensing coils shall have an integral subcooler for more efficient, stable operation.

4. Condenser Fans and Motors - Condenser fans shall be direct drive, propeller type, discharging vertically. Condenser fan motors shall be 3 phase, totally enclosed air over (TEAO) type, with built in thermal overload protection.

5. Refrigerant Piping

   a. All interconnecting piping between refrigeration components shall be copper tubing with brazed joints.

   b. Each refrigerant circuit shall be equipped with liquid line filter drier, and moisture indicating sight glass. Each circuit shall also have both high and low pressure switches installed on either side of the compressor and include shrader depressors for replacement of the pressure switches without removing charge.

   c. Polyurethane sleeves shall protect all small diameter distributor tubing to the evaporator coil over the length of the tubing to prevent the tubes from copper-to-copper contact during shipment or operation.

6. Hot Gas Bypass - Unit shall have hot gas bypass factory installed on the lead compressor/circuit (required on all VAV units), or digital scroll compressor.

I. Hot Water Heating Coil

1. When specified, units 25 tons and larger shall be furnished with a factory installed hot water coil in discharge section of unit. Units 20 tons and smaller shall ship with a loose hot water coil to be field installed in supply duct. Control of HW coil, including control valve, shall be by ATC subcontractor. Rooftop unit shall function as a cooling only unit. ATC furnished DDC controller to command unit cooling or hot water heating as required to meet space load(s).

J. Controls

1. VAV units (6.5 ton thru 40 tons) shall be supplied with complete integral factory controls from factory, with Open Protocol BACnet interface card. Intent is for BAS system to determine the operating schedule, operating mode, and resets and allow the integral control to operate to meet the set point.

2. ATC subcontractor to start and test the unit with the equipment manufacturer, balancing subcontractor, and HVAC sub to assure a proper interface and operation throughout the full operating ranges.

3. Manufacturer's factory mounted controllers shall have the following safeties:

   a. High and low pressure cut-outs (one each refrigerant circuit)

   b. Minimum on time for compressors

   c. Delay between compressor stages

   d. Anti-recycle (minimum off time) for compressors

   e. Brown-out protection (lock out compressors in case of a drop in voltage)

   f. Cooling lockout at O°F

   g. Minimum heat on/off times

   h. Air flow proving switch requiring proper air flow for heat or cool operation

4. Full Perimeter Roof Curbs - 14' high standard flat roof curb with wood nailer. Roof curb covers the entire perimeter of the unit (where applicable). Roof curb shall ship separate from unit for installation by HVAC subcontractor.

2.37 VARIABLE AIR VOLUME TERMINAL UNITS (VAV)

A. Provide single duct variable volume air control assemblies of sizes and capacities shown on Drawings. Acceptable manufacturers shall be: Price, Titus, Envirotech, Trane, Metallaire. Units shall be 24 gauge galvanized steel, lined with 1 1/2 pound insulation as required by UL 181 and NFPA 90A.

1. Responsibility for the provision of damper actuator, DDC VAV box controller including velocity pressure transducer and control transformer shall be under the Automatic Temperature Controls paragraph of this specification. Terminal box manufacturer shall include with his bid, costs of mounting the controller on his box and piping the controller's transducer to his flow sensor (in accordance with control manufacturers instructions).

B. Provide sound attenuators where indicated on the drawings.

C. Boxes shall have multipoint averaging type airflow sensors. Boxes with single point sensors are unacceptable.

D. Assemblies shall be pressure independent between supply unit's external static pressure and minimum static pressure schedule on Drawings. Valves shall be normally open or normally closed as shown on Schedules. Differential static of complete assembly shall not exceed 0.45" wg for units with sound attenuators nor 0.20" wg for units without. Damper leak rate shall not exceed 2% of full volume at 3" static pressure rated by ADC. Units shall not deviate from set minimum or maximum flow settings by more than 10% regardless of inlet angle. Inlet velocities shall not exceed 2250 fpm.

E. Sound ratings shall not exceed noise criteria NC 30 level unless otherwise scheduled on the Drawings. All NC data must be in accordance with ADC 1062 R4. Discharge NC data shall include 10db room attenuation only. Radiated NC data is to assume a ceiling with sound transmission class 35 39.

F. Terminal units shall be capable of the heating and cooling operation sequences and quantities shown on the schedule, plan and control drawings. Units' control apparatus shall be compatible with the control system.

G. The mechanical division contractor shall have complete responsibility for ensuring that the submitted terminal box and VAV DDC controller are compatible with each other, and that they can perform all sequences of operation shown on the control drawings. Contractor shall submit the following items with his shop drawing submittal:

1. The name of the terminal box manufacturer.

2. The name of the temperature controls manufacturer.

3. A statement that the mechanical division contractor has contacted both vendors and verified that the terminal box and DDC controller are compatible with each other.

H. Provide hot water heating coils as indicated on drawings.

2.38 ELECTRIC HEATERS

A. General

1. Shall be Indeeco or model listed, or approved equal by Chromalox, or Hartzell.

2. All electric heaters shall comply with all applicable State Codes.

3. All electric heaters shall be UL or ETL listed.

4. All electric heaters shall have integral required safeties including but not limited to automatic reset thermal cut out, fan overload protection, and time delay relay for fan operation.

5. Provide service disconnect.

6. All electric heaters shall be controlled by BMS, to maintain space set point.

7. Installation as per manufacturer's recommendation, including but not limited to mounting height and clearances.

B. Electric Wall Heaters

1. WAI series.

2. Color selection by architect based on standard six color choices.

3. Steel finned tubular elements and powder coated steel cabinet.

4. Quiet direct drive low speed fan with permanently lubricated totally enclosed motor.

5. Factory provided relay and appurtenances for remote control by BMS.

6. Fully recessed. Semi-recessed, or surface mounting as required with all parts provided. All exposed parts shall have same color.

7. Voltage, phase, and capacity as indicated.

C. Electric Unit Heaters

1. UHP series.

2. Standard brown or beige of color selected by architect.

3. Steel finned tubular elements.

4. Powder coated steel cabinet.

5. Quiet direct drive low speed fan with permanently lubricated totally enclosed motor.

6. Factory provided relay and appurtenances for remote control by BMS.

7. Complete mounting brackets, hanger and appurtenances required for complete installation and safe operation.

8. Voltage, phase, and capacity as indicated.

9. When capacity larger than 5-KW is indicated, submit appropriate series model to meet the required capacity.

2.39 KITCHEN DEMAND CONTROL VENTILATION (DCV) SYSTEM

A. Areas of Responsibility:

1. DCV system shall be provided by others, under Food Service Subcontract.

2. By HVAC

a. Kitchen Exhaust fan.

b. Makeup air unit with VFD.

a. Traverse of kitchen exhaust fan(s) to measure CFMs at 100%, 75%, 50%, and 25% speed to provide fan performance profile to DCV.

b. MAU and VFD, flow measuring station, and with BACnet interface.

c. BMS as defined below

3. By DCV:

a. Furnishing of VFD for the kitchen exhaust fan equipped with BACnet interface.

b. Furnish complete wiring diagram, component shop drawings, responsibility chart, and sequence of operation for approval by Designer, and to ATC for their integration of DCV into ATC submittal.

c. Provide all components and control wiring.

d. Start/stop and modulates KEF. Sends out linear signal for BAS to pickup to operate MAU to track KEF minus offset CFM.

e. Startup and testing, coordinated with Food Service Equipment sub, electrical sub, Air Balancing sub-sub, HVAC subcontractor, and ATC sub-sub.

f. Commissioning.

4. By others

a. Dry contact from Ansul system to shut down MAU and to put KEF into full capacity.

b. Dry contact from CO detection system to shut off gas valve, to be monitored by BMS.

B. BMS Interface Requirement

1. BACnet interface.

2. Monitoring

a. Kitchen exhaust fan status.

b. Kitchen exhaust fan speed and estimated CFM.

c. Makeup air unit status and CFM through air flow measuring station.

d. Offset CFM.

e. Sensor status.

f. Alarm condition.

3. Override

a. Kitchen exhaust fan on/off.

b. MAU on/off.

c. Schedule.

2.40 AUTOMATIC TEMPERATURE CONTROLS

A. Refer to SECTION 250001.

PART 3 - EXECUTION

3.00 GENERAL

A. Install all items specified under PART 2 - PRODUCTS, according to the applicable manufacturer's recommendations and shop drawings, the details shown on the drawings and as specified under this Section. Provide all required hangers and supports.

B. All welding done under this Section shall be performed by experienced welders in a neat and workmanlike manner. All welding done on piping, pressure vessels and structural steel under this Section shall be performed only by persons who are currently qualified in accordance with ANSI Code B31.1 for Pressure Piping and certified by the American Welding Society, ASME or an approved independent testing laboratory; and each such welder shall present his certificate attesting his qualifications to the Engineer's representative whenever requested to do so on the job.

C. All pipe welding shall be oxyacetylene or electric arc. High test welding rods suitable for the material to be welded shall be used throughout. All special fittings shall be carefully laid out and joints shall be accurately matched intersections. Care shall be exercised to prevent the occurrence of protruded weld metal into the pipe. All welds shall be of sound metal free from laps, cold shots, gas pockets, oxide inclusions and similar defects.

D. All necessary precautions shall be taken to prevent fire or damage occurring as the result of welding operations.

3.01 CIRCULATING PUMPS

A. Circulating pumps shall be installed in accordance with manufacturer's recommendations.

B. Base-mounted pumps shall be set on floor on concrete bases. Give accurate measurements to the general contractor as to base dimensions required.

3.02 EXPANSION TANK

A. Expansion tank shall be installed in accordance with manufacturer's recommendations and as shown on the plans.

B. All hangers and supports required to support the expansion tanks shall be furnished and installed by the HVAC Subcontractor.

C. Install all trim associated with tank.

D. Most expansion tanks are provided with 12 psig bladder charge. Contractor shall increase charge pressure to achieve 15 psig at highest point of the system.

3.03 PIPING

A. Provide and erect in a workmanlike manner according to the best practices of the trade, all piping shown on the plans or required to complete the installation intended by these specifications.

B. This Subcontractor shall inform himself from the Architect's specifications and detailed drawings of the exact dimensions of finished work in all rooms where equipment or pipes are to be placed, and arrange his work accordingly, assuming all responsibility for conformity with the surrounding work.

C. In the erection of mains, special care must be used in their support and proper allowance shall be made for expansion.

D. All steel piping larger than 2" shall have welded joints made by experienced pipe welders. The joints shall all be well filled with metal without interior projections. After welds are made, this Subcontractor shall thoroughly clean inside and leave a smooth bore. Where connections are made on runs, weld-o-lets or thread-o-lets are to be used.

E. All other connections are to be made with screwed fittings.

F. In making welds, this Subcontractor is to have the end of the pipe properly beveled and perfectly lined up.

G. Keep plugged or capped all openings in pipes or fittings.

H. Connections to mains are to be provided with swing arms to provide for expansion.

I. Make such offsets as are shown or required to place pipes on risers in proper position or to avoid other work. Make such offsets neatly and properly locate them.

J. All pipe lines shall be provided with sufficient number of flange fittings or unions to make possible the taking down of the pipes without breakage of fittings. Lines 2" in diameter and less may be connected by R & L couplings, unless otherwise required by the Architect. All of the piping shall be erected so as to provide for the easy flow of water and noiseless circulation. Whenever pipes are cut, three wheel cutters are to be used and the pipes are to be carefully reamed out.

K. Due to the extreme limited headroom, all water mains shall be installed perfectly level or with minimum pitch. Install air vents on all high points and draw-off valves on all low points throughout the entire system.

L. The entire piping system shall be provided with shutoff valves and draw-off valves so that sections of the system may be drained without interrupting the entire system.

M. Extreme care shall be exercised in the location of all piping.

N. No crosses or bullhead tees shall be used in any part of the work.

O. Piping connections to all equipment shall be made with companion flanges, grooved mechanical couplings, or unions for ease in removal of equipment.

P. Provide approved pipe identification markers and flow direction arrows on all piping. Markers to be at 30 foot intervals, except in boiler room where they shall be at 10 foot intervals. Markers to be snap on type by BradySnap-on, Seton Snap-Around, or approved equal.

Q. Grooved joint piping systems shall be installed in accordance with the manufacturer's (Victaulic) guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by Victaulic. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing.

R. Vic Press 304™ Joints: Pipe shall be certified for use with the Vic Press 304™ system. Pipe shall be square cut, +/- 0.030", properly deburred and cleaned. Pipe ends shall be marked at the required location, using a manufacturer-supplied gauge, to ensure full insertion into the coupling or fitting during assembly. Use a Victaulic "PFT" Series tool with the proper sized jaw for pressing.

3.04 VALVES

A. Valves shall be installed where shown on plans and elsewhere as necessary for the proper operation or balancing of the systems.

B. At completion, this Subcontractor shall install min. 1-1/4” stamped brass tag on each valve held on with brass drain with numbers. This subcontractor is to make up schedule with number of each valve. Schedule to describe use of each valve. One copy of the schedule shall be framed under glass and hung in boiler room. Two more copies are to be supplied to the Architect.

C. Extreme care must be used in locating fin tube radiation valves and fittings in order that they shall be installed so as to be readily accessible.

D. Install on each coil, a key type compression air valve.

3.05 STRAINERS

A. Strainers shall be installed at all points shown on the plans. All strainers shall be cleaned prior to balancing, and again at completion of installation.

3.06 THERMOMETERS AND PRESSURE GAUGES

A. Thermometers and pressure gauges shall be installed at all points shown on plans. Care shall be exercised to install gauges and thermometers in locations that can be easily read.

3.07 PIPE HANGERS

A. Pipe hangers of the types specified shall be installed for the support of all piping. Maximum center-to-center hanger spacing shall be as follows, except as otherwise indicated on the Drawings.

Pipe Size	Max. Spacing
Up to 1-1/4 in.	5 ft. -0 in.
1-1/2 in. and 2 in.	8 ft. -0 in.

Pipe Size	Max. Spacing
2-1/2 in. and 3 in.	8 ft.-0 in.
Over 4 in.	10 ft. -0 in.

3.08 SLEEVES

A. Sleeves shall be installed for each pipe passing through masonry floors or walls.

3.09 ESCUTCHEON PLATES

A. Escutcheon plates shall be installed on all piping passing through finished floors, walls or ceilings. Escutcheon plates shall be sized for outside diameter of insulation and installed after insulation is completed.

3.10 SPECIALTIES

A. Specialties of the type specified shall be installed at points specified and elsewhere where shown on the drawings.

B. Air vent valves shall be installed at every high point throughout the system.

3.11 INSULATION

A. All of the insulation work shall be done by subcontractors regularly engaged in this type of work in a neat and workmanlike manner. All insulation shall be completely sealed with no glass fibers exposed to the air.

B. The entire hot water piping system, all refrigerant and condensate piping systems, and applicable ductwork systems, including piping, valve bodies, fittings, specialties, shall be carefully insulated throughout for thermal control and to prevent condensation. All insulated equipment which requires servicing shall be insulated with removable sections.

1. All piping insulation in mechanical room shall be enclosed in a PVC Jacket.

3.12 EQUIPMENT

A. Equipment shall be installed complete with all required hangers and supports in accordance with the manufacturer's recommendations.

B. Furnish and install all steel structural support members for proper hanging and support of equipment. Provide vibration isolation on all hangers.

C. Provide plastic tags with different color text for each piece of equipment. Tags and text shall clearly indicate equipment type and number (ex: B-1).

3.13 SHEET METAL WORK

A. All of the sheet metal work shall be done by subcontractors regularly engaged in this type of work.

B. Neatly erect all sheet metal work as shown on plans or as may be required to carry out the intent of these plans and specifications.

C. All necessary allowances and provisions must be made by this subcontractor in the case of beams, posts, pipes, iron work or other obstructions in the construction of the building or the work of other trades whether or not the same is shown on plans.

D. All ducts are to be rigid and are to be strongly and carefully supported with suitable braces or angles to keep them true to shape and to prevent buckling.

E. All joints are to be made tight and all interior surfaces are to be made smooth.

F. Protect all work under this Section from damage during the progress of erection and until final acceptance by the Architect.

G. All metal work in dead or furred down spaces is to be erected in time to occasion no delay in the work of other trades on the building.

H. Supply collars to diffusers shall be installed inside the neck of the diffusers. Dampers on all registers and diffusers shall be installed in the open position.

I. Joints in all ductwork throughout shall be sealed per Seal Class as specified in Ductwork in Section 2 of this specification. All ductwork shall be taped and sealed.

J. During the progress of the work and after the completion of the same, this Subcontractor shall remove from the premises all dirt, debris, rubbish, waste materials, and the like) cause by him in the performance of this work, together with all his tools and appliances.

3.14 VIBRATION ABSORPTION

A. All equipment and piping shall operate without objectionable or unusual noise or vibration, as judged by the Engineer.

B. Rotating equipment shall be fitted with such vibration-absorbing facilities as required to limit the transmission of vibration to the building and to the attached piping and breaching. The facilities shall be generally designed to limit this transmission to a maximum of 2%, but a greater amount shall be allowed if it does not prove objectionable. The facilities shall also be designed to limit equipment floor loading to 500 lb/square foot or less. If, in order to accomplish this, the equipment requires the job installation of isolation mountings, inertia blocks, special hangers or other arrangements, these shall be carefully and specifically selected for each piece of equipment.

C. Motor driven equipment shall have the motor, equipment and drive mounted on a common base. Hollow bed plates shall be grouted with a rich cement mortar.

D. Submit shop drawing data for approval by the Engineer showing the make, type, and size of isolation mountings, flexible pipe connectors, and other facilities to be provided, including any concrete inertia blocks that may be required. The data shall clearly indicate that the isolating arrangements limits the transmission of vibration as specified.

3.15 MISCELLANEOUS IRON AND STEEL

A. Provide steel supports and hangers required to support fans, tanks, air handling units, pipe, ductwork, and other equipment or materials. Submit details of steel supports and method of fabrication for approval.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets, and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be by experienced metal working mechanics. Members shall be straight and true and accurately fitted. Scale, rust, and burrs shall be removed. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other trades as directed by them.

D. Members shall be generally welded, except that bolting may be used for field assembly where welding would be impractical. Welders shall be skilled.

E. All shop-fabricated iron and steelwork shall be cleaned and dried and given a shop coat of paint on all surfaces and in all openings and crevices.

3.16 BALANCING, ADJUSTING, OPERATING, AND INSTRUCTIONS

A. Engage a balancing company to adjust, balance, and operate the heating, ventilating and air-conditioning system and thoroughly instruct the Owner's personnel in all phases of care and operation of the systems. The Balancing Company shall be certified by Associated Air Balance Council or by the National Environmental Balancing Bureau.

B. Before the air systems are tested and balanced, ducts and equipment shall be thoroughly cleaned by the subcontractor so that no dirt, dust, or other foreign matter can be deposited in or carried through the systems. For this purpose, cheesecloth shall be placed over each opening for entraining such particles during the cleaning operation.

C. The Balancing Company shall not perform water systems balancing until after the systems have been cleaned and treated by the subcontractor.

D. Rooftop units shall not be operated without filters in place. All filters shall be replaced by the subcontractor after rooftop units have been cleaned and ready for system balancing.

E. The subcontractor as a part of this contract shall provide all materials, labor, and service of all subcontractors for fulfillment of air and water balancing of all systems. The Balancing Company shall inform subcontractor of all requirements ahead of time.

F. All equipment shall be operated and adjusted and all air and water systems shall be adjusted and balanced, readings taken and recorded on an approved form submitted to the Engineer for approval, readjusted and balanced again in accordance with the Engineer's review comments and resubmitted.

G. Air Systems

1. Systems shall be adjusted and balanced so that air quantities at outlets are as indicated on the drawings and so that the distribution from supply outlets is free from drafts, and uniform over the face of each outlet.

2. Air balance to within 10% of the indicated air flows. Air balancing shall be achieved by the duct branch volume damper and not by the opposed blade dampers at the terminals.

3. Adjustments shall be made by the Balancing Company to volume dampers at air outlets to produce the least pressure drop consistent with volume requirements.

4. After completion of balancing and adjusting, settings of dampers, shall be permanently marked by the Balancing Company so that they can be restored if disturbed at any time.

5. Direct reading velocity meters may be used by the Balancing Company for comparative adjustment of individual outlets, but air quantities in ducts have velocity of 1,000 feet per minute or greater, shall be measured by means of pitot tubes and inclined gauge manometers. Instrument test opening enclosures as specified shall be provided as required.

6. Adjustment of the temperature controls shall be coordinated by the person in charge of the balancing and adjusting and shall be performed coincidental therewith. In conjunction with the Automatic Temperature Control System, simulate a complete cycle of operation for each system.

7. After completion of the testing, balancing and adjusting of the air systems, six copies of a report showing the following information shall be submitted to the Engineer for review and approval. The report shall be arranged as follows:

   a. Location of each air outlet or inlet.

   b. Dimensions or size of each outlet or inlet.

   c. Type: diffuser, grille, register, supply, return exhaust, and Ak value for each.

   d. CFM of air as indicated on drawings for each outlet or inlet.

   e. CFM of air as measured, after each complete system has been balanced and adjusted, for each outlet or inlet.

   f. After each complete system has been balanced and adjusted, the total cam at fan discharge, static pressure at fan outlet, total static pressure for apparatus, fan speed, motor amperage for each phase and voltage shall be listed.

H. Water System

1. Water circulating system shall be adjusted and balanced by the Balancing Company so that water quantities circulated through all coils, pumps, and other equipment can be as specified.

2. Water balance to within 10% of the indicated water flows.

3. Where no meters are provided, the adjustment of individual coil circuits shall be based on return water temperature, provided air balancing and adjusting has been satisfactorily completed first. Temperature control valves on each branch shall be wide open during the balancing. Adjustment of water flows through coils shall be based on manufacturer's pressure drop data. Balancing cocks and valves shall be set. The settings of cocks, valves, and the like, shall be permanently marked so that they can be restored if disturbed at any time.

4. The following shall be established and listed:

   a. Temperatures and water flow at the pumps and each coil after each complete system has been balanced and adjusted.

   b. Pressure drops, manufacturer's ratings, and water flow at each coil after each complete system has been balanced and adjusted.

   c. Suction and discharge pressures at each pump and total water flow at each coil after each complete system has been balanced and adjusted.

   d. Motor amperage for each phase and voltage at each pump.

I. The Balancing Company shall provide all instruments and accessories required to perform the tests.

J. Upon completion of the systems, during the first stages of the first cooling season, the Balancing Company shall operate the systems until temperatures in all areas are uniform. The period of time shall be no less than a five-day, forty-hour period. During these times, the Balancing Company shall keep at least two men on the job continuously, together with a man from the temperature control Sub-Subcontractor for the purpose of testing and balancing systems.

K. The subcontractor shall obtain from the manufacturer of each piece of equipment, five copies of lubrication, operating and maintenance data sheets and control system drawings. He shall prepare five complete sets of written coordinating operating and maintenance instructions into complete operating and maintenance manuals.

L. The balancing company shall demonstrate accuracy of information included in test report(s) by re-testing up to 10% of randomly selected points in the presence of the owner representative. The report(s) shall be rejected and new test required, at no additional cost to the owner, if more than 10% of readings are outside of the specified acceptance criteria. These tests shall satisfy Mass Energy Code requirements for acceptance testing of HVAC systems. These tests shall also verify information included in test report(s).

M. Refer to Section 019113 – Building Commissioning Requirements for additional requirements.

3.17 TESTING

A. All hot water and chilled water piping in whole or in part, prior to insulating and being closed in, shall be subject to a hydrostatic test pressure of 100-psig for eight hours without a pressure drop at the end of the test period. All leaks that occur shall be repaired by removing the joints in their entirety, rejoining, and test repeated as often as necessary until the piping system or systems are absolutely tight.

B. Furnish all necessary equipment to conduct the testing of the piping system.

C. Two pressure gauges shall be used whose range shall not exceed 0 to 150-psig, nor less than 0 to 120-psig. Evidence of leakage or pressure drop shall be cause for rejection.

D. A log of all tests shall be kept by the subcontractor. The log shall provide a description of the test or inspection, the date performed, and the signatures of the responsible subcontractor's person performing the work and the witnessing engineer. This log shall form part of the final documentation. Failure to maintain this log shall result in re-inspection or testing at the subcontractor's expense.

E. Per the requirements of NFPA-72 chapter 14, a differential pressure test shall be preformed for all duct smoke detectors by the Electrical subcontractor and HVAC subcontractor during the pretest and the final fire department test. Electrical subcontractor and HVAC subcontractor to submit a test report for all duct smoke detectors after both tests to the architect for approval. The Electrical subcontractor and HVAC subcontractor shall relocate all duct smoke detectors as required by the test results at no additional cost to the owner.

F. Refrigerant piping shall be testing to the equipment manufacturer’s requirements, including but not limited to pressure test, triple evacuation, and sign-offs.

3.18 BOILER/BURNER INSTALLATION

A. Boiler manufacturer shall provide the services of a representative to supervise the installing subcontractor with the assembly and erection of each Boiler. Upon completion, install each boiler in accordance with the manufacturer's instructions and of the Boiler assemblies, the Boiler manufacturer's representative shall certify the proper assembly and connection of each Boiler prior to startup.

B. Boiler drain valves shall be connected to the lowest water space available and shall be installed with pipe and fittings to connect the bottom blow off full size to drain. Furnish and install 3-inch by 1-1/2-inch eccentric reducer in the lower left or right hand tappings of the front section of each forced hot water Boiler, complete with a short nipple and blow off valve installed. Each blow off valve shall be Brass, ball type, not less than 1-1/2-inch minimum and rated equal to the pressure stamped on the Boiler and to a temperature rating of not less than 250°F and all blow down discharges shall be arranged so as to allow the Operator to view the water that is discharged to drain. Ends of blow down piping shall be cut at a 45-degree angle to prevent a cap or plug from being installed.

C. All boiler discharges shall be piped to floor drains or as indicated by the Consulting Engineer. Furnish and install all necessary pipe and fittings to connect the pressure relief valve discharge full size to floor drain. Discharge to be arranged so that there shall be no danger of scalding Boiler room personnel in the event of a pressure relief situation. Size and arrangement of discharge piping to be such that any pressure that may exist or develop shall not reduce the relieving capacity of the relief valve below that required to protect the Boiler. All such discharge piping shall be supported by hangar or standoff to prevent the valve body from undue stress or strain.

D. Installing subcontractor shall utilize capped tees at all turns in the return piping to the back section of each Boiler for cleaning of the return piping at or near each Boiler. Feed water, makeup water and/or water treatment shall be introduced into the Boiler water through the return piping only. Provisions shall be made for the expansion and contraction of all hot water mains connected to each Boiler by providing substantial anchorage at suitable points and by providing swing joints so there shall be no stress or strain transmitted to any Boiler. Stop valves shall be provided in the supply and return pipe connections to each Boiler permitting draining either Boiler without emptying the entire system.

E. After final assembly and connection, each Boiler shall be thoroughly cleaned internally following the manner described within the Boiler manufacturer's installation instructions, or by ASME Section VI, either method acceptable by the Engineer.

F. The process of cleaning the Boiler(s) shall include the use of a boil-out compound of Caustic Soda or Tri-Sodium Phosphate at the rate of one pound of either chemical per 50-gallons of total water in the system being cleaned. This cleaning shall include Boiler Cleanout, Surface Blow off, Blow down and a wash as directed and detailed in referenced instructions.

G. The process of cleaning the Boiler(s) shall be repeated as often as necessary and as directed by the Consulting Engineer to ensure that all mill scale, core sand, rust, dirt and debris, cutting oils and thread sealers or any other contaminants have sufficiently been eliminated from the Boiler(s) and to produce a condition of the Boiler water that is clean and considered acceptable to the Consulting Engineer.

H. All field tests after the Boiler(s) have been installed and connected to the system shall be limited to not more than 36-psi. Installing subcontractor shall furnish all equipment, piping, labor, staging, fittings, valves, hoses and other materials and shall pay all required permits for Inspection as may be required to perform such tests as may be directed by these Contract Documents and as required by the Consulting Engineer and the State Boiler Inspector.

I. An initial hydrostatic pressure test of 36-psi shall be conducted on each Boiler for a period of not less than 5 hours. Tests shall be of such duration as necessary and as directed by the Consulting Engineer to ensure that the Boilers have been installed and piped correctly with no leaks or other improper operating conditions.

J. Installing subcontractor shall contact and notify the State Boiler Inspector when the installation of the Boiler(s), Burner(s) and controls is substantially complete. Installing subcontractor shall request an inspection of the Boilers to be conducted by the State Boiler Inspector and to have a Certificate of Inspection issued upon satisfactory inspection.

K. After receipt of certificate of Inspection, Installing subcontractor shall furnish a suitable glass front frame in which to place said certificate. Frame, with Inspection certificate inserted therein, shall then be placed on or posted in a suitable location within the Boiler room in which the new Boilers have been installed.

L. Installing subcontractor shall maintain all apparatus in satisfactory operating condition. Perform periodic Burner tune-up and cleaning of the Boiler fireside surfaces when dirty, provide preventative maintenance, perform turndown tests, conduct tests for Flame Safeguard, Combustion Efficiency, Draft tests, Limit Control tests and Safety Valve tests, check the ignition system and adjust, repair or replace any as necessary while the heating system is under his ownership and control a and until such time as the Owner accepts the equipment, issues the Final certificate of Payment and assumes the full obligation of Ownership.

M. Installing subcontractor shall note that any Warranty Service (hereinafter specified) as may be absorbed by the authorized Service representative shall in no way absolve the Installing subcontractor from any and all responsibility for the Care, Service and Preventative Maintenance for Materials furnished to this Contract, while the Heating System is under his Control, and until final acceptance by the Owner.

N. Installing subcontractor shall guarantee the entire installation for a period of one year from the date of Owner Acceptance and beneficial usage by the Owner and Date of Final Payment.

3.19 BOILER COMMISSIONING

A. An authorized representative of the Boiler or Burner manufacturer shall perform the initial start-up, final adjusting and testing of the Burners and Controls in the presence of the Owners Operating Personnel.

B. The process of Start-Up and Commissioning shall include Purging of the Boiler; Burner Operation Tests, including CO sampling, Stack Temperature; CO2 sampling; Tests for Venting; Ignition Tests; Pilot Turndown Tests; Manifold Pressure Tests, Instruction to the Owner and all other such procedures as may be directed by the Consulting Engineer.

C. The final results of a Combustion Efficiency Test with all pertinent Combustion Data shall be logged onto a check sheet which shall be submitted to the Consulting Engineer to prove compliance with this Section of the Specifications and for Record purposes.

D. Combustion efficiency testing shall include no less than the following:

E. Clock and adjust Burner input at the Meter to establish correct rate of fire and set each Burner to rated input at High Fire. Provide all adjustments to both Primary and Secondary Air as necessary to ensure proper flame shape at 100% input with no direct impingement upon heating surfaces and with good quality combustion with not more than 0.04% CO in the flue gas analysis.

F. CO2 in the flue gas with recorded Gross and Net Stack Temperatures to establish stack loss value. Each Burner shall be set to operate at the overall best performance and combustion efficiency for which the equipment is designed and capable of.

G. Adjustment and checkout of all aquastat controls, limits, switches, operating controls, low water cutoff devices, pressure regulators, and combustion controls.

H. He shall supervise purging of the Boiler(s) and shall conduct Pilot turndown tests. All required tests for proper venting which shall include setting and adjusting the Boiler outlet damper to the Boiler manufacturer's specifications.

I. Provide instruction to the Owners Operating Personnel in the procedures to resolve a “Lockout” condition. Operating personnel shall also be instructed in the Operation and routine daily maintenance of the Burner and controls during the light off process. The Owner shall arrange to have the personnel who require training to be present at the light off.

J. Factory Authorized Service representative shall provide the initial Burner light off and one year of Warranty Burner service. This requirement shall not be waived, nor shall the responsibility for the Service Contract be assumed by any other party, unless previously approved by the Consulting Engineer in writing.

K. Authorized manufacturer's service representative shall furnish one year of Warranty Burner Service on the Burner(s) and Control(s) which shall commence from the Date of Original light off and shall continue Warranty Burner Service coverage up to and including the First Anniversary of Burner light off.

L. Warranty burner service shall include labor and materials to replace any parts or controls, which might fail in service as the result of a defect in materials or manufacture. Normal wear and tear on parts as the result of daily operation shall not be included as “no charge” items (nozzles, igniters, and similar items) and other such devices, which may require replacement as the result of operation during the Warranty Service Contract shall also not be included. Preventative maintenance, in the form of yearly tune-up and biyearly cleanings and adjustments shall be the responsibility of the Installing subcontractor throughout the duration of the Warranty Contract while the equipment is under his control. Preventative maintenance, cleaning and routine adjustments shall not be performed by the warranty service subcontractor but by the Owners obligated Service Company.

3.20 OPERATING AND MAINTENANCE INSTRUCTIONS

A. All operating equipment installed under this section shall be placed in operation and shall function continuously in an operating test for a period of one week without shutdown due to mechanical failure or necessity of adjustment. Prior to scheduling the Project Final Inspection and after completion of all installation and running adjustments, the HVAC Subcontractor shall perform all work required to place the equipment in complete operating condition to meet all requirements under this Specification.

B. During this running test prior, the HVAC Subcontractor shall deliver to the designated representative of the Owner, through the Architect, six complete sets of operating, service and replacement data for all equipment, which require operating maintenance or replacement and one copy of this literature shall be available during the instruction of the operating personnel while the other is checked for completeness by the Architect.

3.21 TRAINING

A. Conduct a training course for the maintenance and operating staff. The training period of 40 hours normal working time shall start after the system is functionally complete but before final acceptance tests. The training shall include all of the items contained in the operating and maintenance instructions as well as demonstrations of routine maintenance operations. The owner's Representative shall be given at least two weeks advance notice of such training.

B. During all working hours of the one-week operating test, the HVAC Subcontractor's instruction personnel shall be available for and provide thorough and detailed training to the Owner's operating and maintenance personnel in operation, maintenance and adjustment of all equipment installed. The instructions shall be videotaped by the Subcontractor. The master tape and one(1) copy shall be turned over to the Owner not more than 10 days following the completion of the training.

C. Give sufficient notice to the designated operating personnel of the owner in advance of this period. Upon completion of instruction, obtain from such representatives written verification on that which the above mentioned instruction has been performed, such verification to be forwarded to the Architect.

D. A factory-trained field representative shall provide on-site training for subcontractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Subcontractor shall remove and replace any improperly installed products.

3.22 BUILDING AIR QUALITY TEST POST-CONSTRUCTION

A. At substantial completion of construction, HVAC sub-contractor shall be responsible for performing air quality testing in accordance with LEED v4 – Indoor Air Quality Assessment credit.

B. Testing shall be performed by an appropriately accredited professional, using the current ASTM or ISO methods.

C. Determine air-testing Locations:

1. Air-testing locations shall be selected based upon the least amount of ventilation and greatest concentration of VOCs.

2. Test at least (1) location per ventilation system. There also must be a minimum of one test per floor.

3. Each testing area is limited to 5,000 square feet. Similar spaces, such as classrooms, can be sampled by testing one in seven. If a sampled space fails, all seven must be tested.

4. The gymnasium, Cafeteria and Media Center testing area limits are 50,000 square feet.

D. Ensure that the following procedures are followed at all test locations:

1. The measurement equipment must be positioned in the breathing zone, between 3-6 ft above the floor.

2. The test must occur during normal occupied hours, with the HVAC system starting at the normal start time and delivering outdoor air at the minimum rate.

3. The gravimetric method must be used for testing.

4. If a test fails, take corrective action (e.g., clean and flush out the space) and retest. The duration of any flush-out between tests is at the discretion of the project team.

E. Report to be provided by the subcontractor shall include:

1. Narrative describing procedures and how testing locations were determined.

2. Dates and results of each test.

3.23 COMMISSIONING

A. Refer to specification 0191132 for Commissioning scope.

END OF SECTION

Division 25
Building Automation System

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SECTION 250001

BUILDING AUTOMATION SYSTEM

(SUB SUB-BID REQUIRED – PART OF SUB-BID SECTION 230001 HVAC)

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SECTION 250001

BUILDING AUTOMATION SYSTEM

(SUB-SUB BID REQUIRED. PART OF SUB BID SECTION 230001-HVAC)

PART 1 - GENERAL

1.00 GENERAL REQUIREMENTS

A. Part A and Division 1 of Part B, Section 230001 HVAC, and Section 260001-Electrical, apply to work specified in this section. This Subcontractor is bound by the provisions of these Divisions and Sections and must familiarize himself with the terms of the above documents.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

C. Building Automation System (BAS) shall be made part of SUB BID SECTION 23001 – HVAC Section 230001 HVAC.

D. Building Automation System (BAS) shall be responsible for all work as defined in the SECTION 018623 – integrated automation performance requirements.

E. This contractor shall comply with all requirements as set forth in Section 019113 – General Commissioning

1.01 QUALIFICATIONS OF BIDDER

A. All bidders must be building automation subcontractors in the business of installing direct digital control building automation systems for a minimum of 5 years.

B. Bidder must have an office within 50 miles of the job site:

1. Staffed with minimum of ten (10) fulltime factory-trained and certified engineers capable of trouble shooting and maintaining all systems for the project.
2. Minimum of five (5) years of continuous factory authorized dealer or branch of the vendor listed below.

C. All bidders must be authorized distributors or branch offices of the manufacturers specified.

D. All bidders must have a trained staff of application engineers, who have been certified by the manufacturer in the configuration, programming and service of the automation system. The Installer shall have successfully completed the Control Systems Manufacturer's classes on the control system he is to install. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request. All systems design and programming shall be done by the bidder's staff and not subcontracted to a third party.

E. Acceptable Vendors: The below listed vendors are acceptable providing they meet the requirements of these specifications. The BAS shall be by one of the following or an acceptable approved equal:

1. Base specification is Delta
2. Or equal by Johnson Controls or Honeywell

F. Must use Open Protocol BACnet devices down to lowest components.

G. Experience with Tridium JACE product and Niagara platform.

H. Web based interface.

I. Successful installation and complying with minimum of five different municipalities which have established IT standards.

1.02 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 01 91 13 – Building Commissioning Requirements.

B. Complete installation and startup checks and functional tests according to Section 01 91 13 – General Commissioning and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per requirements of Section 01 91 13 and manufacturers written instructions/requirements.

E. All points shall be data logged as soon as they have been activated and shall be made accessible to the commissioning agent.

1.03 SCOPE OF WORK

A. Except as otherwise noted, the control system shall consist of all Building Network Controllers, Custom Application Controllers, Application Specific Controllers, workstations, routers, software, sensors, transducers, relays, control valves, control dampers, valve and damper operators, control panels, and other accessory equipment to fully provide all required control functions. Provide a complete system of electrical interlock wiring to fill the intent of the specification and provide for a complete and operable system. Except as otherwise specified, provide operators for equipment such as dampers if the equipment manufacturer does not provide these. Coordinate requirements with the various Subcontractors.

B. The BAS subcontractor shall review and study all HVAC drawings and all mechanical and electrical specifications to familiarize him with all equipment and sequences. BAS subcontractor shall provide all the required quantities and types of devices necessary to completely perform all sequences, whether or not such devices are explicitly shown on the drawings or specified. If any devices are not specified they shall be of the same high quality of specified components.

C. BAS submission shall be made after all equipment shop drawing has been processed. It is responsibility of BAS to include all control, whether it is installed by BAS or provided as part of the equipment, to fully understand the control system in its entirety and submit shop drawing including detailed sequence of all equipments. All such equipment shall include but not limited to chillers, boilers, packaged rooftop units, Kitchen demand control ventilation (DCV) system, ERU's heat wheel controller, and split DX systems. Following example requirements:

1. RTUs- indicate all control points, and indicate sequence of operation.
2. Boilers- indicate sequence of operation, primary and secondary pumps operations. Boiler plant shall be configured so that staging is done to assure the proper primary-to-secondary side flow cooperation (first boiler loaded to 80% before staging on the next boiler), time delay to continue flow after cycling off to prevent high temperature shut down. Indicate all control points.
3. Chillers- indicate all control points, and indicate sequence of operation including pump operation.
4. Split DX system- full integration to the BAS.
5. Kitchen DCV- full integration with kitchen hood exhaust and proper tracking of MAU with offset. Full Kitchen DCV system information shall be made part of the ATC submission, and ATC sub-subcontractor shall be responsible to fully integrate this system as part of the BAS.

D. All interlocking, wiring and installation of control devices associated with the equipment to be controlled shall be provided under this Contract. When the BAS system is fully installed and operational, the BAS subcontractor and representatives of the Owner shall review and check out the system and train the Owner's personnel. At that time, the BAS subcontractor shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications. The BAS subcontractor shall carry 40 hours of additional on-site programming to allow for field modifications that may be needed to optimize the various systems to fully conform to the requirements of these specifications and work with the actual operating conditions as installed.

E. The Subcontractor shall furnish and install a complete building automation system including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification. At a minimum, provide controls for the following:

1. Graphics, reports, trending, alarms and occupancy (occupied, unoccupied and warm-up/cool-down) schedules as appropriate for all equipment.
2. Interface with controls provided by equipment manufacturers through BACnet interface.
3. Supply, make-up air, and exhaust air handling units.
4. Supply, exhaust and return air fans.
5. Condensing units and condensers.
6. Air-conditioning units.
7. Pumps.
8. Variable Frequency Drives
9. Boilers.
10. Packaged Rooftop Units.
11. Hot water heating systems.
12. Finned tube radiation.
13. Elevator hoist way isolation damper.
14. Variable volume terminals including heating coils.
15. Fan coil units.
16. Filters.
17. Monitoring points for packaged equipment such as split AC units (via BACnet), and tanks, alarms, and similar items.
18. Monitoring for plumbing systems: gas meter gas consumption data logging, gas pressure data logging, water meter consumption data logging, domestic hot water supply temperature data logging, sump pump high water level alarm status. Refer to Plumbing drawings and specifications.

19. Monitoring points for electrical system: refer to electrical drawings, Section 018623 Integrated Automation Performance Requirements, and drawing 9.9.01 for requirements.

20. Full integration of lighting control system, as defined in Section 018623. Provided with Cat 6 cable and #16 twisted shielded pair for BACnet connection and integration to BAS.

21. Monitoring of Other Systems: temperature data logging of walk-in freezers and walk-in coolers.

22. Power and control wiring to all DDC devices, transformer, disconnects, control valves and dampers, BAS panels, and similar items. All power associated with BAS shall be on Emergency or Standby power. Intent is for all equipment to be able to be monitored during a power outage. If a piece of equipment is not on emergency power, the associated field controller shall be powered from an ATC panel that is on emergency power.

23. All other equipment scheduled or shown on drawings.

24. The Commissioning process requires the participation of Section 250001, Building Automation Systems, to ensure that all systems fulfill the functional and pre-functional requirements set forth in these construction documents. The general commissioning requirements and coordination are detailed in Section 019113 General Commissioning. Section 250001, Building Automation Systems, shall fulfill commissioning responsibilities assigned to division 25 in accordance with Section 019113 General Commissioning.

25. Refer to drawings 9.0.01 through 9.9.01.

F. Provide services and manpower necessary for testing of system in coordination with the HVAC Subcontractor, Commissioning Agent, Balancing Subcontractor and Owner's representative and in accordance with the acceptance testing plan and functional performance test narratives.

G. All work performed under this section of the specifications shall comply with all codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Subcontractor shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification shall govern. The Subcontractor shall obtain and pay for all necessary construction permits and licenses.

1.04 SYSTEM DESCRIPTION

A. The Building Automation System (BAS) shall consist of controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions. The intent is for the BAS to seamlessly connect devices throughout the building, regardless of sub-system type. Gateways shall not be used.

B. The ATC system shall be based on direct digital controls (DDC) system, based on native BACnet technology down to the lowest components, and shall comply with Web based interface.

C. Owner Requirements:

1. Point naming convention shall comply with City of Amesbury standards to assure that each point has unique identification.
2. The system shall be based on BACnet technology open contract to be compatible with the City's existing system.
3. Comply with owner's IT requirements and standards.

D. For this project the system shall consist of the following components:

1. Operator Workstation(s): The BAS Subcontractor shall furnish Operator Workstation Computers and printers as described in Part 2 of the specification. System monitoring and supervisory control shall be through the installation of graphical user interface (GUI) software applications through a fast interface/graphics sub-system. GUI workstations shall provide complete access to any point in the system at any time. Remote operator interfaces and configuration tools shall be supported in a client server fashion.
2. Custom Application Controllers (CAC):
    a. Provide the necessary quantity and types of Custom Application Controllers to meet the requirements of the project for control of the designated mechanical equipment. All controllers shall be seamlessly integrated utilizing the same network and the same programming language.
    b. Each controller shall be completely programmable and provide functionality based on I/O configuration rather than application. For example, the Custom Application Controllers shall have the ability to provide local lighting control.
    c. Each CAC shall operate completely standalone, containing all of the I/O (including 15% spare points of each type) and programs to control its associated equipment.
3. Application Specific Controllers (ASC):
    a. Provide the necessary quantity and types of Application Specific Controllers to meet the requirements of the project for control of the designated equipment. All controllers shall be seamlessly integrated utilizing the same network and the same programming language.
    b. Each ASC shall be capable of executing the required sequences of operation and provide the I/O point capacity and types as indicated on the drawings.
    c. Each ASC shall operate completely standalone, containing all of the I/O and programs to control its associated equipment.

4. Portable Computer and Service Tool: Provide one portable computer and one portable service tool for monitoring and testing of the BNCUs, CACs, and ASCs. The portable service tool to be for use by the balancing subcontractor. The Owner, upon completion of the project, shall retain the portable computer and service tool. If the BNCUs and CACs have integrated touch screen displays that allow the user to perform basic daily operations tasks, the service tool shall be returned to the BAS subcontractor upon completion of the project.

5. WEB Server: The BAS shall function as a WEB server to allow an operator to view and/or modify any point in the system via the Internet and/or the Owner's Intranet (coordinate this with the Owner). HTML pages shall be capable of being accessed via any computer connected to the Internet and/or company Ethernet backbone via standard Internet browser software after confirmation of authorized user name and password. Web based HTML graphics shall be identical to workstation. Provide a firewall for the BAS network. Systems requiring any version of the workstation software loaded on the accessing computer shall not be acceptable.

6. Modem: Modems shall be furnished for remote interrogation of the system after confirmation of authorized user name and password. Modems shall operate at a minimum of 56.6 KBaud and allow for access to the entire network of controllers.

1.05 WORK BY OTHERS

A. The BAS Subcontractor shall cooperate with other subcontractors performing work on this project necessary to achieve a complete and neat installation. To that end, each subcontractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work.

B. The BAS Subcontractor shall furnish all control dampers (not furnished by equipment manufacturers), control valves, sensor wells, flow meters and other similar equipment for installation by the HVAC Subcontractor.

C. The BAS Subcontractor shall provide field supervision to the designated subcontractor for the installation of the following:

1. Control dampers and valves.
2. Blank-off plates for dampers that are smaller than duct size.
3. Air and water flow monitoring stations.
4. Sheet metal baffle plates to eliminate stratification.
5. Location of all sensor wells and tappings in all piping and duct systems.

D. The Electrical Subcontractor shall provide:

1. All power wiring to motors, heat trace, and to junction boxes in mechanical rooms. All power wiring from the boxes to all BAS panels and devices, regardless of location, shall be by the BAS subcontractor.

2. Furnish smoke detectors and wire to the building fire alarm system. HVAC subcontractor to mount devices. BAS subcontractor to hardwire to fan shut down and BAS alarm.

3. Contact(s) from fire alarm system for opening of elevator shaft vent damper(s) for wiring by BAS subcontractor.

4. Contact(s) from standby generator for status of power (normal verses standby), for wiring to the control system by the BAS subcontractor.

1.06 CODE COMPLIANCE

A. Provide BAS components and ancillary equipment, which are UL-916 listed and labeled.

B. All equipment or wiring used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.

C. All wiring shall conform to the National Electrical Code and the Division 16 specifications – whichever is more stringent.

D. All smoke dampers shall be rated in accordance with UL 555S.

E. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.

F. Comply with FCC, Part 68 rules for telephone modems and data sets.

1.07 SUBMITTALS

A. Submittals shall be in accordance with Section 013300-Submittals.

B. All shop drawings shall be prepared in both hard copy and electronic form (in a standard format such as AutoCAD 2012 or newer). In addition to the drawings, the subcontractor shall furnish a CD/diskette containing the identical information. Drawings shall be B size or larger. See Section 230001 HVAC for additional requirements. Upon request, VAV INTERNATIONAL Engineers shall provide via email the CAD floor plan drawings for use by the BAS subcontractor. The drawings are diagrammatic and final floor plans and equipment locations are the responsibility of the BAS subcontractor.

C. Shop drawings shall include a riser diagram and floor plans depicting locations of all controllers, routers, hubs, workstations, and the like with associated network architecture and wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. “Typicals” to be allowed where appropriate. Wiring diagrams detailing interconnecting devices such as fan and pump starters, freezestats, smoke detectors, relays, and similar items, shall be provided for each system. Written narratives for all sequences shall be included. Any deviations from the original design shall be highlighted. A “Bill of Materials” list shall be provided for each system indicating part numbers, descriptions, manufacturer, and quantities of each component utilized.

D. Submittal data shall contain manufacturer's data sheets on all hardware and software products required by the specification and sequences. Valve, damper, and airflow station schedules shall indicate size, type, configuration, capacity, maximum pressure rating, pressure drop, maximum differential pressure shut-off capabilities, and name and location of all equipment served.

E. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, trends, alarms and configuration to be furnished with the workstation software. Provide complete information on user programming (commands, sequences, and similar items). Information shall be bound or in a three ring binder with an index and tabs.

F. Conform to the requirements of Section 013300-Submittals, for schedule and form of all submittals. Coordinate this submittal with submittals for all other finishes.

G. The Engineer shall make corrections, if required, and return to the subcontractor. The subcontractor shall then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made and the submittals are fully approved.

H. No work may begin on any segment of the project until submittals have been successfully reviewed for conformity with the design intent of the project.

1.08 SYSTEM STARTUP AND ACCEPTANCE TESTING

A. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS shall be tested against the appropriate sequence of operation. Successful completion of the system test shall constitute the beginning of the warranty period. A written report shall be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.

B. The BAS subcontractor shall submit their acceptance testing plan, pre-functional performance test forms and narratives, and functional performance test forms and narratives. The controls system shall not be accepted without the prior acceptance of the submitted documents noted herein.

C. The BAS subcontractor shall test and set in operating condition all equipment and systems. For major equipment such as chillers, boilers, and air handling units, this shall be done in the presence of the equipment manufacturer’s representatives, as applicable, and the Owner and Architect’s representatives. Coordinate with all required attendees.

D. All equipment startup and testing shall be done with concurrent presence of BAS subcontractor, HVAC subcontractor, equipment manufacturer and balancing subcontractor.

E. The BAS Subcontractor shall provide all manpower and engineering services required to assist the HVAC Subcontractor and Balancing Subcontractor in testing, adjusting, and balancing all systems in the building. The BAS Subcontractor shall have a trained technician available on request during the balancing of the systems. The BAS Subcontractor shall coordinate all requirements to provide a complete air balance with the Balancing Subcontractor and shall include all labor and materials in his contract.

1.09 TRAINING

A. The BAS subcontractor shall provide both on-site and classroom training to the Owner's representative and maintenance personnel using the BAS acceptance testing documents.

B. On-site training shall also include a minimum of 40 hours of hands-on instruction geared toward the operation and maintenance of the systems. Prior to training, the necessary lesson plans, training documents, handouts, and the like shall be provided with the curriculum outline, which shall include as a minimum:

1. System Overview.
2. System Software and Operation.
3. System Access.
4. Software features overview.
5. Changing set points and other attributes.
6. Scheduling.
7. Editing programmed variables.
8. Displaying and editing color graphics.
9. Running reports and trending.
10. Workstation maintenance.
11. Application programming.
12. Operational sequences including start-up, shutdown, adjusting and balancing.
13. Equipment maintenance.
14. System integration.

C. On site training shall include a minimum of 8 hours of hands-on instruction geared toward the daily operation of the systems.

D. Six months re-training: Provide 24 hours of on-site training six months after initial training is completed.

1.10 OPERATION AND MAINTENANCE MANUALS

A. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation, and parts procurement for the entire BAS. This documentation shall include specific part numbers and software versions and dates. A complete list of recommended spare parts shall be included with the lead time and expected frequency of use of each part clearly identified. These manuals shall be delivered to the Owner's representative within 2 months of the final approved submittals before substantial completion. (Refer to Section 017823-Operation and Maintenance Data.)

B. The preventative maintenance shall include all tasking, frequency, and special instructions required for a proactive preventative maintenance action plan.

C. Following project completion and testing, the BAS subcontractor shall submit "as-built" record drawings reflecting the exact installation of the system. The as-built documentation shall also include a copy of all application software both in written form and on CD/diskette.

1.11 WARRANTY

A. The BAS subcontractor shall warrant the entire system (parts and labor) for 12 months after successful system acceptance testing is accepted by Owner's Representative. Beneficial use by the owner may be an alternative method to begin the warrantee period (providing there is a minimum of 12 months left after successful system acceptance testing and system acceptance by Owner's Representative). During the warranty period, the BAS subcontractor shall be responsible for all software and hardware upgrades and revisions during normal workday schedule, and within 48 hours of notification if solution cannot be resolved via the remote or web-site connection, to provide and maintain complete and workable building control systems.

B. Updates to the manufacturer's software shall be provided at no charge during the warranty period.

PART 2 - PRODUCTS

2.00 SYSTEM ARCHITECTURE

A. General

1. The Building Automation System (BAS) shall consist of Building Network Control Units (BNCU) and associated Input/Output Unit Modules (I/O, as applicable), Custom Application Controllers (CAC), Application Specific Controllers (ASC), and Operator Workstations (OW)/File Server. The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN), if applicable, from a single ODBC-compliant database. The BAS shall have the capability to accommodate integration of and to other building sub-systems (fire alarm, security, card access, lighting, and similar items) as indicated on the drawings and detailed in the specifications.

2. Level 1 Network Description (BAS Network):

   a. Level 1, the main backbone of the system, shall be an Ethernet (ISO/IEC 8802-3) LAN/WAN. Building Network Control Units and Operator Workstations/File Server shall connect directly to this network without the need for Gateway devices.

3. Level 2 Network Description (Field Bus Level)

   a. Level 2 of the system shall consist of one or more field buses managed by the Building Network Control Units. The Level-2 field buses may consist of one or more of the following types:

      1) An RS-485 proprietary field bus (or “machine bus”) that supports up to 32 Input/Output Units (I/O) directly connected to a Building Network Control Unit. The I/O modules may be mounted within the BNCU or remotely mounted via a single twisted, shielded pair of wires.

      2) An RS-485 proprietary token-passing bus that supports a minimum 120 Custom Application Controllers or Application Specific Controllers.

      3) ANSI/ATA 878.1 Arcnet: Field bus utilizes RS-485 signaling. Both Custom Application Controllers and Application Specific Controllers may reside on this network bus (minimum of 60 devices).

      4) Master-Slave/Token Passing (ANSI/ASHRAE Standard 135-2001, BACnet): Field bus utilizes RS-485 signaling. Both Custom Application Controllers and Application Specific Controllers may reside on this network bus (minimum of 60 devices).

      5) EIA-709.1, LonTalk: Field bus utilizing LonTalk FTT-10a network protocol over twisted pair wiring. Both Custom Application Controllers and Application Specific Controllers may reside on this network bus (minimum of 60 devices).

B. BAS Configuration

1. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN), sharing a single workstation/file server (10/100 megabits/sec Ethernet). This enables workstations to manage a single LAN (or building), and/or the entire system with all devices being assured of being updated by and sharing the most current database. In the case of a single workstation system, the workstation shall contain the entire database – with no need for a separate file server.

C. Standard Network Support

1. All BNCUs and Workstations/File Server shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the BNCU's, Workstations/File Server shall be capable of using standard, commercially available, "off-the-shelf" Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems department as all devices shall utilize standard TCP/IP components.

D. Remote Communications

1. In addition to the above LAN/WAN architecture support, the same workstation software (front end) must be capable of managing remote systems via both the internet via WEB server capability and standard dial-up phone lines via modem as a standard component of the software.

E. System Expansion

1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same Level 1 and Level 2 controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
2. The BAS shall be expandable to interoperate with Lighting, Fire, Security and Access Control sub-systems at any time in the future utilizing "Open Protocol" standards such as ASHRAE/ANSI 135-2001 BACnet.
3. The system shall use the same application programming language or configuration software application for a given systems communications level controller (i.e. Operator Workstation, Building Network Control Units, Custom Application Controllers, and Application Specific Controllers).

F. Support For Open Systems Protocols

1. The BAS design shall include solutions for the integration of the following “open systems” protocols: ANSI/ASHRAE 135-2001 BACnet and digital data communication to third party microprocessors such as any equipment manufacturer’s controllers and variable frequency drives (VFDs).

   a. BACnet: The BAS shall, as a minimum, support the BACnet Interoperable Building Blocks (BIBBS) for Read (Initiate) and Write (Execute) Services as defined in the Data Sharing BIBBS as follows:

DS-RP-A, B
DS-RPM-A, B
DS-WP-A, B
DS-WPM-A, B

2. The system shall also provide the ability to program custom ASCII communication drivers, residing in the BNCU, for communication to third party systems and devices. These drivers shall provide real time monitoring and control of the third party systems.

2.01 BUILDING NETWORK CONTROL UNITS (BNCU)

A. General: Provide Level 1 Building Network Control Units to provide the performance specified in Part 1 of this Section. Each of these panels shall meet the following requirements.

1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based BNCUs to manage the global strategies required by this project.
2. The BNCUs shall have sufficient memory to support its operating system, database, and programming requirements with 50% spare capacity.
3. The BNCUs shall provide communications ports for connection of the Portable Computer and Portable Operators Terminal.
4. The operating system of the BNCUs shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
5. All BNCUs shall have battery-backed real time clocks.
6. Data shall be shared between all BNCUs.
7. Each BNCU shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

   a. Assume a predetermined failure mode.

   b. Generate an alarm notification.

B. Communications: Each Building Network Control Unit shall reside on the same Level 1 inter-network as the Workstations/File Servers. The network shall be on ISO 8802-3 (Ethernet) and support the Internet Protocol (IP). This network shall be provided by the BAS subcontractor and shall communicate with the Owner's network as defined by the Owner's IT department. Each BNCU shall also perform routing to a network of Level 2 Custom Application and Application Specific Controllers.

C. Environment: Controller hardware shall be suitable for the anticipated ambient conditions. Controllers used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 32 F to 120 F.

D. Serviceability: Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.

E. Memory: The Controllers shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

F. Immunity to Power and Noise: Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage. The Controllers shall contain surge protection and not require any external AC power signal conditioning.

2.02 CUSTOM APPLICATION CONTROLLERS (CAC)

A. General: Provide Level 2 Custom Application Controllers to provide the performance specified in Part 1 of this Section. Each of these panels shall meet the following requirements.

1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based CACs to manage the local strategies required by this project.
2. The CACs shall provide communications ports for connection of the Portable Operators Terminal.
3. The CACs shall have sufficient memory to support its operating system, database, and programming requirements with 50% spare capacity.
4. The operating system of the CACs shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
5. Each CAC shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
    a. Assume a predetermined failure mode.
    b. Generate an alarm notification.
6. All devices shall be BACNET.

B. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used in conditioned ambient shall be mounted in NEMA 1 type enclosures, and shall be rated for operation at 32 F to 120 F.

2. Controllers used outdoors and/or in wet ambients shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -30 F to 150 F.

2.03 APPLICATION SPECIFIC CONTROLLERS (ASC)

A. General: Provide Level 2 ASCs as required for this project. ASCs are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but shall be customized for operation with the specified sequences, within the confines of the equipment they are designed to serve. Applications are limited to small HVAC equipment such as VAV and CV terminal units (including fan powered), Unit Ventilators, Heat Pumps, Fan Coil Units, and other similar equipment.

1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.

a. VAV and CV terminal unit controllers shall include damper actuators with minimum torque of 35 in-lb, with override for manual positioning during start-up and servicing. Velocity sensors shall have an accuracy of +/- 5% of full range.

2. Each ASC shall contain sufficient I/O capacity and programming flexibility to control the target system.

3. The ASCs shall provide communications ports for connection of the Portable Operators Terminal.

4. All devices shall be BACNET.

B. Environment: The hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -30 F to 150 F.

2. Controllers used in conditioned ambients shall be mounted in NEMA 1 type rated enclosures. Controllers located where they shall not be disturbed by building activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. Exception: Use NEMA 1 enclosures and provide conduit for all wiring for systems that control any outdoor air dampers, or connect to the fire management or smoke control systems. All ambient controllers shall be rated for operation at 32 F to 120 F.

C. Serviceability: Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.

D. Memory: ASCs shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.

E. Immunity to Power and Noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

F. Transformer: Power supply for the ASCs must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type with all wiring by the BAS subcontractor.

2.04 COMMUNICATIONS

A. This project shall comprise of an Ethernet network for communications between Building Network Control Units and Workstations/File Servers.

B. The BAS subcontractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the controls system inter-network.

C. Remote operator interface via a 56kbaud or faster modem shall allow for communication with any and all controllers on this network.

D. Communications services over the inter-network shall result in operator interface and value passing that is transparent to the inter-network architecture as follows:

1. Connection of an operator interface device to any one controller on the inter-network shall allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, and the like, for all controllers shall be available for viewing and editing from any one controller on the inter-network.
2. All database values (i.e., points, software variable, custom program variables) of any one controller shall be readable by any other controller on the inter-network. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform inter-network value passing.

E. The time clocks in all controllers shall be automatically synchronized daily and automatically corrected for daylight savings time and leap years.

2.05 INPUT/OUTPUT INTERFACE (I/O)

A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.

B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage shall cause no damage to the controller. Provide a minimum of 15% spare I/O points of each type for BNCUs and CACs.

C. Binary (digital) inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.

D. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

E. Binary (digital) outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Binary outputs on custom and building controllers shall have 3-position (on/off/auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

F. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device.

2.06 OPERATOR WORKSTATION

A. General.

1. The BAS workstation software shall be configurable as either a single workstation system (with a local database) or multi-workstation system where the database is located on a central file server. The client software on multi-workstation system shall access the file server database program via an Ethernet TCP/IP network running at 10/100 MBPS.

2. All Workstations shall be Pentium 4 based personal computers operating under the Microsoft Windows 10 professional operating system. Provide all computers with virus protect (equal to the latest version of Norton Antivirus with 12-month upgrades) and all required cables. Workstation computers shall include tower case, 3-year on-site warranty, and be as manufactured by Dell (Dimension 4550), Gateway (E-6000 Deluxe) or equal by IBM or HP/Compaq. The application software shall be capable of communication to all Network Control Units and Standalone Digital Control Units, feature high-resolution color graphics, alarming, reporting, and be user configurable for all data collection and data presentation functions.

3. For multi-workstation systems, a minimum of 250 workstations shall be allowed on the Ethernet network along with the central file server. In this client/server configuration, any changes or additions made from one workstation shall automatically appear on all other workstations without the requirement for manual copying of files. Multi-workstation systems with no central database shall not be acceptable. Multi-workstation systems with distributed/tiered file servers and a central (master) database shall be acceptable.

4. Provide an uninterruptible power supply (UPS) system capable of operating the computer, monitor, printers, WEB server, and any other workstation components for at least 20 minutes. If power is not restored in 10 minutes, provide software to accomplish an orderly shutdown after saving all data in memory. The UPS shall also function as a surge suppressor and voltage regulator. UPS to be on standby power circuits.

5. Provide Lonmaker Integration Tool Professional Edition software for the workstation.

6. Coordinate workstation location with owner.

B. Workstation Requirements (Single workstation or multi-workstation configuration).

1. The workstations and file server shall consist of the following (as a minimum):

a. Minimum 3.06 GHz Pentium 4 processor with Hyper-Threading Technology

b. 1 GB DDR SDRAM at 333 MHZ minimum

c. One parallel port

d. One serial port

e. Six USB 2.0 ports (2 on front)

f. 10/100 MBPS Ethernet NIC

g. Two 200 GB ATA/100 7200 RPM hard drives

h. 48x/24x/48x speed CD-RW drive

i. 16x DVD-ROM drive

j. SXGA+ compatible, 19 in. flat panel wide angle LCD monitor

k. 128MB DDR accelerated 4X AGP video card equal to ATI Radeon 9700 Pro or NVIDIA GeForce4 Ti-4600G

l. Mouse

m. Full function keyboard

n. SoundBlaster compatible sound and speakers

o. License agreement for all applicable software

p. Workstation-compatible 56 Kbaud PCI modem

C. Printers: Provide an alarm printer and a separate report/graphics printer. The alarm printer shall be a tractor feed 24 pin Epson Model LQ-5703 dot matrix impact printer with 10,000 hour MTBF rating and 2-year warrantee or equivalent by Okidata or IBM. The report printer shall be a color inkjet type, HP 1220C series using both 8.5 in. x 11 in. and 11 in. x 17 in. paper with 2400 by 1200 dpi resolution capability and print speeds up to 11 ppm black and 9.5 ppm color, or equivalent model by Epson, Cannon, or Lexmark. Supply three boxes of printer paper each with a minimum of 2000 sheets. One (1) box each shall be for 8.5 in. x 11 in. tractor feed paper, 8.5 in. x 11 in. inkjet paper, and 11 in. x 17 in. inkjet paper. Provide two (2) spare ribbons and/or cartridges (of each color) of the largest capacity available for each printer.

2.07 PORTABLE OPERATOR'S COMPUTER AND SERVICE TOOL

A. Provide full screen, laptop operator's computer and a portable proprietary (or second laptop) service tool to communicate directly to all controllers. The laptop software shall enable users to monitor both instantaneous and historical point data, modify control parameters, and enable/disable any point or program in any controller on the network. The laptop shall be usable as a backup computer to the workstation/file server and shall include all workstation programs and capability (provide all required hardware/software for this). The service tool (or second laptop) shall be used by the balancing subcontractor and then turned over to the Owner.

B. The laptop computers shall be Mobile Pentium 4 based laptop computers operating under the Microsoft 2000 professional or XP professional operating system. Provide all computers with virus protect (equal to the latest version of Norton Antivirus with 12-month upgrades), surge protectors (equal to Belkin Surgemaster Gold), and all required cables. Laptop computers shall include carrying case, 3-year on-site warrantee, and be as manufactured by Dell (Inspiron 8200), Gateway (600XL) or equal by IBM, HP/Compaq, or Sharp. The application software shall be capable of communication to all Network Control Units and Standalone Digital Control Units, feature high-resolution color graphics, alarming, reporting, and be user configurable for all data collection and data presentation functions.

C. Laptop Computer Requirements

1. The laptops shall consist of the following (as a minimum):
    a. Minimum 2.4 GHz Mobile Pentium 4 processor with on-die 512KB cache and 32 KB internal L1 cache
    b. 1 GB DDR RAM at 266 MHz minimum
    c. 15 in. SXGA active matrix display
    d. 64MB DDR ATI Mobility Radeon 9000 or equal 4X AGP video
    e. Internal combo drive 24x/10x/24x speed CD-RW and 8x DVD
    f. Internal 200 GB Ultra ATA hard drive
    g. One parallel port
    h. One serial port
    i. Four USB ports
    j. Two Type II or one Type III PC card slots, capable of warm-swap
    k. Internal 10/100 MBPS Ethernet NIC
    l. Internal 56 Kbaud PCI modem
    m. CD/DVD drive.
    n. Internal SoundBlaster compatible sound card and speakers
    o. Keyboard and slide panel mouse device
    p. Charger/AC adapter
    q. External Mouse

r. External full function keyboard

s. Spare Lithium Ion battery

t. Advanced Port Replicator or Docking Station

u. License agreement for all applicable software

D. The portable service tool shall be the standard by the control system manufacturer (if proprietary) or a second laptop.

E. The laptop and service tool shall be able to connect to any Ethernet controller or standalone controller via a dedicated service port. From this single connection, the user shall be able to communicate with any other controller on the LAN.

F. The laptop and service tool shall limit operator access by passwords. The service tool must support, at a minimum, the following password-protected user types: Administrator, Modify Parameters, View Only.

G. The laptop and service tool software shall include built-in menus for viewing points by controller, enabling, disabling and viewing programs, configuring controllers, and communicating to other controllers on the network.

H. Provide Lonmaker Integration Tool Professional Turbo Edition installed on the laptop.

2.08 SYSTEM SOFTWARE

A. General Description

1. The software architecture must be object-oriented in design, a true 32-bit application suite utilizing Microsoft's OLE, COM, DCOM and ODBC technologies. These technologies make it easy to fully utilize the power of the operating system to share, among applications (and therefore to the users of those applications), the wealth of data available from the BAS.

2. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and set point adjustments.

3. Programming of controllers shall be capable of being done either off-line or on-line from any operator workstation. All information shall be available in graphic or text displays. Graphic displays shall feature visual effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

B. System Database

1. The files server database engine must be Microsoft SQL Server, or another ODBC-compliant, relational database program. This ODBC (Open Database Connectivity)-compliant database engine allows for an owner to utilize “their” choice of database and due to it’s “open” architecture, allows an owner to write custom applications and/or reports which communicate directly with the database avoiding data transfer routines to update other applications. The system database shall contain all point configurations and programs in each of the controllers that have been assigned to the network. In addition, the database shall contain all workstation files including color graphic, alarm reports, text reports, historical data logs, schedules, and polling records.

C. User Interface

1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user that has logged into the workstation software, through LAN or web based. This interface shall support the creation of “hot-spots” that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user’s “PC Desktop” – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, shall enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.

D. User Security

1. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 250 users to be configured per workstation. There shall be an inactivity timer adjustable in software that automatically logs off the current operator after the timer has expired.

E. Configuration Interface

1. The workstation software shall use a familiar Windows Explorer™-style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, and the like) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions. Object names shall not be required to be unique throughout the system. This allows consistency in point naming. For example, each ASC can have an input called Space Temperature and a set point called CFM Set point. The ASC name shall be unique such as VAV for LAB101. Systems requiring unique object names throughout the system shall not be acceptable.

2. The configuration interface shall also include support for template objects. These template objects shall be used as building blocks for the creation of the BAS database. The types of template objects supported shall include all data point types (input, output, string variables, set points, and the like.), alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of template object types shall be able to be set up as template subsystems and systems. The template system shall prompt for data entry if necessary. The template system shall maintain a link to all "child" objects created by each template. If a user wishes to make a change to a template object, the software shall ask the user if he/she wants to update all of child objects with the change. This template system shall facilitate configuration and programming consistency and afford the user a fast and simple method to make global changes to the BAS.

F. Color Graphic Displays

1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units). In addition operators shall be able to command equipment or change set points from a graphic through the use of the mouse. Requirements of the color graphic subsystem include:

   a. SVGA, bit-mapped displays. The user shall have the ability to import AutoCAD generated picture files as background displays. As a minimum graphics shall include: all mechanical equipment including each individual air handling unit, fan, chiller, pump, boiler; systems of equipment including chilled water system (chillers, pumps, control valves), hot water system (boilers, pumps, control valves); air handling systems (AHUs, associated fans, control dampers); floor plans showing equipment locations and visual indication of any rooms in alarm, with point and click selection of any room's system.

b. A built-in library of objects such as dampers, fans, pumps, buttons, knobs, gauges, ad graphs which can be “dropped” on a graphic through the use of a software configuration “wizard”. Objects shall be set up so that it is easy to visually see the state of the object (such as fan on or off). These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels. Using the mouse, operators shall be able to adjust set points, start or stop equipment, modify PID loop parameters, or change schedules.

c. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.

d. Graphic panel objects shall be able to be configured with multiple “tabbed” pages allowing an operator to quickly view individual graphics of equipment, which make up a subsystem or system.

e. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus shall be required.

G. On-Line Help and Training

1. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. Provide an interactive tutorial CD, which shall act as on-line training/help for the systems operator.

H. Automatic Monitoring

1. The software shall allow for the automatic collection of data and reports from any controller through either a hardwire or modem communication link. The frequency of data collection shall be completely user-configurable.

2. Data logging shall be as per City standards.

I. Alarm Management

1. The software shall be capable of accepting alarms directly from controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) shall be integrated into the overall alarm management system and shall appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.

a. Alarm management features shall include:

1) A minimum of twenty alarm notification levels. Each notification level shall establish a unique set of parameters for controlling alarm display, acknowledgment, keyboard annunciation, alarm printout and record keeping.

2) Automatic logging in the database of the alarm message, point name, point value, connected controller, timestamp, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement)

3) Automatic printing of the alarm information or alarm report to an alarm printer or report printer.

4) Playing an audible beep or audio (wav) file on alarm initiation or return to normal.

5) Sending an email, alphanumeric page, or phone call (by text to speech technology) to anyone listed in a workstation's email account address list on either the initial occurrence of an alarm and/or if the alarm is repeated because an operator has not acknowledged the alarm within a user-configurable timeframe. The ability to utilize email, phone and alphanumeric paging of alarms shall be a standard feature of the software integrated with the operating system's mail application interface (MAPI).

2. Individual alarms shall be able to be re-routed to a workstation or workstations at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.

3. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.

4. The font type and color, and background color for each alarm notification level as seen in the active alarm viewer shall be customizable to allow easy identification of certain alarm types or alarm states.

5. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.

J. Custom Report Generation

1. The software shall contain a built-in custom report generator, featuring word processing tools for the creation of custom reports. These custom reports shall be able to be set up to automatically run or be generated on demand. Each workstation shall be able to associate reports with any word processing or spreadsheet program loaded on the machine. When the report is displayed, it shall automatically spawn the associated report editor such as MS Word™.

2. Reports can be of any length and contain any point attributes from any controller on the network.

3. The report generator shall have access to the user programming language in order to perform mathematical calculations inside the body of the report, control the display output of the report, or prompt the user for additional information needed by the report.

4. It shall be possible to run other executable programs whenever a report is initiated.

5. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.

6. Standard Reports: The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the owner.

    a. Points in each controller.

    b. Points in alarm

    c. Disabled points

    d. Overridden points

    e. Operator activity report

    f. Alarm history log.

    g. Program listing by controller with status.

    h. Network status of each controller

K. Spreadsheet-style reports: The software shall allow the simple configuration of row/column (spreadsheet-style) reports on any class of object in the system. These reports shall be user-configurable and shall be able to extract live (controller) data and/or data from the database. The user shall be able to set up each report to display in any text font, color and background color. In addition the report shall be able to be configured to filter data, sort data and highlight data which meets user-defined criteria.

L. Dynamic Graphical Charting: The operator shall be able to select system values to be charted in real time. A minimum of three values at one time can be selected for each chart. The type of chart (bar, line, 3-D) shall be user selectable.

M. Clock Synchronization: The real time clocks in all building control panels and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks; daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable and for leap years.

N. Scheduling

1. It shall be possible to configure and download from the workstation schedules for any of the controllers on the network.

2. Time of day schedules shall be in a calendar style and shall be programmable for a minimum of one year in advance. Each standard day of the week and user-defined day types shall be able to be associated with a color so that when the schedule is viewed it is very easy, at-a-glance, to determine the schedule for a particular day even from the yearly view. To change the schedule for a particular day, a user shall simply click on the day and then click on the day type.

3. Each schedule shall appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.

4. Schedules shall be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation shall be automatically updated to the corresponding schedule in the controller.

O. Programmer's Environment: The programmer's environment shall include access to a superset of the same programming language supported in the controllers. Here the programmer shall be able to configure application software off-line (if desired) for custom program development, write global control programs, system reports, wide area networking data collection routines, and custom alarm management software. On the same screen as the program editor, the programming environment shall include dockable debug and watch bars for program debugging and viewing updated values and point attributes during programming. In addition a wizard tool shall be available for loading programs from a library file in the program editor.

P. Saving/Reloading: The workstation software shall have an application to automatically save and restore field controller memory files. This application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

Q. Data Logging (Trends and Histories): The workstation software shall have the capability to easily configure groups of data points with trend and history logs and display the trend log data. A group of data points shall be created by drag-and-drop method of the points into a folder. The trend and history log data shall be displayed through a simply menu selection. This data shall be able to be saved to file and/or printed. The operator shall be able to define a custom trend and history log for any data in the system. This definition shall include interval, start-time, and stop-time. As a minimum, any point may be recorded at user selected intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, once a month, or for change of value. Trend and history data shall be capable of being selected as either instantaneous at the time of recording or averaged between time intervals. All trends and histories shall start based on the hour. Each trend and history shall accommodate up to a minimum of 64 system objects. The system operator with proper password shall be able to determine how many samples are stored. Trend and history data shall be sampled and stored on the Building Controller and be archived on the hard disk monthly. BAS shall archive histories for a minimum of 24 months and shall prompt operator each January to archive each calendar year's data on a CD. Trend and history data shall be able to be viewed and printed from the operator

interface software. Trends and histories shall be viewable in a text-based format and graphically. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages. BAS subcontractor shall provide setup of custom histories as required for the listed reports.

R. Audit Trail: The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule.

S. Custom Application Programming: Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. The programming language shall have the following features:

1. The language shall be English language oriented and be based on the syntax of programming languages such as BASIC. It shall allow for free form or fill in the blank programming. Alternatively, the programming language can be graphically-based using function blocks as long as blocks are available that directly provide the functions listed below, and that custom or compound function blocks can be created.
2. A full screen character editor/programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete code from the custom programming. It shall also incorporate word processing features such as cut/paste and find/replace.
3. The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
4. The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and to observe any intermediate values and or results. The debugger shall also provide error messages for syntax and execution errors.
5. The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
6. The programming language shall support floating point arithmetic using the following operators: +, -, /, x, square root, and xy. The following mathematical functions shall also be provided: natural log, log, absolute value, and minimum/maximum value from a list of values.
7. The programming language shall have pre-defined variables that represent clock time, day of the week, and date. Variables that provide interval timing shall also be available. The language shall allow for computations using these values.

8. The programming language shall have ability to pre-defined variables representing the status and results of the System Software, and shall be able to enable, disable, and change the values of objects in the system.

T. PID Control: A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set point, and PID gains shall be user-selectable with an option for auto-tuning. The set point shall optionally be chosen to be a reset schedule.

U. Staggered Start: This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.

V. System Calculations: Provide software to allow instantaneous power (e.g. KW), flow rates (e.g. GPM) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window KW demand value. Provide an algorithm that calculates energy usage and weather data (heating and cooling degree days). These items shall all be available for daily, previous day, monthly and the previous month.

W. Anti-Short Cycling: All binary (digital) output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

2.09 DDC SENSORS AND POINT HARDWARE

A. Temperature Sensors

1. All temperature devices shall use precision thermistors or RTDs accurate to +/- 1 degree F over a range of –30 to 230 degrees F. Space temperature sensors shall be accurate to +/- 0.5 degrees F over a range of 40 to 100 degrees F. Outdoor air temperature sensors shall be accurate to +/- 0.5 degrees F over a range of -20 to 110 degrees F.

2. Space sensors shall be tamper proof type with temperature display, momentary contact input for override, local adjustment tab, and occupancy sensor. All space sensors shall measure temperature & humidity. Space sensors in public spaces shall not have any of the above inputs with exception of occupancy sensor. Submit samples for owner and Engineer approval. Standard space sensors shall be available in an off white enclosure for mounting on a standard electrical box. Temperature sensor may be combined with humidity or carbon dioxide sensor in one housing providing it meets the specifications listed above. Provide protective covers for space sensors in gymnasium and corridors.

3. Where manual overrides are required, the sensor housing shall feature both an optional means for adjusting the space temperature set point, as well as a push button for selecting after hours operation.

4. Where a local display is specified, the sensor shall incorporate either an LED or LCD display for viewing the space temperature, set point and other operator selectable parameters. Using built in buttons, operator shall be able to adjust set points directly from the sensor.

5. Duct temperature sensors shall incorporate a thermistor bead or RTD embedded at the tip of a stainless steel tube. Probe style duct sensors are useable in air handling applications where the coil or duct area is less than 14 square feet.

6. Averaging sensors shall be employed in ducts that are larger than 14 square feet. The averaging sensor tube must contain at least one thermistor or RTD for every 3 feet, with a minimum tube length of 12 feet. Sensors shall be accurate to +/- 0.5 F over their normal operating temperature range +/- a 20- degree margin. Example, for a heating/cooling air-handling unit that normally varies between 55 and 100 degrees F, the sensor shall have the stated accuracy over a range of 35 to 120 degrees F.

7. Immersion sensors employed for measurement of temperature in all chilled, condenser, glycol and hot water applications as well as steam and refrigerant applications shall incorporate a precision thermistor or RTD type sensor. “Smart” sensors (where called for) shall be RTD type and include either an LED or LCD display. Chilled water sensors shall be accurate to +/- 0.5 degrees F over their normal operating temperature range +/- a 20-degree margin. Condenser and hot water sensors shall be accurate to +/- 0.5 degrees F over their normal operating temperature range +/- a 20-degree margin. Example, for a hot water system that normally varies between 90 and 200 degrees F, the sensor shall have the stated accuracy over a range of 70 to 220 degrees F. Thermal wells shall be brass or stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications.

8. Outside Air Temperature Sensors: Utilize precision thermistor or RTD-type units. Sensors shall be designed to withstand the environmental conditions to which they are to be exposed. Sensor enclosure shall allow for adequate air flow over the sensing element. Housing shall be NEMA-3R construction as a minimum.

B. Electric Thermostats

1. Provide low temperature thermostats (freezestats) as indicated on drawings. Low reading freezestats shall register alarm and be wired to shut down the associated fan system when temperature along any 1 of element falls below set point. Manual reset shall be required. Provide 1 ft. of element for every square foot of coil face area. Minimum adjustable range shall be 34 to 46 degrees F with an initial set point of 38 degrees F, unless listed otherwise on the drawings. Freeze-stats shall be automatic reset type with DDC interface and with proper time delay to prevent nuisance trips.

2. All controls shall be DDC.

C. Humidity Sensors

1. Humidity devices shall be thin film polymer type accurate to +/- 3% at full scale for space and +/- 3% for duct and outside air applications. Suppliers shall be able to demonstrate that accuracy is NIST traceable. Acceptable manufacturers include Vaisala, General Eastern or Staefa.
2. Provide a hand held field calibration tool that both reads the output of the sensor and contains a reference sensor for ongoing calibration.

D. Pressure Sensors

1. Air pressure measurements in ranges up to 0 to 10 in. water column shall be accurate to +/- 1% using a solid-state sensing element. Select the smallest range applicable to the use of the sensor. Sensors shall be bi-directional for room pressure monitoring. Acceptable manufacturers include Modus Instruments, Setra and Mamac.
2. Differential pressure measurements of liquids or gases shall be accurate to +/- 0.5% of range. Housings shall be NEMA 4 rated.
3. Provide wind baffles for outdoor pressure sensor locations and indoor locations where there can be turbulence.

E. Current and KW Devices

1. Current devices shall be used to monitor fans, pumps, motors and electrical loads. Current devices shall be available in solid and split core models, and offer either a digital (switch for on-off status of constant speed equipment) or an analog (sensor for status of VFD driven equipment) signal to the automation system. Current switches shall be capable of differentiating between free-wheeling (belt breakage) and normal motor load. Acceptable manufacturers are Veris, Siemens, or approved equal.
2. Measurement of three-phase power shall be accomplished with a kW/kWH transducer. This device shall utilize direct current transformer inputs to calculate the instantaneous value (kW) and a pulsed output proportional to the energy usage (kWH). Provide Veris Model 6000 Power Transducer, the equivalent by Siemens or approved equal.

F. Water and Glycol Flow Sensors

1. Provide where indicated insertion vortex flow meters for measurement of liquid and steam flows in pipe sizes above 3 inches. Below 3 in. shall be in-line type with isolation valves and manual bypass.
2. Install the insertion flow meters on isolation valves to permit removal without process shutdown.
3. Sensors shall have local readout and 4 to 20 mA output to the control system. Sensors shall be as manufactured by EMCO or approved equal.

G. Airflow Measuring Stations

1. Provide thermal dispersion velocity meters using bio-medical grade self heated thermistor sensors with thermistor temperature sensors. Each sensing point shall independently measure airflow and temperature prior to averaging.
2. The flow stations shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% of reading. Sensors shall be calibrated to NIST-traceable standards for both airflow and temperature. Installed accuracy shall be percent of reading and demonstrated at both maximum and minimum airflow rates for each measurement location.
3. The output signal shall be field selectable and linear with field adjustable scales, and shall include 0-10 VDC and 4-20 mA.
4. Furnish Ebtron GTA116-Pc airflow stations or approved equal.

H. Carbon Dioxide Sensors

1. Provide wall and duct mounted non-dispersive infrared type carbon dioxide sensors where indicated on drawings. Sensors shall have a field selectable 4 to 20 mA or 0 to 10 VDC linearized output signal over a 0-2000 ppm range (set point shall normally be between 600 and 1200 ppm). Power requirement shall be 24 VAC or 24 VDC. Units shall operate in an environment of at least –20°F to 120°F temperature range and 0 to 95% RH. Accuracy shall be +/- 5% of reading or +/- 75 ppm, whichever is greater. Repeatability shall be +/- 20 ppm. Annual drift shall not exceed 75 ppm. Response time shall not exceed 2 minutes. Enclosure shall be an attractive high impact plastic case. Sensors, providing they meet these specifications, shall be as manufactured by R.E. Technologies, Engelhard, Texas Instruments, Enmet Canada Limited, ToxAlert, AirTest, MSA, or approved equal.

2.10 CONTROL VALVES AND ACTUATORS

A. Provide automatic control valves suitable for the specified controlled media (water or glycol). Provide valves that mate and match the material of the connected piping. Equip control valves with the actuators of required input power type and control signal type to accurately position the flow control element and provide sufficient force to achieve required leakage specification. Valves shall be one of the types (globe, butterfly, or ball) and construction listed in the Division 23 HVAC valve specification for the system's fluid and temperature/pressure limits. Valves shall be manufactured by one of the listed manufacturers (in the HVAC valve specification) or, providing they meet all specified requirements, Belimo, Bray, Fisher, Honeywell, Johnson, TAC or Siemens/Staefa.

B. Control valves shall meet the heating and cooling loads specified, operate against the normal expected differential pressure without any shortening of life, and close-off against the maximum differential pressure condition for the application (typically pump shut-off head) with a 25% safety factor. Valves should be sized to operate accurately and with stability from 10 to 100% of the maximum design flow. Two-position (open/close) valves shall be full line sized. Unless specified elsewhere, the maximum pressure drop for modulating water/glycol systems shall be 4 psi (minimum pressure drop shall be 1 psi), and for modulating steam shall be 50% of the inlet pressure (7.5 psi for a 15 psig steam system) providing the required equipment inlet pressure is met.

C. Trim material shall be stainless steel for steam and high differential pressure applications.

D. Valve actuators shall be electronic direct coupled over the shaft, enabling it to be mounted directly to the valve shaft without the need for connecting linkage. Actuators shall have electronic overload circuitry to prevent damage. Actuators shall have visual position indicators. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Spring shall be capable of easy field change from normally open to normally closed. Actuators shall have an external manual gear release (above 60 in-lb torque, provide manual crank) to allow manual positioning of the valve when the actuator is not powered. Modulating actuators shall be positive positioning and respond to a 2 to 10 VDC or 4 to 20 mA operating range. Actuators on all valves 3 in. and larger shall provide a position feedback signal indicating valve position wired to the BAS and indicated on the graphics. Outdoor mounted actuators shall have NEMA 4 enclosure and shall have same voltage heaters to prevent condensation. Indoor actuators near (within 4 feet) of outdoor air streams shall have NEMA 2 enclosures. Actuators shall be sized for the maximum flow and differential pressure available (such as shut-off head of the associated pump or maximum steam pressure) plus a minimum 25% safety factor. Submit sizing calculations with the shop drawings. Actuators shall be as manufactured by Belimo, Bray, Siemens, or approved equal.

2.11 CONTROL DAMPERS AND ACTUATORS

A. Automatic dampers, furnished by the Building Automation Subcontractor shall be low leakage and include all required linkages, supports, actuators, switches. Dampers are to be installed by the HVAC Subcontractor under the supervision of the BAS Subcontractor. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet Metal Subcontractor. Control dampers shall be designed for operation in a temperature range of -25°F and 180°F.

B. Damper blade width shall not exceed six inches unless otherwise noted on drawings. Blade and frame seals shall be replaceable extruded silicone, EDPM, or PVC coated polyester (for low velocity dampers only) on blade edges, TPE or stainless steel compression at jambs. Seals and linkages shall provide tight closing, low leakage dampers.

C. Dampers installed on fan discharges shall be oriented such the blades are perpendicular to the fan shaft, this shall minimize pressure drop due to uneven airflow from the fan. Unless otherwise noted, provide opposed blade dampers for modulating applications and parallel blade for two-position control. Dampers, providing they meet the requirements of these specifications, shall be as manufactured by Ruskin, Arrow, TAMCO (T. A. Morrison), American Warming and Ventilating, Vent Products, Greenheck, Honeywell, or Johnson Controls. Note that not all manufacturers may make all types of dampers. Ruskin model numbers are used to indicate the minimum acceptable quality for each type of damper.

D. Dampers for use in galvanized steel duct systems shall be either galvanized steel, stainless steel or aluminum. Dampers for use in aluminum duct systems shall be either aluminum or stainless steel. Dampers for use in stainless steel duct systems shall be either stainless steel or baked heresite coated aluminum (with no steel or galvanized steel parts).

E. Low pressure control dampers (on up to 2 in. pressure class ductwork) with velocities up to 1,500 fpm shall be flat blade type designed for a minimum of 2.5 in. differential pressure (all sizes) and up to 2,000 fpm face velocity. These are designated as low pressure dampers. Maximum size of modules for large dampers shall be 4 ft. x 4 ft. (could be pressure limited) with an AMCA certified leakage rate not exceeding 3.7 CFM/SF at 1 in. w.g. static pressure differential. Where larger dampers are needed (either dimension), incorporate mullion supports (same material as damper frame) designed to prevent failure or deformation of the damper assembly up to a differential pressure of 4 in. w.g. Maximum pressure drop of a fully open 2 ft. x 2 ft. damper at 1,500 fpm shall not exceed 0.08 in..

F. Aluminum Dampers:

1. Low Pressure Dampers: Frames and single thickness blades shall be constructed of not less than 0.080 in. thick extruded aluminum, type 6063-T5 with minimum 4 in. deep frame. Linkage hardware shall be installed in frame side and be constructed of aluminum and corrosion resistant, zinc & nickel-plated steel (stainless steel for use in stainless steel duct systems). Coordinate with manufacturers for inclusion of thrust collars and other special requirements where vertical blades are required (such as fan discharges). Aluminum low pressure control dampers shall be equal to Ruskin Type CD51.

G. Steel Dampers:

1. Low Pressure Dampers: Frames shall be a minimum of 5 in. deep, 1 in. high, 13 gauge galvanized steel hat channel (stainless steel for use in stainless steel duct systems) or 16 gauge with corner reinforcements to equal 13 gauge strength. Single thickness blades shall be a minimum of 16 gauge galvanized steel (stainless steel for use in stainless steel duct systems). Linkage hardware shall be installed in frame side and be constructed of corrosion resistant, zinc & nickel-plated steel (stainless steel for use in stainless steel duct systems). Coordinate with manufacturers for inclusion of thrust collars and other special requirements where vertical blades are required (such as fan discharges). Steel low pressure control dampers shall be equal to Ruskin Type CD36.

H. Damper actuators shall be electronic direct coupled over the shaft, enabling it to be mounted directly to the damper shaft with a “V” shaped toothed cradle (to minimize slippage) without the need for connecting linkage. Actuators shall have electronic overload circuitry to prevent damage. Actuators shall have position indicator. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Spring shall be capable of easy field change from normally open to normally closed. Actuators shall have an external manual gear release (above 60 in-lb torque, provide manual crank) to allow manual positioning of the damper when the actuator is not powered. Modulating actuators shall accept a 0 to 10 VDC or 0 to 20 mA control input and provide a 2 to 10 VDC or 4 to 20 mA operating range. All actuators on dampers larger than 2 square feet shall provide a position feedback signal (such as 2 to 10 VDC) indicating damper position, wired to the BAS and indicated on the graphics.

I. Actuators for dampers mounted in up to 2 in. pressure class shall be sized for a minimum 2,500 fpm velocity and 2 in. differential pressure with a minimum 15% safety factor. Actuator for dampers mounted in higher pressure class ductwork shall be sized for 4,000 fpm velocity and a differential pressure equal to the duct design pressure with a minimum 15% safety factor. Show actuator sizing calculations on submittals. Actuators shall be as manufactured by Belimo, Siemens, or approved equal.

PART 3 - EXECUTION

3.00 CONTRACTOR RESPONSIBILITIES

A. General

1. Installation of the building automation system shall be performed by this Subcontractor or his subcontractor(s). However, all installation shall be under the personal supervision of the HVAC Subcontractor. The BAS Subcontractor shall certify all work as proper and complete. Under no circumstances shall the design, scheduling, coordination, programming, training, and warranty requirements for the project be delegated to a subcontractor.

B. Code Compliance

1. All wiring shall be installed in accordance with the more stringent of all applicable electrical codes, equipment manufacturer's recommendations, and wiring specifications in Section 260001 - Electrical.

C. Cleanup

1. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of grease, plaster, or other foreign materials.

3.01 WIRING, CONDUIT AND CABLE

A. All wire shall be copper and meet the minimum wire size and insulation class listed below:

Wire Class	Wire Size	Isolation Class
Power	12 Gauge	600 Volt
Class One	14 Gauge Std.	600 Volt
Class Two	18 Gauge Std.	300 Volt
Class Three	18 Gauge Std.	300 volt
Communications	Per Mfr.	Per Mfr.

B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

D. Where wiring is required to be installed in conduit, EMT shall be used unless indicated otherwise on the Drawings or as required by Division 26 specifications. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

E. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

F. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

G. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management or smoke control systems shall be in conduit.

H. Coaxial cable shall conform to RG62 or RG59 rating. Provide plenum rated coaxial cable when running in return air plenums.

I. Ethernet 10/100 Base –T network wiring shall be equivalent to Owner's premise wiring or, as a minimum, Category 5 cabling.

J. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.

K. Only glass fiber is acceptable, no plastic.

L. Fiber optic cable shall only be installed and terminated by an experienced subcontractor. The BAS subcontractor shall submit to the Engineer the name of the intended subcontractor of the fiber optic cable with his submittal documents.

3.02 HARDWARE INSTALLATION

A. Installation Practices for Wiring

1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
2. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run shall include a separate hot, neutral and ground wire. The ground wire shall terminate at the breaker panel ground. This circuit shall not feed any other circuit or device.
3. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.

4. Wires shall be attached to the building proper at regular intervals such that wiring does not droop. Wires shall not to be affixed to or supported by pipes, conduit, ducts. Supports shall be at 8 foot maximum.

5. Conduit in finished areas, shall be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.

6. Conduit, in non-finished areas where possible, shall be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit shall run parallel to or at right angles to the building structure.

7. Wires shall be kept a minimum of three (3) inches from all piping.

8. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.

9. Wire shall not be allowed to run across telephone equipment areas.

B. Installation Practices for Field Devices

1. Well-mounted sensors shall include thermal conducting compound within the well to insure good heat transfer to the sensor.

2. Actuators shall be firmly mounted to give positive movement and linkage shall be adjusted to give smooth continuous movement throughout 100 percent of the stroke.

3. Relay outputs shall include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.

4. Water line mounted sensors shall be removable without shutting down the system in which they are installed.

5. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.

6. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building with a shield to prevent distortion of reading due to wind.

C. Enclosures

1. For all I/O requiring field interface devices, these devices where practical shall be mounted in field interface panels (FIP). The Subcontractor shall provide an enclosure, which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.

2. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.

3. FIP enclosures shall be of steel construction with baked enamel finish, NEMA 1 rated with hinged doors and keyed locks. The enclosures shall be sized for twenty percent spare mounting space. All locks shall be keyed identically.

4. All wiring to and from the FIP shall be to labeled screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.

5. All outside mounted enclosures shall meet the NEMA-4 rating.

6. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

D. Identification

1. Identify all control wires with labeling tape or sleeves using words, letters, and/or numbers that can be exactly cross-referenced with as-built drawings.

2. All I/O field devices inside FIP's shall be clearly labeled.

3. Junction box covers shall be marked to indicate that they are a part of the BAS system.

4. All enclosures (including controllers), all I/O field devices (except space sensors), all control valves and actuators, all routers and other field devices that are not mounted within FIP's shall be identified as follows:

a. Identification shall be with Bakelite nameplates. The lettering shall be in white against a black or blue background, be keyed to the as built drawings, and indicate that the device is a control device.

E. Location

1. The location of sensors shall be per mechanical and architectural drawings. Coordinate with installing subcontractor to provide appropriate straight upstream and/or downstream runs for accurate readings of mixed temperatures or flows.

2. Space humidity, carbon dioxide or temperature sensors shall be mounted away from machinery generating heat, direct light and diffuser air streams.

3. Outdoor air temperature sensors shall be mounted on the north building face directly in the outside air. Install outdoor temperature and humidity sensors with solar radiation/precipitation shields to minimize the effects of heat radiated from the building or sunlight and from rain.

4. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.03 SOFTWARE INSTALLATION

A. General: The subcontractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

B. Database Configuration: The subcontractor shall provide all labor to configure those portions of the database that are required by all systems and their respective sequence of operation.

C. Color Graphics: Unless otherwise directed by the owner, the subcontractor shall provide color graphic displays for each system and floor plan. Due to limitations on monitor size, some systems may need to be divided into multiple graphics. Provide hot links to all associated graphics for easy switching. For each system or floor plan, the display shall contain the associated points identified in the sequence and submitted point list and allow for set point changes. Color shall be used to highlight conditions that are out of range or in alarm.

D. Reports: The subcontractor shall configure a report for each system as well as overall energy usage and demand reports. As built software documentation shall include the following as a minimum:

1. Descriptive point lists.
2. Application program listing.
3. Application programs with comments.
4. Printouts of all reports.
5. Alarm list.
6. Printouts of all graphics.

3.04 SYSTEM STARTUP AND ACCEPTANCE TESTING

A. Cooperate and coordinate with all trade subcontractors in the start-up of all BAS controlled and monitored equipment, as well as during the testing, balancing, and acceptance of the systems. Work with the balancing subcontractor to verify readings from the BAS agree with field measurements (such as VAV box flows) and that final set points for items such as differential pressure sensors (for VFD control) are not too high or too low for all downstream components to reach design flow.

B. Point to Point Checkout: Each I/O device (both field mounted and located in FIPs and FOPs) shall be inspected and verified for proper installation and functionality (such as fan status and valve positioning). A pre-functional performance test checkout sheet itemizing each device shall be filled out, dated and approved by the Owner's Project Manager for submission to the Owner.

C. Controller and Workstation Checkout: A field checkout of all controllers and front-end equipment (computers, printers, modems) shall be conducted to verify proper operation of both hardware and software (including automatic switching to back-up computer – where called for in specs). A pre-functional performance test checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the Owner's Project Representative by the completion of the project.

D. System Acceptance Testing

This subcontractor shall coordinate with requirements of building commission scope of work.

1. All application software shall be verified and compared against the specified sequences of operation in both normal and failure modes. Control loops shall be exercised by inducing a set point shift of at least 10% and observing whether the system successfully returns the process variable to set point. Record all test results and attach to the Functional Performance Test Results Sheets and submit to Owner's Representative.
2. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, and the like). Submit a Functional Performance Test Results Sheet to the Owner's Representative.
3. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, that the computer readings (flows, temperatures, and similar criteria) match field readings, and that any special features work as intended. Submit a Functional Performance Test Results Sheet to the Owner's Representative.
4. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information. Submit a Functional Performance Test Results Sheet to the Owner's Representative.
5. Perform an operational test of the web server and modem by testing all graphics and systems (including alarm acknowledgement) from remote locations. Submit a Functional Performance Test Results Sheet to the Owner's Representative.
6. After the above tests have been completed and the system has demonstrated to function as specified, a 30-day performance test period shall begin. If all systems perform as specified throughout the test period, requiring only routine maintenance, submit a Functional Performance Test Results Sheet for each system to the Owner's Representative and the BAS system shall be accepted. If any system fails during the test, and cannot be fully corrected within 8-hours, the owner may request that the performance test be repeated and delay acceptance until all systems pass.

3.05 SEQUENCES OF OPERATION

A. Sequences of operation shall be as shown on drawings. If any items are not shown, include BAS manufacturer's standard sequences.

B. Where any portion of the sequence of operations cannot be performed by the Boiler, Air Handlers, or Chiller packaged controllers, the BMCS shall assume responsibility to achieve that portion of the sequence

3.06 COMMISSIONING

A. Pre-Functional Checklists

1. Pre-functional checklists assist in the process to document that the equipment and systems are installed properly.
2. The subcontractor to be provided with construction checklists from the CA for completion. The subcontractor shall complete the checklists as provide the CA with completed copies in accordance with Section 019113.
3. See attached for a sample pre-functional performance test checklist, attached is included only to provide sample of a typical process and scope.

B. Functional Performance Testing

1. Intent of functional performance testing is to prove thru functional test procedures proper system operation.
2. The subcontractor to be provided with functional performance test procedures to perform while CA witnesses. The subcontractor shall perform functional tests in accordance with Section 019113.
3. See attached for a sample functional performance test checklist, attached is included only to provide sample of a typical process and scope.

C. Prefunctional Checklists and Functional Performance Testing

1. Pre-Functional Checklists and Functional performance testing procedures shall be performed on the following system types. (Pre Functional and Functional performance testing requirements are in addition to and do not replace any testing required elsewhere in Section 250001 or by applicable codes.) Equipment specifically marked as such below shall be provided with start-up of equipment by factory-authorized service representative.
    a. Building Automation System

D. Sample Checklists

1. See Attached

Functional Test

BUILDING AUTOMATION SYSTEM

IMPORTANT:

Please refer to the Master Deficiency and Resolution Log for deficiencies discovered and resolved pertaining to control issues. For quick reference you shall find, in the front of this section a list of Master Deficiency and Resolution Log items pertaining only to this section.

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. A Statement of Correction to be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

2. Prerequisite Checklist

a. Ensure that all of the associated equipment under BMS control/monitoring is started up and is ready for functional testing.

b. All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final set points and schedules with debugging, loop tuning and sensor calibrations completed.

c. Safeties and operating ranges reviewed.

d. Schedules and set points implemented.

e. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures.

f. Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).

g. Subcontractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.

3. Installation Checks

Check if Okay. Enter comment or note number if deficient.

Check **Equip Tag➔**	BAS	COMMENT
BMS Controllers and Control Cabinets		
Permanent labels affixed		
Shielded wiring used on electronic sensors		
Areas or equipment panels served clear on control drawings		
Panel location and Number identified on As-Built Drawings		
General appearance good, no apparent damage		
BAS connection made to labeled terminal(s) as shown on drawings		
Wiring labeled inside panels (to controlled components)		
Control Wiring to all control devices, thermostats, operators.		
Environmental conditions according to manufacturer's requirements		
110 volt AC power available to panel		
Front End Computer (Workstation)		
System Graphics are installed and functioning		
Correct mapping of points and descriptors verified		
System date and time correct		
Surge suppression in place and operable		
Battery backup in place and operable		
Check trend logging		

The checklist items of Part 3 are all successfully completed for given trade ☐ ***YES*** ☐ ***NO***

END OF SECTION

Division 26
Electrical

SECTION 260001

ELECTRICAL

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ELECTRICAL
(Filed Sub-Bid Required)

PART 1 – GENERAL

1.00 TIME, MANNER AND REQUIREMENTS FOR SUBMITTING SUB-BIDS

A. Trade Contractor Bids (filed Sub-bids) shall be submitted in accordance with provisions of the General Laws (Ter. Ed.), Chapter **149 Section 8,** inclusive, as amended. The time and place for submission to Sub-Bids shall be set forth under INSTRUCTIONS TO BIDDERS.

B. Each Trade Bid filed with the Awarding Authority must be accompanied by BID BOND, CASH, or CERTIFIED CHECK, or a TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company, payable to the **City of Amesbury**, in the amount stipulated in the INSTRUCTIONS TO BIDDERS. A Trade Bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Each Trade Bid submitted for the work, under this SECTION, shall be on a form furnished by the Awarding Authority, as required by SECTION 44F of Chapter 149 of the General Laws, as amended.

D. If the Sub-Contractor intends to use sub-trade subcontractors to perform any portion of the trade work other than the customary sub-trade classes of work listed in Paragraph 1.1(E), above, the Sub-Contractor shall list on the bid form the names of each such sub-trade subcontractor and each respective sub-trade subcontract sum unless: (a) the value of the sub-trade subcontract is less than Twenty Five Thousand Dollars ($25,000), or (b) the sub-trade subcontract is not subject to the provisions of G.L. c. 149, §§ 44A-J.

E. Section 260001 includes section 260001 and the following systems.

1 – NETWORK LIGHTING CONTROL SYSTEM.	Section 260943
2 – EMERGENCY RADIO COMMUNICATION SYSTEM	Section 265561
3 – STRUCTURED CABLING SYSTEMS	Section 270100
4 – AUDIO-VIDEO COMMUNICATIONS SYSTEM	Section 274000
5 – DISTRIBUTED COMMUNICATION SYSTEM	Section 275000
6 – INTEGRATED SECURITY SYSTEMS	Section 281000

F. Additional Requirements

1. Sub-bidders' attention is directed to MGL Chapter 149 p44H, as amended, which provides in part as follows:

2. Each sub-bidder shall list in Paragraph E of the "Trade Contractor Bid Form" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the specification for that sub-trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the specified requirements of the Awarding Authority that he does customarily perform such class of work with persons on his payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

3. The following sections shall be listed on the bid form as Paragraph E filed sub bid sections.

STRUCTURED CABLING SYSTEMS	Section 270100
AUDIO-VIDEO COMMUNICATIONS SYSTEM	Section 274000
DISTRIBUTED COMMUNICATION SYSTEM	Section 275000
INTEGRATED SECURITY SYSTEMS	Section 281000

G. Work to be performed under this SECTION is shown on Contract Drawings numbered:

General:	G.0.01 through G.0.07, inclusive.
Landscape/ Civil:	1.0.01 through 1.8.03, inclusive;
Structural:	2.1.00 through 2.6.03, inclusive
Architectural:	3.4.01 through 5.8.01, inclusive;
Food Service:	6.1.00, 6.1.01, 6.1.02
Fire Protection:	7.2.01 through 7.5.01, inclusive
Plumbing:	8.2.01 through 8.6.01, inclusive
HVAC:	9.0.01 through 9.9.01, inclusive
Electrical:	10.0.01 through 10.3.13, inclusive

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this trade.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure a steady progress of all work under Contract.

D. When referred to, standard specifications of technical societies, manufacturer's associations, and federal agencies shall include all amendments current as of the date of issue of these Specifications.

1.02 SCOPE OF WORK

A. The scope of the work under this Section, without limiting the generality thereof, includes all materials, labor, equipment, services and transportation, unless otherwise specified, necessary to complete all systems of electrical wiring and equipment specified by the Drawings and/or specified herein. It is the intent of this Section of these Specifications and accompanying Electrical Drawings to cause these Systems to be furnished complete in every respect. The Electrical Subcontractor shall furnish all wiring, equipment, staging, access panels, and labor needed and usually furnished in connection with such work, whether specifically mentioned of not.

B. The structure and its appurtenances, clearance, and the related services such as Plumbing, Heating, Ventilating, Air Conditioning and Electrical provisions have been planned to be legal, adequate and suitable for the installation of the equipment specified under this Section. The Owner will not assume any increase in cost caused by differing requirements peculiar make or type of equipment, and any such incremental cost must be included in this Section.

C. The fire stopping of all electrical penetrations through fire resistance rated wall, partitions, floors and ceilings shall be a part of the Electrical Subcontract. The electrical contractor shall provide all required fire/smoke stopping for all electrical penetrations through all fire rated partitions and all corridor walls.

D. This Section 260001 Subcontractor shall provide, install and maintain in a safe adequate condition all staging, scaffolding and hoist equipment that is necessary for the proper executing of the work of this section.

E. This Section 260001 Subcontractor shall perform all cutting, coring required for the work of this section, for holes 5’ in diameter or less.

F. The Commissioning process requires the participation of Section 260001 - Electrical, to ensure that all systems fulfill the functional and pre-functional requirements set forth in these construction documents. The general commissioning requirements and coordination are detailed in Section 019113 – General Commissioning Requirements and Section 280800 Commissioning of Electrical Systems. Section 260001-Electrical, shall fulfill commissioning responsibilities assigned to Section 260001 in accordance with Section 019113 - General Commissioning Requirements and Section 26080 Commissioning of Electrical Systems.

G. LEED-S Requirements:

1. The work of this section includes material and submittal requirements for fulfillment of Project LEEDv4-S Certification. LEEDv4-S Certification at LEED SILVER is an Owner Requirement that is critical to secure project funding from the Massachusetts School Building Authority. LEEDv4-S requirements for the work of this Section are detailed herein, and additionally in Section 018113 of this Project Manual.

2. For all adhesives, sealants, paints, coatings, and insulation, meet the LEED requirements for IEQ Credit 2 Low Emitting Materials and as defined in Section 018113 - SUSTAINABLE DESIGN REQUIREMENTS.

3. Light fixtures and lighting controls shall meet the LEED requirements for Sustainable Sites Credit 6 for Light Pollution Reduction.

4. The Work shall meet the energy performance requirements for LEED Energy and Atmosphere Prerequisite 2 and Credit 1.

5. Light fixtures and lighting controls shall meet the LEED requirements for Indoor Environmental Quality Credit 6 for Interior Lighting.

I. Refer to the applicable Trade Contractor Bid Forms for additional information and scope of work.

J. The electrical contractor shall provide the scope of work for the Structured Cabling System, Audio-Visual Communication, Integrated Security System, Distributed Communication Systems, Network Lighting Control System, and Emergency Radio Communication System as shown in the electrical and technology specifications including sections 260001 1.02 and 1.03 and as shown on the electrical drawings.

K. Responsibilities of the Electrical Contractor for STRUCTURED CABLING SYSTEMS, AUDIO-VIDEO COMMUNICATIONS SYSTEM, DISTRIBUTED COMMUNICATION SYSTEM, INTEGRATED SECURITY SYSTEMS scope of work: The Electrical Contractor shall be responsible for providing and installing all related building preparation including, but not limited to: power, cableways, J hooks, cable supports, conduits with bushings, outlet boxes, conduit stubs with bushings, sleeves with bushings (all electrical equipment including but not limited to conduits, stubs, sleeves, shall be brought to an accessible hallway ceiling), including but not limited to backboxes, plaster rings, pull strings, bonding, grounding, for a completely operational system, as specified. Refer to the Electrical Drawings for additional information on scope of work. The electrical contractor shall furnish and install two 2" conduits from every office in the admin suit to the adjacent corridor.

1.03 RELATED WORK UNDER OTHER SECTIONS

A. Section 01 91 13 – General Commissioning

B. Painting of electrical conduits, surface metal raceways, pull boxes, hangers, panelboard doors and trim, and all other electrical equipment to match the surrounding finish as directed by the Architect, shall be done by the Section 090007 - Painting.

C. All electric motors shall be furnished and set in place by the trade requiring same and shall be wired by the Electrical Subcontractor.

D. All control devices, including thermostats, pneumatic-electric switches, electric-pneumatic switches, aquastats, fire detection thermostats, flow switches, freeze protection controls and alternators required for the automatic temperature control system shall be furnished and installed under Section 250001 – Building Automation System Section of these Specifications, unless otherwise indicated on the Electrical Drawings.

E. All automatic temperature control wiring, including wiring for all control devices shall be furnished and installed under Section 250001 – Building Automation System Section of these Specifications, unless otherwise indicated on the Electrical Drawings.

F. All electrical interlock wiring and remote control wiring required for the Heating, Ventilating, Air Conditioning and Plumbing Systems shall be furnished and installed under the Electrical Section to the extent shown on the Electrical Drawings. All interlock and control wiring not specifically shown on the Electrical Drawings but required for correct operation of the Heating, Ventilating, Air Conditioning and Plumbing Systems shall be included as work under the Heating, Air Conditioning and Plumbing Sections of these Specifications.

G. All excavating, back-filling, wood form work, reinforcing rods, and concrete work specified for the installation of all electric underground manholes, ductlines and conduits shall be done under Section 312000 – Earthwork, Section 033000 – Cast-in-place Concrete, and Section 321313 Site Conctrete. Manholes and ductlines shall be constructed in accordance with the details shown on the Electrical Drawings.

H. Refer to each Section of these Specifications for equipment furnished by Heating, Ventilating, Plumbing and equipment Subcontractor requiring connections and installation under this Subcontract. All equipment delivered to this Subcontractor for installation shall be clearly marked for location by the Supplying Subcontractor. The Supplying Subcontractor shall be responsible for all tests after the electrical connections are completed.

I. All flow alarm switches and tamper switches specified for the sprinkler system shall be furnished and installed under Section 210001 - Fire Protection of these Specifications and wired under the Electrical Section.

J. The flashing of all electrical conduits passing through roofs shall be done under Section 070002 - Roofing and Flashing.

K. The General contractor shall construct under Section 033000 - Cast in Place Concrete, and Section 321313 Site Concrete the concrete pad for the main switchboard, pad mounted transformer, step down transformers and CT cabinet in accordance with the details shown on the Electrical Drawings.

L. All excavating, back-filling and concrete work for the roadway, parking and walkway lighting shall be provided under Section 312000 – Earthwork and Section 321313 site Concrete.

M. The General contractor shall pay the cost of the electrical energy consumed by all trades during the construction period and this contractor shall provide temporary lighting and power. Refer to Section 015000 - Temporary Facilities and Controls.

N. The applicable contractor shall install all access panels furnished by the Electrical Subcontractor. Electrical contractor shall coordinate all equipment that needs to be installed in ceilings or walls with the applicable contractor.

O. Magnetic contact switches in doors for intrusion alarm system shall be furnished and wired under this section and installed flush in doors and door frames under Section 081113 - Hollow metal work and Section 080001 - Metal Windows.

P. The Electrical Contractor shall coordinate the installation of any electrical equipment associated with Door Hardware with the Door Hardware Contractor.

1.04 SHOP DRAWINGS

A. Prepare and submit complete shop drawings in accordance with requirements of Section 013300 - Submittals and in the manner described herein.

B. Shop drawings and catalog cuts shall indicate Specification Section and paragraph requiring equipment submitted.

C. Shop Drawings shall include all necessary wiring diagrams of all equipment. Shop drawings shall be required of all motor starters, disconnect switches, receptacles, lighting switches, main switchboard, emergency generator, transfer switch, lighting fixtures, lighting and power panelboards, relays, conduit, wire, fire alarm system, fire seals, sound system, floor boxes, dimmers, lighting track, underfloor duct, manholes, ductlines, surface metal raceways, scoreboards, shot timers, intrusion alarm system and auditorium dimming system.

D. Shop drawings of heavy equipment shall specify requirements, loads imposed upon the building structure, and all other information necessary to, and affecting the work of others, and the building structure.

E. Provide complete manufacturer's operating equipment manuals, diagrams and other data to such persons as directed by the Owner for the operation and maintenance of this equipment.

F. Three (3) additional copies of all shop drawings, fixture cuts, brochures shall be incorporated into the operating and maintenance manuals.

G. LEED for Schools Submittals: (Refer to SECTION 013300 - Submittals):

1. Relevant supporting documentation, as specified by LEED for Schools v4 and as detailed in Section 018133 – Sustainable Design Requirements.
2. A completed LEED MATERIALS REPORTING FORM, per Section 018113 – Sustainable Design Requirements.
3. Product substitution requests are subject to additional LEED-S submittal requirements, see SECTION 012500 – SUBSTITUTION PROCEDURES.

1.05 SAMPLES

A. Submit samples of all materials as requested by the Architect.

B. Samples shall be prepared and submitted in accordance with requirements of Section 01300 - Submittals with all postage and transportation costs paid by the Contractor submitting same.

1.06 PERMITS, LAWS AND ORDINANCES AND CODES

A. The work shall be executed in full accordance with the current rulings of the latest edition of the Massachusetts Electrical Code and all state and local rulings. Where codes conflict, the more stringent shall apply. Any changes necessary to the Drawings and Specifications, as submitted for bid, required to make conformity to any of the above state authorities shall be called to the attention of the Architect by this Subcontractor at the time of his Bid, otherwise he shall be held financially responsible for all work necessary for an approved installation. If this Subcontractor performs any such work knowing it to be contrary to any such laws, rules or regulations, he shall assume all costs arising therefrom to make conformity to such above rulings.

B. This Subcontractor shall obtain the necessary permits for construction and approval of the plans by the necessary authorities and shall obtain all other permits, licenses or certificates of approval, arrange for all inspections and pay all fees and charges connected therewith. This Subcontractor shall, at the completion of the job, furnish the Architect with a certificate of inspection of the work from the authorities having jurisdiction. Contractors are responsible to file for and obtain required permits and call for inspections. All other permits and fees are in force and are the responsibility of the applicable Contractors.

C. No work shall be covered before examination and approval by the Architect and by all inspectors and authorities having jurisdiction. Replace any imperfect or condemned work with work conforming to requirements and satisfactory to the Architect, without extra cost to the Owner. If work is covered before due inspection and approval, this Subcontractor shall pay all costs of uncovering and reinstalling such work.

D. In addition to the Massachusetts Electrical Code and the local inspection authorities, the electrical work shall be executed in full accordance with the Occupational Safety and Health Administration's latest requirements for "Safety and Health Regulations for Construction".

1.07 RECORD DRAWINGS

A. This Subcontractor shall furnish and keep on the job at all times, one (1) complete and separate set of blackline prints of the electrical work on which shall be clearly, neatly and accurately noted, promptly as the work progresses, all architectural and electrical changes, revisions and additions to the Project. The Electrical Subcontractor shall incorporate all electrical and architectural revisions issued by the Architect. The Electrical Subcontractor shall document his work on these drawings during construction. Wherever work is installed otherwise than as shown on the Contract Drawings, such changes shall be noted.

B. Indicate daily progress on these prints by coloring in various conduits, fixtures, apparatus and associated appurtenances as they are erected.

C. No approval of requisition for work installed will be given unless supported by record prints as specified above.

D. At the conclusion of work, prepare Record Drawings in accordance with the requirements Section 017700 - Project Closeout and Section 017839 – Project Record Documentation. The Electrical Subcontractor shall submit to the Architect a complete set of Electrical Record Drawing using CAD. Submit one set of drawings and a CD-ROM with a complete set of drawings files. Drawings files shall be in the DWG format and shall be Autocad 2010 compatible.

1.08 OPERATING INSTRUCTION AND MAINTENANCE MANUALS

A. This Subcontractor shall instruct to the Owner's specified requirements such persons as the Owner designates, in the proper operation and maintenance of the systems and their parts. Submit to the Architect, a letter naming the person or persons so instructed and the dates of such instruction.

B. This Subcontractor shall video tape all instructions given to the Owner on the proper operation and maintenance of the electrical systems installed under the electrical subcontract. Provide up to twelve (12) hours of video taped instructions and three (3) copies of the video taped instructions shall be given to the Architect for transmittal to the Owner. All video taped instructions shall be done in accordance with the requirements of Section 017700, Project Closeout and Section 017823 – Operation and Maintenance Data and Section 017900 Demonstration and Training.

C. Furnish operating and maintenance manuals in accordance with Section 01700 - Project Closeout and forward same to the Architect for transmittal to the Owner. These manuals shall be bound.

D. The operating instructions shall be specific for each system and shall include copies of posted specific instructions.

E. For maintenance purposes, provide shop drawings, parts lists, specifications and manufacturer's bulletins for each piece of equipment.

F. Provide name, address, and telephone number of the manufacturer's representative and service company for each piece of equipment so that service or spare parts can be readily obtained.

1.09 GUARANTEE

A. The manufacturer shall provide their standard guarantee for work under this Section; however, such guarantees shall be in addition to and not in lieu of all liabilities which the manufacturer and contractor may have by law or by other provisions of the Contract Documents.

B. All materials, items of equipment and workmanship furnished under this Section shall carry the standard warranty against all defects in materials and workmanship for a period of not less than one (1) year. Any fault due to defective or improper material, equipment, workmanship or design which may develop within that period shall be made good, forthwith, by and at the expense of the Electrical Subcontractor, including all other damage done to areas, materials and other systems resulting from this failure.

C. The Electrical Subcontractor shall guarantee that all elements of the systems are of sufficient as set forth or as indicated.

D. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Electrical Subcontractor.

E. Furnish before the final payment is made, a written guarantee covering the above requirements.

F. A lamp shall be furnished and installed in each lighting fixture as soon as fixtures are properly hung. Replace all lamps that fail within ninety (90) days after final acceptance at no additional cost. If the Electrical Subcontractor fails to replace such lamps during the above named guarantee period after a second request, the Owner may replace such lamps and back charge the Electrical Subcontractor.

1.10 EXAMINATION OF SITE AND CONTRACT DRAWINGS

A. Before submitting prices or beginning work, thoroughly make an examination of the site and Contract Documents.

B. Bidders are advised to visit the site and inform themselves as to the conditions under which this work will be performed. Failure to do so will in no way relieve the successful bidder from the responsibility of furnishing any material or performing any work in accordance with the true intent and meaning of the Drawings and Specifications.

C. No claim for extra compensation will be recognized if difficulties are encountered which an examination of site conditions and Contract Documents prior to executing the Contract would have revealed.

D. The Electrical Subcontractor should inspect the location and length of conduit and duct runs, and the location of equipment installation mentioned in these Specifications.

E. The Electrical Subcontractor shall be responsible for ordering and furnishing the correct length of material required. The lengths shown on the Drawings are approximate only and are not warranted to be accurate.

1.11 WORKMANSHIP

A. The entire work provided in this Specification shall be constructed and finished in every respect in a workmanlike and substantial manner. It is not intended that the Drawings shall show every pipe, fitting and appliance, but the Electrical Subcontractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best trades practice and to the specified requirements of the Architect.

B. This Subcontractor shall keep other Subcontractors fully informed as to shape, size and position of all openings required for his apparatus and shall give full information to the General contractor and other Subcontractors sufficiently in advance of the work so that all openings may be built in advance. Furnish and install all sleeves, support hereinafter specified or required.

C. In the case of failure on the part of this Subcontractor to give proper notice and timely information as noted above, the Electrical Subcontractor shall do his own cutting and patching at his own expense.

D. This Subcontractor shall obtain detailed information from the manufacturers of apparatus as to the proper method of installation and connecting same. He shall also obtain all information from the General contractor and the other Subcontractors which may be necessary to facilitate his work and the completion of the whole project.

E. Remove daily to a central location on site, all rubbish and debris and all refuse from workmen' lunches and at completion, remove all surplus materials, temporary works and construction plant and leave all work in clean condition, acceptable to the Architect.

1.12 PROTECTION

A. Each Subcontractor shall be responsible for his work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

B. Each Subcontractor shall protect work and material of other trades from damage that might be caused by his work or workmen and make good damage thus caused.

1.13 TESTS

A. Furnish all labor, material, instruments, supplies and services and bear all costs from the accomplishment of the tests herein specified. Correct all defects appearing under test and repeat the tests until no defects are disclosed; leave the equipment clean and ready for use.

B. All grounds, crosses, shorts must be eliminated from the wiring. Test out all lighting fixtures, together with switches and controls, test the operation of all motors, controllers and other electrical equipment devices. Each piece of electrical equipment, including lighting fixtures, motors and controls shall be operated continuously for a period of not less than one (1) hour in the presence of the Architect or his authorized representative, before acceptance.

C. The Electrical Subcontractor shall perform all tests other than herein specified which may be specified requirements by legal authorities or by agencies to whose requirements this work is to conform.

1.14 ABBREVIATIONS

UL	Underwriters' Laboratories, Inc.
NFPA	National Fire Protection Association
IEEE	Institute of Electrical & Electronic Engineers
ASTM	American Society for Testing and Materials
NEMA	National Electrical Manufacturers Association
IES	Illuminating Engineering Society
CBM	Certified Ballast Manufacturers
ANSI	American National Standards Institute
ICEA	Insulated Cable Engineers Association
NEC	National Electrical Code
MEC	Massachusetts Electrical Code
AEIC	Association of Edison Illuminating Companies

A. "E.C." as used hereinafter in this SECTION shall mean the "Electrical Subcontractor," i.e., the filed bid subcontractor under this SECTION 260001.

B. "Concealed" shall be defined as areas where conduit and wiring is located in chases, walls, partitions, shafts, and above finished ceilings.

C. "Underground" shall mean conduit and wiring exterior to or within the building that is buried. All other conduit and wiring shall be considered "exposed."

D. "Exposed" shall mean conduit and wiring run on the surface of the building construction.

E. "Conduit" shall mean in addition to conduit, all fittings, hangers and other accessories relating to such conduit systems.

F. "Provide" shall mean "provided complete in place," that is, "furnished and installed."

1.15 TEMPORARY FACILITIES

A. The Electrical Subcontractor shall provide at his expense, his own field office which shall be located as directed by the Architect.

B. Any temporary buildings, trailers, or other structures required by the Electrical Subcontractor shall be provided by him and shall be located as directed by the Architect and removed at completion of the work under this Subcontract.

1.16 CLEANING

A. Upon completion of the electrical installation, remove all debris, clean, polish and leave all work in perfect operating condition.

1.17 EQUIPMENT DIRECTORIES AND NAMEPLATES

A. Furnish and install typed directories under .020" clear plastic in directory cardholder in each panelboards, showing the utility of each circuit.

B. Identify each item of equipment, including disconnect switches, motor starters, panelboards, circuit breakers on switchboard, relays, contactors and cabinets, by a permanently attached nameplate made of a black surface, white core, laminated micarta with indented letters. Nameplates shall be a minimum of 2" long by 3/4" wide and shall bear the equipment name as designated in the schedules, specifications, or on shop drawings. All nameplates shall be fastened to each piece of equipment with screws.

C. The Electrical Contractor shall furnish and install a self-adhesive (P-Touch) label on all receptacle and switch device plates indicating panel and circuit serving device.

1.18 ACCEPTANCE OF INSTALLATION CONDITIONS

A. This Subcontractor shall be fully responsible for the proper execution and performance of the work described herein. It shall be his responsibility to inspect all installation conditions and request the general contractor arrange for correcting any conditions which may affect his work adversely. He shall report to the Architect, prior to commencing any portion of his work, any failure of the general contractor arrange for suitable installation conditions for his portion of the work.

1.19 APPROVED EQUAL

A. Approved equal shall mean that the use of all materials shall be submitted to the Architect for approval, and that such approval shall be the sole discretion of the Owner/Architect.

B. The term "submit for approval" or similar expressions shall mean that work shall be contingent upon the specific approval of shop drawings by the Architect in writing.

1.20 DRAWINGS

A. The Electrical Drawings are diagrammatic only and are not intended to show ever detail of construction or arbitrary location of wiring. Each system shall be complete with minor parts not specifically noted on the Drawings, but required for a properly functioning system conforming to state and local codes. Where building construction makes it advisable or necessary to change location of wiring or fixtures without increasing the cost of the work, such changes shall be made with the consent of the Architect and at no additional cost to the Owner.

B. In case of conflict with building parts or the work of other trades, the Architect shall be notified immediately and requested to render a decision so that there will be no delay in the building construction.

1.21 GIVING INFORMATION

A. Keep fully informed as to the shape, size and position of all openings and foundations required for all apparatus furnished under this SECTION and give full information to the general contractor sufficiently in advance of the work, so that all such openings and foundations may be built in advance. Furnish all sleeves and supports herein specified, so the general contractor to arrange for installation.

B. In the case of failure to give proper information as noted above, assume the cost of having necessary changes to the work made by the general contractor.

C. Obtain detailed information from the manufacturers of apparatus which is to be provided, for the proper methods of installation. Obtain all information from the General contractor and other Subcontractors which may be necessary to facilitate the work and the completion of the whole project.

D. Electrical Subcontractor shall inspect the site associated with this project prior to submitting his bid and shall investigate all conditions under which this work shall be performed. This shall include determination of exact locations of items indicated as existing on the Drawings. Such existing locations are diagrammatic and shall not be construed as exact enough to use for equipment and labor estimating purposes. Failure to inspect existing conditions or to fully understand the work which is required shall not excuse the Electrical Subcontractor from his obligation to supply and install work in accordance with the Specifications and Drawings and under all existing site conditions. It shall be the responsibility of the Electrical Subcontractor to investigate and locate all existing underground utilities which may conflict with the installation of this electrical work. Coordinate elevations of conduits required to be installed under this Contract to avoid interference with any existing underground utilities.

1.22 COORDINATION DRAWINGS

A. Before materials are purchased or work is begun the Subcontractor shall prepare Coordination Drawings showing the size and location of his equipment and lines in the manner described under Section 013300 – Submittals. Base all required measurements, both horizontal and vertical, on reference points established by the General contractor and be responsible for the correct laying out of the electrical work. In the event of a discrepancy between actual measurements and those indicated, notify the General contractor in writing, and do not proceed with the work required until written instructions have been issued by the General contractor.

B. HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.

C. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow speedy and efficient completion of the work.

D. Furnish to other trades advance information on locations and sizes of all frames, boxes, sleeves and openings needed for their work, and also furnish information and shop drawings necessary to permit trades affected by the work to install same properly and without delay.

E. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Designer. Where the electrical work shall interfere with the work of other trades, assist in working out the space conditions to make satisfactory adjustments before installation. Without extra cost to Owner, make reasonable modifications to the work as specified by normal structural interferences. Pay the General contractor for additional openings, or relocating and/or enlarging existing openings through concrete floors, walls, beams and roof required for any work which was not properly coordinated. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

F. If any electrical work has been installed before coordination with other trades so as to cause interference with the work of such trades, all necessary adjustments and corrections shall be made by the electrical trades involved without extra cost to Owner.

G. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Designer for review and approval.

H. Protect all materials and work of other trades from damage which may be caused by the electrical work, and repair all damages without extra cost to Owner.

I. HVAC Subcontractors shall furnish and install various electrical items relating to the heating and ventilating equipment and control apparatus. The Electrical Subcontractor shall be required to connect power wiring to this equipment as indicated on the electrical drawings unless noted otherwise.

J. The HVAC, Security and Electrical Subcontractors shall coordinate their respective portions of the work, as well as the electrical characteristics of the heating and ventilating equipment.

K. All power wiring and local disconnect switches shall be provided by the Electrical Subcontractor for the line voltage power. All control and interlocking wiring shall be the responsibility of the BAS Subcontractor.

L. 120V and above power wiring sources extended and connected to heating and ventilating control panels, transformers and switches shall be the responsibility of the Electrical Subcontractor as indicated on the electrical drawings. All other 120V wiring not shown on the electrical drawings but required by the BMS contractor shall be furnished and installed by the BMS Contractor. All low voltage thermostat, zone valve and any switch wiring shall be the responsibility of the BMS Subcontractor.

M. Temperature control and equipment wiring shall be installed by BMS Subcontractor.

N. The Electrical Subcontractor shall furnish and install all magnetic starters except those furnished as an integral part of packaged equipment.

1.23 LIST OF DRAWINGS

10.0.01	Symbol List
10.0.02	Technology Symbol List
10.1.01	Site Electrical Demolition Plan
10.1.02	Site Power Plan
10.1.03	Site Lighting Plan
10.1.04	Site Details Sheet
10.2.01	Ground Floor Lighting Plan
10.2.02	Ground Floor Power Plan
10.2.03	First Floor Lighting Plan
10.2.04	First Floor Power Plan
10.2.05	Second Floor Lighting Plan
10.2.06	Second Floor Power Plan
10.2.07	Ground Floor Fire Alarm Plan
10.2.08	First Floor Fire Alarm Plan
10.2.09	Second Floor Fire Alarm Plan
10.2.10	Ground Floor Security Plan
10.2.11	First Floor Security Plan
10.2.12	Second Floor Security Plan
10.2.13	Roof Electrical And Lightning Protection Plan
10.2.14	Enlarged Kitchen Electrical Plan
10.3.01	Power Riser Diagram
10.3.02	Panel Schedules
10.3.03	Mechanical Equipment Schedule
10.3.04	Fire Alarm Riser Diagram
10.3.05	Voice/Data Riser Diagram
10.3.06	Voice/Data Details
10.3.07	Lighting Control Detail Sheet #1
10.3.08	Lighting Control Detail Sheet #2
10.3.09	Sound System Detail Sheet #1
10.3.10	Sound System Detail Sheet #2
10.3.11	Security System Details
10.3.12	Details Sheet
10.3.13	Details Sheet

1.24 ALTERNATES

A. Not Used.

1.25 CONSTRUCTION SCHEDULE

A. All work under this Contract shall be arrange and carried out in a continuous manner permitting completion of the work in accordance with the completion dates outlined in the Contract Documents.

B. It is essential to the successful performance of the Contract that the Electrical Subcontractor initiate orders for all "lead time" items immediately upon execution of the Contract agreement. Submit equipment and material list and shop drawings for the "lead time" items as soon as possible after the Contract award and notify the Architect at that time of any possible foreseeable delivery delays. Place orders immediately upon receipt of approvals and follow through on all items to avoid construction delays and to assure compliance with established scheduled Project completion time.

C. It shall be the responsibility of the Electrical Subcontractor to properly staff the Project with competent personnel to insure proper supervision and control.

D. It is imperative that the Project be staffed at all times by the Electrical Subcontractor with the required number of personnel to adhere to the construction schedules and completion dates.

E. It shall be the responsibility of the Electrical Subcontractor to coordinate with the general contractor the phasing of this project. The Electrical Subcontractor shall install the electrical installation within the requirements of the phasing requirements of the general contractor and the phasing information shown on the Construction Documents and Technical Specifications.

1.26 COMMISSIONING OF ELECTRICAL SYSTEMS

A. The Electrical Subcontractor and the manufacturer's representative shall witness all testing of all lighting systems, lighting control systems and power distribution systems in accordance with the requirements of the Massachusetts Energy Code. The contractor shall prepare a final performance acceptance reports in accordance with the code requirements and in a form acceptable to the local code officials. The actual testing shall be performed by the Electrical Subcontractor. All costs associated with testing, witnessing of the testing and preparation of reports shall be included in the Electrical Subcontractor bid and shall be a part of the base contract bid.

B. At the completion of the electrical installation, the Electrical Subcontractor shall demonstrate to the Owner and to the Engineer the proper operation of all major electrical systems. This shall include but not be limited to generator, fire alarm, lighting systems, dimming systems, lighting control systems, occupancy sensors. Allow minimum of eight full days (64 hours) for these demonstrations.

C. Refer to Section 260943 Network Lighting Control Systems for commissioning scope of work.

D. Provide Owner and Engineer at least one week notice before demonstration is to begin. Electrical contractor shall ensure the presence of personnel from local manufacturer's representative for the specific pieces of equipment involved as well as for the generator, fire alarm, lighting control, scoreboard, local sound contractor who shall be present throughout the entire procedure. All testing and training shall be performed and coordinated with the third party commissioning agent.

E. If any piece of equipment or control panel does not operate as specified then this contractor shall remedy the deficiency and repeat the demonstration in the Owner's and Engineer's presence at no additional cost.

F. Refer to Section 01 91 13 – General Commissioning Requirements for additional requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Materials specified for the work on all systems in this building shall be new and shall comply with the National Electrical Manufacturers Association's specifications (NEMA), the Massachusetts Electrical Code (MEC) and the American National Standards Institute (ANSI). Where materials are not specified, these materials shall be the best of their respective kinds. Submit a list of all materials to the Architect for approval within thirty (30) days after the contract is signed and before any orders are placed. Wiring materials, stock fixtures and equipment shall bear the label of the Underwriters' Laboratories, Inc. (UL), or shall be accompanied by a duly signed certificate from an approved inspection organization which states that the requirements of the Underwriters' Laboratories, Inc. (UL) for such materials and/or equipment have been complied with, but such label or certificate shall not obligate the Architect to approve said materials, fixtures and/or equipment.

B. LEEDv4-S REQUIREMENTS

1. Products and materials used for this section of work are required to meet the following criteria for LEEDv4-S materials Credits, and a completed LEEDv4 MATERIALS REPORTING FORM shall be submitted for all materials in this SECTION:

   Furnish any adhesives, sealants, paints and coatings, meet the requirements for IEQ Credit 2 as defined in Section 018113 – SUSTAINABLE DESIGN REQUIREMENTS.

2. For SS Credit 6 Light Pollution Reduction, submit product data for all exterior lighting fixtures and fill out all templates specified in the LEED submission forms.

3. For IEQ Credit 6 Interior Lighting, submit product data for all exterior lighting fixtures and fill out all templates specified in the LEED submission forms.

2.02 RIGID METAL CONDUIT

A. Rigid metal conduit shall be manufactured of fine, evenly-grained steel. Rigid metal conduit shall be threaded and shall be thoroughly cleaned to remove all scale and rust before applying a galvanized coating outside and a coating of clear, baked-on enamel on the interior surfaces. Rigid conduit shall be of full weight and shall meet all Massachusetts Electrical Codes and Underwriters' Laboratories, Inc. standards for rigid metal conduit. Each standard length shall be threaded at both ends and fitted with a coupling at one end and a thread protector at the other. All rigid metal conduit fittings shall be threaded and shall be made of full weight material and treated with the same protective coatings required for rigid conduit. Set screw-type connectors and couplings for rigid metal conduit will not be allowed. Rigid metal conduit shall be used in concrete or other wet construction unless indicated otherwise on the Drawings.

B. Thread fittings such as elbows, bends shall be made of full weight material and treated with the same protective coatings required for rigid metal conduit. Set screw-type connectors will not be allowed.

C. All conduit shall be supported with a minimum of two (2) hanger supports for each ten (10) feet of conduit and additional supports shall be provided where structural conditions require them. On flat surfaces, supports shall consist of one-hole heavy wall conduit clamps and one-hole conduit clamp backs.

D. Conduit shall be manufactured by one of the following or approved equal:

Allied Tube & Conduit Corp.	LTV Steel Tubular Products
Wheatland Tube Company	Triangle Conduit Company

2.03 ELECTRIC METALLIC TUBING

A. Electric metallic tubing (EMT) shall be of welded steel construction and manufactured of light-weight, cold-rolled steel. The exterior shall be protected by an electro-galvanized zinc coating. The interior shall be coated with lacquer. Fittings for electric metallic tubing shall be of the threadless type and shall be constructed and finished as described for tubing. All fittings for tubing shall be of the compression or set-screw and shall be of the steel type. Tubing shall not be installed in concrete or other wet constructions.

B. Electric metallic tubing shall be supported as specified for rigid metal conduit.

C. Electric metallic tubing shall be manufactured by one of the following or approved equal:

Allied Tube & Conduit Corp.	LTV Steel Tubular Products
Wheatland Tube Company	Triangle Conduit Company

2.04 FLEXIBLE METAL CONDUIT

A. Flexible metal conduit shall be constructed of continuous interlocking bands of zinc-coated steel and shall be complete with fittings approved for this type of conduit. Flexible conduit, known as Greenfield, shall be used to connect a motor to its junction box or recessed lighting fixture to its junction box. In mechanical rooms and wet locations, install UL approved liquid-tight flexible metallic conduit for final connection to motors with flexible length not-to-exceed six (6) feet.

B. Flexible metal conduit shall be manufactured by one of the following or approved equal:

American Flexible Conduit	Electric-flex Company
Alflex Corp.	Allied Tube & Conduit Corp.

2.05 PLASTIC CONDUIT

A. Plastic conduit encased in concrete shall be schedule 40, rated for 90 degrees C. Cables and plastic conduit installed underground (direct burial) shall also be schedule 40. Plastic conduit shall be composed of polyvinyl chloride, U.L. listed and shall conform to NEMA standards TC-2 and Article 347 of the National Electrical Code. The materials shall have a tensile strength of 6,000 PSI at 73.4 degrees F, flexural strength of 12,500 PSI, tensile modules 470,000 PSI and a compressive strength of 9,000 PSI.

B. Plastic conduit, fittings, and elbows shall be produced by the same manufacturer. All joints shall be solvent welded in accordance with the recommendations of the manufacturer.

C. Plastic conduit shall only be installed in underground locations as indicated on the Electrical Drawings. Plastic conduit shall **NOT** be installed within the Building or in any concrete floor slab. All PVC conduit within the underground ductline system shall be concrete encased. Light and power feeders may be installed in PVC conduits under the first floor slab without being concrete encased.

D. Plastic conduit and fittings shall be manufactured by one of the following or approved equal:

Carlon Products Corporation Cantex, Inc.

Scepter Electrical Systems

2.06 METAL CLAD CABLE

A. Metal clad cable (type MC) shall be made of interlock galvanized steel protective armor, solid insulated copper conductors. All conductors shall be insulated solid copper conductors. Type MC cable shall have a solid fully rated insulated green ground conductor. Type MC cable shall be furnished in accordance with the National Electrical Code. Type MC cable shall be used for lighting, and receptacle branch circuit wiring in concealed locations. No type MC cable will be allowed for panel feeders. All fittings hall be steel, dies cast fitting are not allowed. Refer to General Note on Symbol List for details.

B. Type MC cable shall be AFC type MC metal clad cable or approved equal. MC Cable and fittings shall be manufactured by one of the following or approved equal:

AFC Corporation Southwire

KAF-Tech

2.07 OUTLET BOXES

A. Outlet boxes on concealed conduit work shall be of galvanized steel. These boxes, in all cases, shall be designed to accommodate the equipment or apparatus to be installed either in them or attached to them. Where boxes of a standard size are not available for a particular requirement, special boxes shall be manufactured and furnished to comply with the requirements. Outlet boxes shall be furnished of a size and type to meet the requirements of each type of concrete construction. If standard boxes are not available, special boxes shall be furnished as specified by each type of construction.

B. Barriers shall be provided where two (2) or more electric system have wires or connections in the same box. Boxes shall be furnished of a size and type to meet the requirements of each type of construction. Special boxes shall be furnished as specified by each type of construction.

C. Where boxes are used to support fixtures on ceiling or on the walls, suitable fixture supports of the required type for the specific fixture shall be furnished in each box. Plaster rings shall be furnished of the required depth to meet the conditions for all locations where plaster construction is specified for walls and ceilings. Where lighting fixtures are specified to be installed in concrete ceiling construction, fixture back boxes designed for this purpose shall be provided.

D. Outlet boxes for exposed work in mechanical areas shall be of cast malleable iron with cast covers designed for the specific device. Cast-iron boxes shall have cadmium finish

E. All fittings for exposed conduit work shall be malleable galvanized steel of the type and size adequate to meet the structural and architectural requirements at each locations.

F. Outlet boxes shall be manufactured by one of the following or approved equal:

RACO	Steel City Electric
Hubbell	All Steel Equipment, Inc.

2.08 PULL AND JUNCTION BOXES

A. Pull and junction boxes shall be of the proper type, class and construction to suit the specific conditions encountered.

B. Pull and junction boxes shall be of sufficient volume and physical configuration to accommodate the number of conductors entering and leaving the box as well as any splices or connections that may be made within same.

C. Pull and junction boxes that are not specifically shown on the Drawings, but are required for the proper installation of the electrical system shall be installed by the Electrical Subcontractor so that they do not interfere with the structural or architectural features of the building.

D. Pull and junction boxes shall be constructed of code gauge galvanized sheet metal, of not less than the minimum size required by the Massachusetts Electrical Code or other applicable specification standards and shall be furnished with screw fastened covers. Boxes exceeding 48" in any direction shall be properly reinforced with angle iron stiffeners.

E. Pull and junction boxes of other than manufacturer's trade size shall be manufactured by one of the following or approved equal

Keystone Manufacturing Company Lee Products Company

Commercial Sheet Steel

2.09 WIREWAY

A. Wireway shall be made of code gauge galvanized steel with formed flanges on body and cover. Finish shall be gray baked enamel and the covers shall be fastened to the body with screws. Wireways shall be furnished with the necessary fittings, including elbows, tees, end caps, couplings, flanges, and hangers.

B. Wireway shall be securely supported at intervals not exceeding five (5) feet.

C. Wireways shall be manufactured by one of the following or approved equal:

Square D Company Lee Products Company

Commercial Sheet Steel

2.10 BRANCH CIRCUIT AND FEEDER CONDUCTORS

A. All branch circuit wiring for lighting, receptacles and power branch circuits shall be manufactured of copper with a minimum size of #12 solid AWG. All wiring shall be rated at 600 volts with a type THWN/THHN insulation and conductors #10 AWG and larger shall be stranded. All HVAC and power wiring shall be installed in conduit raceways (Rigid or EMT). Receptacle and lighting branch circuit homerun wiring from the panel to each room shall be and all lighting and branch circuit wiring in the walls shall be type MC cable or installed in surface metal raceways.

B. All lighting and power feeders shall manufactured of copper and rated at 600 volts with THWN insulation.

C. All branch circuit and feeder conductors shall conform to the Massachusetts Electrical Code requirements as to construction and use.

D. The interior wire for the fire alarm system shall be copper, #14 AWG, type THWN for Speaker circuits, #12 AWG, type THWN for strobe light circuits and rated at 600 volts unless otherwise indicated on the Electrical Drawings. The addressable loop circuits shall be a shielded cable. All firing alarm wiring shall be installed in conduit raceways (EMT) (exposed) or fire alarm mc cable (concealed).

E. The interior wire for remote control, signal circuits and interlocking wiring shall be copper #14 AWG, type THHN and rated at 600 volts unless otherwise indicated on the Electrical Drawings.

F. All exterior wiring shall be copper, type THWN and rated at 600 volts unless otherwise indicated on the Electrical Drawings.

G. Wiring installed in one (1) section of a continuous fluorescent lighting fixture to supply a ballast in another section of the same continuous fixture shall be type SFF, rated at 150 degrees C. with the insulation rated at 300 volts.

H. All branch circuit and feeder conductors shall be color coded for phase identification. Phases shall be identified by the following colors throughout:

120/208 Volts	277/480 Volts
A Phase – Black	A Phase – Brown
B Phase – Red	B Phase – Orange
C Phase – Blue	C Phase – Yellow
Neutral – White	Neutral – White with Colored Stripe
Ground – Green	Ground – Green

I. Switch leg wiring shall be of the same color as the corresponding phase.

J. Phase markings shall be accomplished as follows:

1. Wires of #6 gauge and smaller shall have an outer braid of insulation of a solid continuous color for the entire length.

2. It is preferable that wires larger than #6 gauge shall have an outer braid or insulation of a solid continuous color for the entire length. If the particular manufacturer of wire ordered for this project does not provide such continuous coloring, wires shall be identified by a gummed plastic or cellophane marker tape which can be wrapped around the outer braid. Such markers shall be a type as manufactured by the W.H. Brady Company of Milwaukee, Wisconsin, or approved equal. The wires shall be so identified at any and all points of connection to equipment.

K. Branch circuit and feeder conductors shall be manufactured by one of the following or approved equal:

Rome Cable Corporation — American Insulated Wire Corp.

Hi-Tech Cable Corp — Southwire Company

2.11 SOLDERLESS LUGS AND CONNECTORS

A. All lugs terminating feeder conductors shall be of the solderless type approved by Underwriters' Laboratories for use with copper wires.

B. Branch circuit connections or joints shall have an approved type connector suitable for copper conductors.

C. Wire connectors shall consist of a phenolic compound body with a cone-shaped coil spring and threaded skirt. Outer shell shall be knurled for each grip and capable of use with wrench or pliers.

D. Lugs shall be manufactured by one of the following or approved equal:

Trego Incorporated — Burndy Corporation

O.Z. Gedney Company

E. Wire connectors shall be manufactured by one of the following or approved equal:

3M Company — Burndy Corporation

Ideal Industries

2.12 PANELBOARDS AND CABINETS

A. Each panelboard shall consist of automatic short-circuit and over-current protective devices assembled into a single interior unit which shall be mounted in a sheet steel enclosure, consisting of a box and front designed to be placed in or against a wall or partition. The panelboards shall be of the dead-front type and shall be in accordance with the Underwriters' Laboratories, Inc. standard for panelboards and enclosing cabinets, and so labeled.

B. The panelboard boxes shall be fabricated from galvanized sheet steel. A turned edge shall be provided around the front of the box for rigidity and attachment of the front. Wiring gutters shall be in accordance with the Massachusetts Electrical Code. All lighting and power panelboards shall be furnished with an equipment ground bus.

C. The panelboard front shall consist of a flat piece of sheet steel, with a door-in-door arrangement. One door shall expose the circuit breaker handles and the other door will provide access to the wiring gutters. The panelboard doors shall be attached by means of semi-concealed, 5-knuckle steel hinges. The doors shall have cylinder tumbler-type lock. On doors more than 48" high, a combination 3-point catch and lock shall be provided. The front shall be attached to the box with rotating adjustable trim clamps. A 5" x 7" circuit directory card and cardholder shall be provide on the inside of the door. Fronts shall be finished in ANSI-61 light gray enamel over a rust inhibitor, except in finished building areas and panels shall primed for painting. All panelboards shall be furnished with locks and all locks shall be keyed alike.

D. The interior shall be of the unit type mounted on a back plate, properly reinforced by flanging to provide a rigid assembly to protect against damage during handling or installation. Structure shall be so designed that units may be easily removed without disturbing adjacent sections, bus structure or insulation. A removable dead front shield shall be provided for easy access to the wiring. Panel bussing shall be arranged to maintain sequence phasing throughout, that is, adjacent poles shall be unlike polarity and rotated in sequence. All lugs shall be of the solderless type, suitable for copper conductors. See paragraph entitled "Solderless Lugs and Connectors".

E. Branch circuit protective devices shall be General Electric Company or approved equal, molded case circuit breakers. The breakers shall have quick-make, quick-break toggle mechanism, inverse time-limit characteristics and shall be trip-free on over-load or short-circuit. Automatic release is to be secured through the medium of bi-metallic, thermal type element engaging the releasing latch of the mechanism. In addition, a magnetic armature shall be provided and calibrated so as to trip the breaker instantaneously for short-circuits above the over-load range.

F. Automatic tripping shall be indicated by handle automatically assuming a position between the manual "OFF" and "ON" position. The individual breakers shall be calibrated and sealed to eliminate tampering or unauthorized changes in calibration. Breakers shall be interchangeable and capable of being operated in any position. Two and three-pole breakers shall be common trip so that an over-load on one pole will trip all poles simultaneously. All circuit breakers with frame sizes larger than 100-amperes rating shall have interchangeable trips. No "Common trip" handle bar ties will be allowed on "Q-Line" multi-pole circuit breakers to accomplish either manual or automatic tripping.

G. Where more than one (1) panel occurs at any one (1) location, a common trim shall be provided with separate panel access doors.

H. No plug-in type circuit breakers will be allowed, and no feed-through bus panels will be approved.

I. All lighting and power panelboards shall be furnished with an equipment ground bus.

J. The exact type of circuit breaker required for each lighting and power panelboard shall be determined from the panel schedules on the Electrical Drawings.

K. The NEMA interrupting ratings of molded case circuit breakers shall be as follows:

120/208 Volts - Three Phase - Four Wire System

100-ampere frame, General Electric Co., type THQB, 10,000-ampere RMS at 120/240-volts AC (for lighting and receptacle branch circuits only)

100-ampere frame, General Electric Co., type THHQB, 22,000-ampere RMS at 120/240-volts AC (for lighting and receptacle branch circuits only)

100-ampere frame, General Electric Co., type TXQB, 65,000-ampere RMS at 120/240-volts AC (for lighting and receptacle branch circuits only)

100-ampere frame, General Electric Co., type TEB, 10,000-ampere RMS at 240-volts AC (for power branch circuits)

100-ampere frame, General Electric Co., type TED, 18,000-ampere RMS at 240-volts AC.

100-ampere frame, General Electric Co., type THED, 65,000-ampere RMS at 240-volts AC.

225-ampere frame, General Electric Co., type TFK, 25,000-ampere RMS at 240-volts AC.

225-ampere frame, General Electric Co., type THFK, 65,000-ampere RMS at 240-volts AC.

400-ampere frame, General Electric Co., type TJK4, 42,000-ampere RMS at 240-volts AC.

600-ampere frame, General Electric Co., type TJK6, 42,000-ampere RMS at 240-volts AC.

00-ampere frame, General Electric Co., type TKM8, 42,000-ampere RMS at 240-volts AC.

277/480 Volts - Three Phase - Four Wire System

100-ampere frame, General Electric Co., type TED, 14,000-amperes RMS at 277/480-volts AC.

100-ampere frame, General Electric Co., type THED, 65,000-ampere RMS at 277-volts AC

225-ampere frame, General Electric Co., type TFK, 22,000-amperes RMS at 480-volts AC.

225-ampere frame, General Electric Co., type THFK, 25,000-amperes RMS at 480-volts AC.

400-ampere frame, General Electric Co., type TJK4, 30,000-amperes RMS at 480-volts AC.

400-ampere frame, General Electric Co., type THJK4, 35,000-amperes RMS at 480-volts AC.

600-ampere frame, General Electric Co., type TJK6, 30,000-amperes RMS at 480-volts AC.

800-ampere frame, General Electric Co., type TKM8, 30,000-amperes RMS at 480-volts AC.

800-ampere frame, General Electric Co., type THKM8, 35,000-amperes RMS at 480-volts AC.

L. Type THQB, THHQB or TXQB circuit breakers or the equivalent shall not be used for any power branch circuits or in any distribution panelboards as identified by panel schedules on the Drawings.

M. All lighting and power distribution panelboards shall be General Electric Company, type CCB.

N. Panelboards and cabinets shall be manufactured by one of the following or approved equal:

General Electric Company	Square D Company
Cutler Hammer Company	Siemens

2.13 RECEPTACLES

A. Duplex tamper resistant receptacles shall be rated at 20-amperes, 3-wire, 125-volts, with "T" slots, ground slot, double binding screws and plaster ears and shall be Hubble HBL5362 tamper resistant or approved equal.

B. Single receptacles rated at 20-amperes, 3-wire, 125-volts shall be Hubbell #HBL5361 or approved equal.

C. Duplex ground fault interrupter (GFI) receptacles shall be rated at 20-amperes, 3-wire, 125-volts with ground slot and shall be Hubble HBL5362GF or approved equal.

D. Ground fault interrupters installed in wet locations shall be installed in FS boxes with Arrow Hart #4501FS cast aluminum covers. Receptacles mounted outside shall be weather resistant per MEC.

E. Duplex surge suppression receptacles shall be rated at 20-amperes, 125-volts with ground slot, power-on, damage alert alarm, blue face and shall be Hubbell #HBL5362-S or approved equal.

F. Duplex isolated ground surge suppression receptacles shall be rated at 20-amperes, 125-volts with ground slot, power-on, damage alert alarm, blue face and shall be Hubbell #HBLIG5362-S or approved equal.

G. Single dryer receptacles rated at 30-amperes, 4-wire, 125/250-volts shall be Arrow Hart, Inc. #5744N or approved equal and shall match the dryer cord set.

H. Single receptacles rated at 30-amperes, 3-wire, 125-volts, shall be Arrow Hart #5716N or approved equal.

I. The color of all receptacles connected to the emergency light and power system shall be red.

J. The color of all receptacles shall be "brown" or "ivory". In general, receptacles installed in all finished areas throughout the building shall be "ivory" and receptacles installed in areas with wood paneling or in wood furniture shall be "brown". All receptacles installed in storage, boiler, mechanical and electric rooms shall be "brown". The exact color of the receptacles for each of the various areas of the building shall be determined by the Architect.

K. Receptacles shall be manufactured by one of the following or approved equal:

Arrow Hart, Inc. Hubbell, Inc.

Pass & Seymour

2.14 SWITCHES

A. All toggle switches except those required for special application shall be of the same manufacturer.

B. Switches for use on incandescent or fluorescent lighting circuits shall be of the AC general use type and shall be fully rated at 20-amperes at 120/277-volts.

C. AC toggle switches shall be specification grade, heavy duty, single or double pole, 3 or 4 way, or maintained momentary, or lock-type as indicated by the symbols on the Drawings.

D. Toggle switches shall be of the fully rated enclosed cap type with the entire body of molded phenolic, urea, or melamine.

E. Switch handles shall be of an "ivory" color.

F. Switches shall be classed as "silent-acting".

G. All toggle switches shall comply with Underwriters' Laboratories, Inc. standards.

H. Single-pole switches shall be Hubble HBL1221 or approved equal, rated at 20-amperes, 120/277-volts.

I. Double-pole switches shall be Hubble HBL1222 or approved equal, rated at 20-amperes, 120/277-volts.

J. Three-pole switches shall be Hubble HBL1223 or approved equal, rated at 20-amperes, 120/277-volts.

K. Four-pole switches shall be Hubble HBL1224 or approved equal, rated at 20-amperes, 120/277-volts.

L. Momentary contact switches shall be Arrow Hart #1995 or approved equal, rated at 120/277-volts.

M. All pilot lights rated at 120-volts shall be neon with red lucite jewel and shall be Arrow Hart #1720 or approved equal.

N. All pilot lights rated at 277 volts shall be neon with red lucite jewel and shall be Arrow Hart #1722 or approved equal.

O. In general, switches installed in all finished areas throughout the building shall be "ivory" and switches installed in areas with wood paneling or in wood furniture shall be "brown". All switches installed in storage, boiler, mechanical and electric rooms shall be "brown". The exact color of the switches for each of the various areas of the building shall be determined by the Architect.

P. Switches shall be manufactured by one of the following or approved equal:

Arrow Hart, Inc. Hubbell, Inc.

Pass & Seymour

2.15 DEVICE PLATES

A. A metal device plate shall be provided for each switch, receptacle, signal and special purpose outlet.

B. All device plates shall be stainless steel with a brushed finished and shall be corrosion resistant (18 percent chromium, 8 percent nickel). Device plates shall be Arrow Hart, 93,000 series or approved equal.

C. The color of all device plates for receptacles connected to the emergency light and power system shall be stainless steel with a red finish.

D. Screws for device plates shall match the plates.

E. Device Plates shall be manufactured by one of the following or approved equal:

Arrow Hart, Inc. Hubbell, Inc.

Pass & Seymour

F. The Electrical Contractor shall furnish and install a self-adhesive (P-Touch) label on all receptacle and switch device plates indicating panel and circuit serving device.

2.16 FLOOR BOXES

A. All floor boxes shall be of the cast iron watertight, fully adjustable type with four (4) wiring compartments. Floor boxes shall be of the multiple service type with steel wiring compartment covers to allow wiring feed-thru from one compartment to another. Floor boxes shall be furnished with the necessary Duplex receptacle brackets, Duplex tel/data brackets, flush access hatch, carpet trim and wire management blocks. Each floor box shall be designed to accept two (2) Duplex surge receptacles and two (2) Duplex tel/data jacks. All tel/data jacks and associated wiring shall be furnished and installed by others.

B. Floor boxes shall be Wiremold #RFB11-C1, RFB6-C1, RFB2-C1 or approved equal with a Wiremold flush access hatch. Refer to the symbol list. Access hatch covers shall be reversible with vertical and angular adjustments to permit matching to uneven surfaces.

C. Whenever floor boxes are installed in carpeted areas, the floor boxes shall be furnished with carpet flanges. All device plates installed in the floor boxes shall be of the type and capacity shown on the Electrical Drawings and as specified in the "Products" Section of the Specifications.

D. Whenever floor boxes are installed in concrete floors, the metal deck shall be cut as specified to install the top of the floor box level with the concrete slab.

E. Floor Boxes shall be manufactured by one of the following or approved equal:

Wiremold
FSR
Hubbell

2.17 MOTOR DISCONNECT SWITCHES

A. Disconnect switches: Power switches for disconnecting means at all motors ½ HP and over shall be heavy duty type with quick-make, quick-break mechanisms. Disconnect switches shall have interlocking doors. Cabinets shall be bonderized and furnished in gray enamel. Where one (1) feeder supplies more than one motor, disconnecting switches shall be fusible type and shall be complete with fuses of the size required for each motor. NEMA type 3R enclosures shall be used where the disconnect switch is exposed to the weather or installed in wet locations. Disconnect switches shall be capable of being secured in the open position with a padlock.

B. A manual starting thermal-type switch with pilot light shall be provided as a disconnecting means for all motors less than ½ HP unless otherwise indicated on the Electrical Drawings. These thermal switches shall be toggle operated and shall be rated at 1 HP, size 00. Motor overload protection shall be provided by means of a bi-metallic type thermal relay in combination with interchangeable heaters. Heaters shall be installed without removing the starter from the housing or disturbing the wiring. Toggle shall be trip-free. Thermal switches shall be furnished in a NEMA type 1 enclosure in mechanical and utility areas and flush in walls with stainless steel plates in architecturally finished areas.

C. Motor disconnect switches shall be mounted in NEMA type 1 or 3R enclosures and shall be General Electric Company, type TH or approved equal.

D. Motor disconnect switches shall be manufactured by one of the following or approved equal:

General Electric Company	Square D Company
Siemens	Cutler Hammer

2.18 MAGNETIC STARTERS

A. All motors ½ HP thru 60 HP connected to the 480 volt system shall be solid state wye delta. These motors shall be designed to operate on 480 volts, 3-phase, 60 hertz.

B. Across-the-line starters shall be enclosed in NEMA general purpose enclosures, except NEMA type 3R enclosures shall be used where the starter is exposed to the weather and NEMA type 5 enclosures shall be used in all hazardous locations. Across-the-line starters shall NEMA size 1, 2, or 3 depending on the size of the motor. Momentary contact start-stop pushbuttons shall be located in the covers of the starters enclosure unless other type of starting switches are required. Current sensitive relays shall be provided in each line to the motor to guard against continued operation at excessive loads. These relays shall be of the bi-metallic type "inverse-time" operating characteristics. Heaters shall be provided of the correct size for the motor controlled. Two (2) sets of auxiliary contacts shall be provided with each starter in addition to those needed for normal operation or in addition to those required by the wiring diagrams. These auxiliary contacts shall be "normally open" or "normally closed" depending on the specific control circuit requirements. Red and green pilot lights shall be located in the cover of the starter enclosure to indicate position of main contacts.

C. Two-speed magnetic starters shall consist of two mechanical and electrically interlocked contactors with two three-leg block type overload relays, one on each contactor. Relays shall provide overload protection for each speed. Provide pilot lights to indicate each of the motor speeds. Provide auxiliary contacts, starting switches and pilot lights as specified for across-the-line starters.

D. The Electrical Subcontractor shall consult with the Automatic Temperature Control Subcontractor to determine the type of control required for each magnetic starter (start-stop pushbuttons or HOA switches).

E. Furnish and install a 480/120 volt fused transformer of the required size in each magnetic starter enclosure for control power. Control power transformers are specified for all starters connected to the 480 volt system.

F. Magnetic or manual starters shall be manufactured by one of the following or approved equal:

General Electric Company	Square D Company
Siemens	Cutler Hammer

2.19 MECHANICAL SUSPENSION CHANNEL

A. Mechanical suspension channel shall be furnished and erected and used to support electrical equipment such as panelboards, starters, disconnect switches, plywood backboards and the like. All channel and fittings shall be furnished with the manufacturers standard rust-proofing finish.

B. Channel shall be factory formed of 12-gauge steel and shall have outside cross section measuring 1-1/2" x 1-1/2" or approximately that size, provide that the moment of inertia and the section modulus in the horizontal axis of the channel are at least equal to that of the above-described Section. All required fasteners and fittings shall be furnished to satisfactorily complete the installation as shown on the Electrical Drawings.

C. Mechanical suspension channel shall be manufactured by one of the following or approved equal:

Unistrut Products Company Power-Strut

Kindorf (Steel City Electric Co.)

2.20 120 OR 277-VOLT LIGHTING CONTROL RELAYS

A. 120 or 277-volt lighting control relays shall be rated at 25-amperes and shall be of the mechanically held or magnetically held type as indicated on the Electrical Drawings. In general, relays for the control of lighting fixtures shall be of the mechanically held type on the normal lighting circuits and relays for the control of small power circuits shall be of the magnetically held type. Relays shall be fully rated when enclosed in metal cabinets.

B. 120 or 277-volt lighting control relays shall be manufactured by one of the following or approved equal:

Automatic Switch Company General Electric Company

Allen-Bradley Company

2.21 MAIN SECONDARY SWITCHBOARD

A. Furnish and install the main secondary switchboard as specified hereinafter and as described on the Electrical Drawings. The main secondary switchboard shall consist of 2000-ampere bussing; one (1) 2000/2000-ampere main insulated case circuit breaker with metering section, utility company metering section and a 480-volt molded case circuit breaker feeder section.

B. The switchboard enclosure for the main breaker section, metering section and 480-volt feeder section shall be General Electric Company type AV-2 or approved equal and shall be a completely self-supporting structure of the required number of vertical sections bolted together to form one (1) metal enclosed rigid switchboard 90" high. The sides and top shall be covered with removable screw-on gauge steel plates. The rear of each vertical section shall be furnished with a full height hinged door. Switchboard shall include all protective devices and equipment as scheduled on the Electrical Drawings with necessary inter-connections, instrumentation and control wiring, terminal blocks and mechanical solderless connectors for terminals. Switchboard shall be capable of withstanding all normal installation handling including lifting and rolling into place. The switchboard shall be designed, tested and assembled in accordance with applicable standards of NEMA, IEEE and ANSI.

C. The 480-volt main circuit breaker section shall include a stationary, manually operated, heavy duty, 100% continuous rated, UL listed, insulated case circuit breaker rated 2500-amperes. Main breaker shall be furnished with ambient insensitive solid-state trips and shall have current sensors and solid-state logic circuits integral in the circuit breaker frame. The solid-state current control shall provide adjustable current setting, adjustable long-time pick-up, long-time timing light, adjustable long-time delay, adjustable short-time pick-up, adjustable short-time delay and ground fault. Also, main breaker shall be furnished with overload and short circuit trip indicators. All settings shall be sealable to prevent tampering. The main circuit breakers shall be General Electric Company type SSLSHG or approved equal.

D. The main circuit breaker section shall contain a metering section consisting of a microprocessor based monitoring and protective device that provides complete electrical metering and system voltage protection. The electrical metering device shall provide direct reading values for ampere, voltage, watts, vars, power factor, frequency, watts demand and watt hours. The electrical metering and voltage protection device shall be General Electric Company type EPM or approved equal. The multiplier for both kilowatts and kilowatt hours shall be the instrument transformer ratios. The metering section shall contain three (3) 2500/5-ampere current transformers and the specified potential transformers for the switchboard metering. All metering transformers shall be installed in the metering section in a separate compartment accessible through a hinged door.

E. The switchboard shall be furnished with a utility company metering cubicle for Eversource cold sequencing metering.

F. The switchboard shall be furnished with a metering compartment with sufficient space for the three sub-meters and metering transformers. The sub-meters are for metering lighting, HVAC and miscellaneous loads separately. Provide a data cable from all four meters to the nearest BAS panels, coordinate with HVAC. All four meters shall be furnished with remote monitoring features and Bacnet IP options.

G. The 480-volt feeder sections shall consist of molded case circuit breakers of the type, size and number of poles scheduled on the Electrical Drawings. The 480-volt feeder breakers shall be General Electric Company ""Spectra" series type or approved equal. All molded case circuit breakers with frame sizes larger than 100 amperes shall be furnished with interchangeable trips.

H. The main secondary switchboard shall be of the class 2 group mounted type. The switchboard shall be furnished with three separate sub-meters so that the owner can monitor lighting, HVAC and misc electric usage separately. All four meters shall include the capability for remote reporting. Provide the required connections including data cable from each meter to the building automation system.

I. Buses shall be tin plated aluminum sized on the basis of not more than 750-amperes per square inch current density. The bus structure shall be arranged to permit future additions. The bus bars in the main and 480-volt sections shall be mounted on supports of high impact non-tracking insulating material and shall be braced to withstand mechanical forces exerted during short circuit conditions up to 50,000 RMS amperes.

J. Control wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished where specified or required by code.

K. All steel surfaces shall be chemically cleaned and treated to provide a bond between paint and metal surfaces to help prevent the entrance of moisture and formation of rust under the paint film. All hardware shall be of medium carbon steel, having a tensile strength of 120,000 PSI and having a suitable protective finish. The switchboard exterior shall be furnished in the manufacturers standard color.

L. An equipment ground bus shall be furnished and secured to each vertical section and shall extend the entire length of the switchboard.

M. Engraved nameplates shall be provided for each circuit breaker and metering device. See paragraph entitled "Equipment Identification and Directories" in this Section of these Specifications.

N. Shop drawings shall be furnished providing the following information: complete bus ratings, short-circuit withstandability of bus and of lowest rated device plates, overall outline dimensions, including space available for conduits, circuit schedule showing circuit number, device description, device frame ampere rating, trip ampere rating, feeder circuit identifications, conductor ratings and one-line diagram with each circuit device numbered.

O. The switchboard shall be designed, assembled and tested in accordance with applicable portion of the latest editions of NEMA PB-2 and Underwriters' Laboratories, No. UL-891.

P. The main switchboard consisting of main breaker section and 480-volt feeder sections shall be General Electric Company AV-2 Line, NEMA Class II or approved equal. The switchboard shall be UL labeled for use as service entrance equipment.

Q. The main switchboard shall be manufactured by one of the following or approved equal:

General Electric Company	Square D Company
Siemens	Cutler Hammer

2.22 EMERGENCY GENERATOR UNIT

A. Manufacturers:

1. The generator shall be a 250 KW natural gas driven generator with and soundproof enclosure by one of the manufacturers listed below or approved equal.
    a. Kohler model 250REZXB series
    b. Caterpillar
    c. Cummins

B. Scope of work

1. The Generator shall be mounted on the roof.
2. Generator with all required labor and material listed below:
    a. Generator sound attenuating housing with steel floor for mounting on dunnage.
    b. 260A and 600A Automatic transfer switches
    c. 260A manual transfer switch/load bank cam lock
    d. Delivery to site of equipment.
    e. Remote annunciator panel
    f. Training to operate and maintain the generator.
    g. The personnel and equipment required to perform NFPA 110 and UL onsite testing and startup including load bank test.
3. Furnish and install one (1) standby tier 3 certified 250 KW natural gas driven generator rated for continuous standby service. Voltage shall be 277/480-volts, 3-phase, 4-wire at 60 hertz. The system shall be a package of new and current equipment consisting of:
    a. A 4 cycle natural gas engine driven electric plant to provide emergency electric power.
    b. Start-stop control system.
    c. Automatic and manual load transfer controls to provide automatic starting and stopping of the unit and switching of the loads.
    d. Mounted accessories as specified.
    e. Remote NFPA 99/110 generator annunciator panel.
    f. Two integral electronic circuit breakers – 600-ampere and 100-ampere
    g. Sound attenuating generator housing.
    h. Exhaust system and insulation.
    i. 260-ampere and 600-ampere Automatic transfer switches.
    j. EPA certified for stationary emergency and non-emergency applications

C. Source of Supply

1. This system shall be built, tested and shipped by the manufacturer so there is one source of supply and responsibility. The performance of the electric plant shall be certified by an independent testing laboratory as to the plant's full power rating, stability and voltage and frequency regulation. Submit certificate of compliance with shop drawings. Furnish detailed summary of testing of unit of this rating in accordance with NFPA-110T.

D. Parts and Service

1. The supplier of this equipment shall maintain a full-time "in-house" parts and service organization within 75 miles of the job site. The manufacturer of this set shall have a minimum of ten (10) years of experience in building similar units in this part of this country. This supplier shall have his name, address, and telephone number clearly and visibly located on all equipment. Service shall be available on a 24-hour a day, 7-day a week basis. The supplier shall be authorized by the engine generator manufacturer to provide service and warranty coverage for all generator components.

E. Shop Drawings

1. Enclosed with each submittal set shall be the following information:
   a. Unit drawings of all major components showing exact dimension data.
   b. Catalog information on the engine, generator, battery charger, vibration isolators, exhaust silencer, flexible exhaust connector, and automatic transfer switch.
   c. A complete bill of material indicating exactly what is to be provided.
   d. A list of at least two similar installation using the same major components as specified herein.
   e. Furnish engine heat rejection data to jacket water, exhaust, and ambient and total DB measurement of engine, generator, and radiator measured at 23 feet. Mechanical noise shall not exceed 95 DBA at 23 feet and exhaust noise shall not exceed 103 DBA at 23 feet before the exhaust silencer. Exhaust flow shall not exceed 2500 CFM.
2. Any notation marked on submission of the equipment is outlines in this section by reviewing authority must be responded to in writing, by the equipment manufacturer.
3. Complete engineering submittal, catalog cuts, wiring diagrams, interface drawings, unit drawings, A.C. and D.C. schematics, termination chamber drawings, terminal strip drawings, foundation plan, annunciator panel layout and wiring must accommodate all shop drawings.

F. Intent

1. This Specification is for furnishing one (1) natural gas fueled engine driven generating set rated for continuous standby service 250 KW rating. The KW rating shall be continuously available during any power outage whether the duration be minutes, hours, or days. The unit shall be complete with all accessories, controls, attachments, fuel and exhaust systems. Rating shall be with engine driven radiator fan attached regardless of cooling system specified herein.

G. General Operation

1. The operation of this unit shall be automatic such that upon the closing of a remote starting contact, the engine shall start and attain rated voltage and frequency within ten (10) seconds.

2. All necessary accessories shall be provided to assure starting within the time described above under the ambient conditions described herein.

H. Engine

1. The natural gas engine shall be water-cooled, 4 cycle industrial type with removable cylinder liners, 1800 rpm type. Other than 1800 rpm type engines or engines which utilize reduction from a higher rpm down to 1800 rpm shall not be approved.

2. Lubrication shall be a full pressure system, using an engine-driven gear-type lube oil pump with replaceable element full flow lube oil filter. Lube oil cooler shall be provided.

3. The engine generator unit shall be complete with engine, generator, exciter, main circuit breaker, vibration isolators, muffler, radiator, flexible connections between the engine and muffler and all electrical and mechanical connections. The engine and generator shall be directly connected with flexible coupling and mounted on a structural steel skid base.

4. The engine-mounted gas fuel system equipment shall include the following:

   a. Flexible fuel line.

   b. Gas filter.

   c. Gas regulator

   d. Gas solenoid valve

5. Governor: The engine shall be equipped with a hydraulic/electronic isochronous governor capable of maintaining the engine speed from no load to full load within plus or minus .25% of the synchronous speed.

6. Starting system: The engine shall have a 24 VDC starting system with starting motor and starter solenoid switch.

7. Batteries: One set of starting batteries with cables and steel battery rack and heater shall be included for each starter. Batteries shall be sized for operation at -20°F.

   a. Batteries shall be heavy duty lead acid type, rated not less than 210 ampere hours each.

   b. A float type battery charger shall maintain the starting batteries at full charge. The charger shall be suitable for wall mounting and shall have a cranking disconnect relay or current limiting feature. The charger shall be Charles AE2420, Lamarche A46 or equal. The charger shall have high and low voltage alarm relays, and have 20 amp output.

c. There shall be a belt-driven battery charging alternator with regulator and charge rate ammeter for charging the batteries while the engine is running.

8. Heaters:

a. Engine jacket water heaters and thermostats shall be provided to maintain the engine jacket water a temperature high enough to assure starting the engine and attaining rated voltage and frequency within 10 seconds. The jacket heaters shall be of the capacity recommended by the engine generator manufacturer to meet above conditions. Input voltage to the heaters shall be 208 volts, 1 phase, 60 cycles.

b. Battery heater shall be thermostatically controlled and shall keep battery at optimum temperature for both operation and battery life.

9. Engine Cooling System:

a. Engine shall be provided with 130°F ambient unit mounted radiator. Radiator shall have sufficient capacity to dissipate not less than total British thermal units per hour rejected at 100% full load under the condition specified. Filler cap shall be designed for pressure relief.

b. Cooling system shall be provided with initial charge of permanent type anti-freeze solution containing rust inhibitor.

c. Water-cooled manifold shall be furnished.

I. Safety Shutdowns

1. The engine shall be equipped with safety shutdown contacts for:

a. Low lube oil pressure, prewarn and shutdown.

b. High jacket water temperature, prewarn and shutdown.

c. Overspeed.

d. Overcrank

e. Low water level, prewarn.

f. Low water temperature, prewarn.

J. Generator Control Panel

1. The following electrical instruments and devices shall be included in the generator control panel. Kohler 550 digital or approved equal:

a. digital metering with: voltmeter, ammeter, KVAR meter, power factor meter, KW meter,RWH meter.

b. line circuit breakers.

c. autostart circuitry.

d. NFPA 99/110 alarm and shutdown system.

e. emergency stop pushbutton.

f. Provide programmable protective relay functions for under and over voltage and frequency, reverse power, overcurrent (phase and total), KW, and 3 spare leds.

2. The following engine instruments shall be included in the generator control panel:

   a. Lube oil pressure.

   b. Water temperature.

   c. D.C. voltmeter.

   d. Tachometer.

3. Any other instruments and devices considered necessary by the Manufacturer shall be included.

K. Exhaust System

1. An exhaust silencer suitable for critical type silencing (complete with condensate drains) shall be supplied of the size recommended by the generator set manufacturer. An octave band center frequency, in hertz, data sheet shall accompany all muffler shop drawings. Silencer shall include all required flanges, nuts, boxes, and gaskets.

2. A section of seamless, flexible stainless steel exhaust piping of the size and type recommended by the generator set manufacturer.

L. Mounting

1. The engine and generator shall be close-coupled and mounted on a structural steel base designed to maintain proper alignment of the unit.

2. The unit shall be certified by the manufacturer to be free from any critical torsional vibrations within a range of plus or minus 10% of synchronous speed.

3. Vibration isolators of spring type shall be supplied with the unit. The number of isolators shall be as recommended by the generator set manufacturer, and shall be mounted within the enclosure.

4. Vibration isolators shall be Ace Mountings or approved equal.

5. The generator will be located on the roof of the building. The generator enclosure shall be furnished with a diamond plated floor. The generator and enclosure shall be capable of mounting on a roof curb. Refer to structural plans for details.

M. Generator

1. Rating as shown on the drawings and with the following characteristics.

2. Type – Revolving field, 4 pole, single-bearing, drip-proof, 93% efficiency at nameplate rating.

3. Exciter – Brushless, direct connected, fully tropicalized, SCR rectifiers, static voltage regulator, rheostat, excellent motor starting capability.

4. Voltage Regulation - Plus or minus 1/2% of any preset valve over the three phase load range. Instantaneous voltage dip or rise when measured with an oscilloscope, will not exceed 20% upon full load application, and will return to preset valve within 0.5 seconds. Voltage regulator shall be three phase sensing, provide volts/hertz regulation, provide overvoltage and undervoltage protection, and shall include a solid state circuit to remove excitation when generator is overloaded for more than 10 seconds.

5. Provide a 600-ampere and 100-ampere electronic circuit breakers for the automatic transfer switches.

6. Waveform – Deviation factor of output voltage will not exceed 5% and the value of any individual harmonic will not exceed 2% of the fundamental when operating with an unbalanced load.

7. Temperature Rise – Temperature rise of any component will not exceed the rise permitted by NEMA standards.

8. Rotor – One piece lamination welded and secured to shaft by a key and press fit. Amortisseur windings installed and connected between poles as an aid to parallel operation and improve wave form during unbalanced loads. Field coil machine would on insulated pole body and securely braced. Rotor statically and dynamically balanced.

9. Stator – One piece lamination welded together. Stator coils from wound and placed in insulated slots. Starter pressed and welded in a rigid steel frame.

10. Bearing – Double sealed ball bearing, lubricated for life.

11. Insulation – NEMA Class F insulation.

12. Varnish – Three coats modified polyester type, will not support fungus growth.

13. Cooling – Cast aluminum fan mounted on generator shaft.

14. Radio Suppression – Radiated or conducted radio interference will not affect normal commercial apparatus.

N. Remote Annunciator Panel

1. The engine generator shall be supplied with a surface mount NFPA 99/110 remote annunciator panel with face plate, mounted to annunciation terminal strip, to give remote indication of the following:

   a. Generator power.

   b. Battery charger malfunction (red).

   c. Annunciator "off" (red).

   d. High jacket water temperature (prewarn - amber) (shutdown - red).

   e. Low water temperature (prewarn - amber).

   f. Low oil pressure (prewarn - amber) (shutdown - red).

   g. Low fuel/rupture.

h. Overspeed (red).

i. Overcrank (red).

j. Lamp test switch.

O. Sound Attenuating Housing

1. The entire generator set shall be enclosed in a sound attenuating enclosure constructed of steel throughout. The housing shall include a steel plated floor. The generator will be installed on dunnage on the building roof and will required a steel floor. The housing shall be designed to accommodate heavy snow loads and shall be equipped with motorized vertical intake and vertical exhaust louvers, pre-wired prior to shipment. Housing shall be Kohler or approved equal and shall be constructed per BOCA requirements and certified by a Structural Engineer Registered in the State where job is being constructed.

2. Housing shall have (5) hinged, lockable, keyed alike doors with stainless steel hardware. The doors shall be so arranged as to provide access to vital parts of the generator set for service. Oil pan well and oil drain extension shall be included. Coolant drain and oil drain shall be extended outside housing with lockable rustproof valves.

3. Housing shall be pre-painted with steel exterior, finish as selected by the Designer at the time of submission. Interior shall be anodized aluminum. Floor of enclosure shall be 3/16" diamond plate backed by 3/4" plywood for rigidity.

4. Provide critical silencer, flexible exhaust connector and rain cap. The housing shall include an exhaust stack that extends a minimum of 10’-0” above the top of the housing. Provide all required supports for the stack.

5. Housing shall include sound attenuation with thickness and type of sound insulation and intake and exhaust baffles necessary to achieve a sound level of 71 dB at 7 meters in any direction. Acoustical insulation shall meet UL94 HF1 flammable classification. Submit DB test data in accordance with SAE Recommended Practice J1074. There shall be no puretone. Walls and ceiling shall be lined with perforated aluminum liner. Intake louvers shall be located on opposite sides of enclosure. Complete exhaust system shall be furnished, installed/insulated and mounted within the housing, by Housing Manufacturer prior to shipment.

6. Housing shall be equipped with indoor/outdoor, incandescent fixtures with lamps and on/off switch to operate on normal power or generator power and a DC lighting unit to operate on generator battery. DC lights shall have time switch.

7. Housing shall be completely wired prior to shipment including \ wired to battery charger, jacket water heaters and lighting.

P. Submit details on generator mounted on roof curb requirements with shop drawings. Refer to structural and electrical drawings for minimum requirements.

Q. Generator shall be EPA tier 3 rated, UL 2002 listed and meet all applicable codes.

R. Quality Assurance

1. The supplier of the equipment shall provide with no additional charge and information or supervision required for the proper installation of the equipment and training of operating personnel.

2. Tests:

   a. Preliminary start-up and operating tests of the generator system with the building load shall be conducted for one (1) hour duration to assure that the system is complete and in proper working order, that all adjustments have been made, and that all deficiencies have been corrected.

   b. Engine alarm and shutdown features shall be function tested, including low oil pressure, high water temperature, overspeed and low water level.

   c. Final tests to be witnessed by the A/E shall be scheduled only after preliminary tests have been successfully completed.

   d. Upon completion of the preliminary test on the unit, a load bank test run of three (3) hours duration shall be conducted by the equipment manufacturer's factory-trained servicemen on site. At this time, adjustments shall be made for correct operation of the equipment and the following readings taken at 15 minute intervals:

      1) Ambient temperature

      2) Engine jacket water temperature

      3) Generator temperature

      4) Oil pressure

      5) Battery charger rate

      6) AC volts (all legs)

      7) AC amps (all legs)

      8) Engine air exhaust temperature

      9) Decibel readings with sound meter at 50 feet in all directions

   e. This test shall be made with the door to the enclosure or room in which the generator is locked maintained in the closed position. The test shall be made by load bank sized at the full kilowatt rating of the generator. This load bank shall be furnished by the supplier of the engine generator unit and shall be connected to the generator terminals as one complete and full unit of kilowatt load. This load bank shall be applied to the generator terminals only after the generator has reached its full voltage output.

S. Include provision for 24 hour a day, seven day a week service with service response within two hours after first notification and need for service.

T. In addition to the testing procedures outlined in paragraph "S" above, all testing and startup procedures shall be performed per NFPA, UL and other applicable codes.

U. The engine manufacturer shall provide the necessary lube oil for the crankcase and antifreeze for the cooling system to provide protection to -20°F.

V. The Generator Distributor shall have an ISO 9002 Certified Quality Program in order to be considered as an acceptable supplier. Details of the Quality Certification shall be included with the Approval Submittal Documentation.

2.23 AUTOMATIC TRANSFER SWITCH

A. Manufacturers:

1. The two 2277/480-volt, 3-phase, 4-wire automatic transfer switches shall be an ASCO 300 series or by one of the manufacturers listed below or approved equal.
   a. ASCO.
   b. Russelectic
   c. Kohler
2. As a condition of approval, the manufacturer of the automatic transfer switches shall verify that their switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3 cycle short circuit closing and withstand as follows:
   a. 65k RMS Symmetrical Amperes 480 VAC.

B. Furnish the automatic transfer switches to automatically transfer between the normal and emergency power source.

1. The automatic transfer switches covered by these specifications shall be designed, tested, and assembled in strict accordance with all applicable standards of ANSI, U.L., IEEE and NEMA.

C. General

1. The two automatic transfer switches shall be rated at 260A and 600A, 277/480-volt, 3-hase, 4-wire with switch neutrals. One ATS is for the life safety system and the second ATS is for the standby system.
2. On 3-phase, 4-wire systems, utilizing ground fault protection, a true 4-pole switch shall be supplied with all four poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
3. The transfer switches shall be mounted in a NEMA 1 enclosure, unless otherwise indicated. Enclosures shall be fabricated from 12 gauge steel. The enclosure shall be sized to exceed minimum wire bending space specified by UL 1008.
4. The transfer switches shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.

5. The transfer switches shall be top and bottom accessible.

6. The main contacts shall be capable of being replaced without removing the main power cables.

7. The main contacts shall be visible for inspection without any major disassembly of the transfer switches.

8. All bolted bus connections shall have Belleville compression type washers.

9. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.

10. Control components and wiring shall be front accessible. All control wires shall be multiconductor 18 gauge 600 volt SIS switchboard type point to point harness. All control wire terminations shall be identified with tubular sleeve-type markers

11. The switches shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.

12. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

D. Automatic Transfer Switch

1. The transfer switches shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds

2. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungston alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable.

3. The transfer switch shall be equipped with a safe manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The manual operator shall be safely operated from outside of the transfer switch enclosure while the enclosure door is closed.

E. Automatic Transfer Switch Controls

1. The transfer switches shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have a real time clock with Nicad battery back-up.

2. The CPU shall be equipped with self diagnostics with a watchdog/power fail circuit

3. The controller shall have password protection required to limit access to qualified and authorized personnel.

4. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.

5. The controller shall include three phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.

6. The controller shall be capable of storing the following records in memory for access either locally or remotely:

   a. Number of hours transfer switch is in the emergency position (total since record reset).

   b. Number of hours emergency power is available (total since record reset).

   c. Total transfer in either direction (total since record reset).

   d. Date, time, and description of the last four source failures.

   e. Date of the last exercise period.

   f. Date of record reset.

F. Sequence of Operation

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.

2. The transfer switches shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.

3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source

4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

G. Automatic Transfer Switch Accessories

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
2. Programmable three phase sensing of the emergency source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.
3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds
4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.
5. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal
6. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 3 seconds.
7. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
8. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
9. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
10. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
11. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
12. Light emitting diodes shall be mounted on the microprocessor panel to indicate: switch is in normal position, switch is in emergency position and controller is running.
13. A plant exerciser shall be provided with (10) 7 day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating plant programmable in one minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad initiated.

14. Two auxiliary contacts rated 10 Amp, 120 volts AC shall be mounted on the main shaft, one closed on normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections.

15. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and emergency source.

16. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source

17. A LCD readout shall display normal source and emergency source availability.

H. Service

1. The transfer switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24-hour a day, 365 days a year, call basis.

2. The manufacture shall include an 800 telephone number, for field service contact, affixed to each enclosure.

3. The manufacturer shall maintain records of each transfer switch, by serial number, for a minimum 20 years.

2.24 DRY-TYPE TRANSFORMER

A. Dry-type transformers shall be furnished and installed at the locations shown on the Electrical Drawings to provide 120/208-volt, 3-phase, 4-wire energy from the 277/480-volt, 3-phase, 4-wire building distribution system.

B. Dry-type transformer rated at 3, 6, 9 and 15 KVA shall have 115 degree C rise insulation system and transformers rated 30 KVA and above shall have 150 degree C rise insulation system. Transformers shall be rated at 480-volts, 3-phase primary to 120/208-volt, 3-phase, 4-wire secondary.

C. Dry-type transformers rated at 3, 6, 9, and 15 KVA shall be General Electric Company type ML or approved equal with four (4) 2-1/2 percent taps in the high voltage winding, two (2) above and two (2) below primary voltage. Transformers shall be designed for wall mounting.

D. Dry-type transformers rated 30 KVA and above shall be General Electric Company type QL or approved equal with six (6) 2-1/2 percent taps in the high voltage winding, two (2) above and four (4) below primary voltage. Transformers shall be designed for wall or floor mounting.

E. Dry-type transformers shall be designed with neoprene rubber isolation pads to completely isolate the core-and-coil assembly from the transformer enclosure. The decibel sound rating of the dry-type transformers rated 3, 6, and 9 KVA shall not exceed forty (40) db, transformers rated 15, 30, 45, and 50 KVA shall not exceed forty-five (45) db and transformers rated 75, 112.5, and 150 KVA shall not exceed fifty (50) db.

F. Dry-type transformers shall be designed to operate at 100% percent of nameplate rating continuously, without derating, if the ambient temperature does not exceed 40 degree C. Transformers shall meet the requirements of ANSI standard C89.2 and shall be listed under UL-506. All step down transformer shall meet the requirements of the DOE 2016 standard and Energy Star standards.

G. All dry-type transformers throughout the building shall be mounted in such a manner so that the transformer vibrations are not transmitted to the structural parts of the building.

H. All transformers shall be of the quiet-type construction suitable for installation in areas of low ambient noise levels and shall be General Electric Company type QHT or approved equal.

I. Dry-type transformers shall be manufactured by one of the following or approved equal:

General Electric Company	Square D Company
Siemens	Cutler Hammer

2.25 MINERAL-INSULATED METAL-SHEATHED CABLE

A. The Electrical Contractor shall furnish and install two-hour rated mineral insulated cable for all feeders connected to the life safety emergency power system per MEC Article 700. MI cable to be installed continuously with-out splicing. If splicing is required, the Electrical Contractor shall use the manufacturer approved two-hour splice kit.

B. MI cables shall meet the following requirements:

1. ANSI standards
2. National Electrical Code (NEC) including Article 332
3. Underwriters Laboratories, Inc UL 2196.

C. The MI cable shall be installed per Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

D. MI cable shall be furnished with the following features:

1. Conductor: Copper
2. 600-volt Insulation Voltage Rating
3. Cable Temperature Rating: 90 degrees C.
4. Termination Temp. Rating: 150 deg. C.
5. Insulation Material: Magnesium oxide refractory mineral.
6. Metal-sheath Material: Seamless softdrawn copper.
7. Fire Rating: Cable assembly including supports shall have a 2-hour fire rating as listed and classified by Underwriters Laboratories, Inc.

8. Overjacket: None required; or PVC if cable is directly buried.

9. Provide the required cable terminations, cable splice and lug connectors.

E. Prior to installation the Electrical Contractor shall verify that the cables were not damaged during shipping or while being stored on site.

F. MI cables to be installed in accordance with manufacturer's instructions. Supports shall not exceed three (3) feet on center horizontally, or six (6) feet vertically. Cables shall be installed parallel to building structure. Refer to manufacturer's instructions for cable bending radiuses. Refer to manufacturer's instructions for pulling instructions. Refer to manufacturer's instructions for cable termination instructions.

G. MI cable to be installed continuously with-out splicing. If splicing is required, the Electrical Contractor shall use the manufacturer approved two-hour splice kit and shall be made in the field by manufacturer's field technician, or made in the field by personnel trained by the cable manufacturer using manufacturer's components.

H. When multi-phase circuits have paralleled single conductors, cables shall be run in groups having one of each phase in each group. Each set of paralleled conductors shall be separated by at least two single cable diameters. On balanced three-phase wye circuits neutral conductors may be located within the two cable diameter space between groups of phase conductors. Each group of cables shall be fastened tightly together, at least once between each cable support on horizontal runs and twice on vertical runs, using ½ inch (13mm) wide by 0.030 inch (0.75mm) thick stainless steel straps.

I. Exposed or Surface installations: Cable may be secured directly to fire rated building structure using an approved method such as one, or any combination, of the following: Straps: ½ inch (13mm) wide x 3-1/2 inch (38mm) long by 0.030 (0.75mm) thick stainless steel or copper straps. Each strap shall contain two ¼ inch (6mm) holes for securing with 3/16 inch (5mm) by minimum 1-3/4 inch (44mm) long steel anchors. Steel struts and cable tray: Use only the steel strut framing system and support recommended by Pyrotenax or approved equal. Aluminum or other materials are not acceptable.

J. Embedded Installations: Cables shall be run in the same trifoil configuration as exposed installations. Protect against damage during pulling, and during concrete pouring or backfill and tamping. Where cables emerge from grade, provide PVC conduit, metal plate or angle iron. This protection shall minimally extend from 18 inches (460mm) below grade to 8 ft. (2.5m) above grade.

K. Wall or floor penetrations: Provide sleeve to protect cable and penetration opening during pulling. Provide approved fire stopping of all penetrations.

L. Mineral insulated type MI cable shall be manufactured by BICC Pyrotenax and shall be 1850 2-hour rated cable or approved equal.

2.26 THERMAL SWITCHES

A. Thermal switches shall be NEMA Type 1 toggle switch for normal duty with thermal overload relay. Switch enclosures shall be of a type approved for the location and atmosphere in which it is mounted. Thermal switches shall be installed where called for or where required by Code. Thermal switches shall be provided with pilot where called for on the drawings.

B. Thermal switches shall be as manufactured by Square D, General Electric, Siemens, or equal.

2.27 ACCESS PANELS

A. Provide access panels for access to concealed junction boxes and to other concealed parts of system that require accessibility for operation and maintenance. In general, electrical work shall be laid out so access panels are not required.

B. Access panels shall be located in a workmanlike manner in closets, storage rooms, and/or other non-public areas, positioned so that junction can be easily reached and size shall be sufficient for purpose (minimum size 12" x 16"). When access panels are required in corridors, lobbies, or other habitable areas, they shall be located as directed by the Architect. Access panels for the electrical installation shall be furnished by the electrical contractor and installed by the General contractor. Refer to the access door specification in the architectural section for access door specs.

2.28 ELECTRICAL SUPPORTING DEVICES

A. All conduit and fittings on all work are to be secured by one or more of the following:

1. Masonry - metal clips secured by toggle bolts or lead expansion sleeves.
2. Woodwork - metal clips secured by wood screws.
3. Bar joists - wedge hangers.
4. Flanged beams - flange clips.

B. All pipe hangers and equipment supports shall be constructed and installed in accordance with Seismic Zone requirements as outlined in the State Building Code. This Contractor shall submit one (1) copy of shop drawings and calculations detailing seismic hanger restraints to the local Building Authority and Architect, along with a letter of compliance signed by a registered structural engineer confirming that the piping hangers meet State Seismic Code requirements. Cable provided for seismic systems shall be color-coded and pre-stressed.

2.29 Not used

2.30 POWER SYSTEM STUDIES

A. Short Circuits Studies, Protective Device Evaluation Studies, and Protective Device Coordination Studies shall be provided by this Electrical Subcontractor. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

B. The studies shall include all portions of the electrical distribution system from the normal power source or sources down to and including the 277/480V and 120/208V distribution systems. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

C. The short circuit study shall be in accordance with ANSI C37.5-1969 (R1975), IEEE std. 320-172 and IEEE std. 1141-1976.

D. The study input data shall include the power company's short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances.

E. Short circuit momentary duty values and interrupting duty values shall be calculated on the basis of assumed three-phase bolted short circuits at each power center bus, distribution panelboards, pertinent branch circuit panel and other significant locations through the system. The short circuit tabulations shall include symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, shall be listed with its respective X/R ratio.

F. A protective device evaluation study shall be performed to determine the adequacy of overcurrent and switching devices and automatic transfer switches, by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied.

G. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings. The objective of the study is to obtain optimum protective and coordination performance from these devices.

H. The coordination study shall include all low voltage classes of equipment from the utility's incoming line protective device down to and including the devices in the 120/208 volt panelboards. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.

I. The time-current characteristics of the specified protective devices shall be drawn on Keuffel and Esser log-log paper. The plots shall include complete titles, representative one-line diagram and legends, associated power company's relays or fuse characteristics, significant motor starting characteristics, complete parameters of transformer withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.

J. The selection and settings of the protective devices shall be provided separately in a tabulated from listing circuit identification, IEEE device number, current transformer ratios and recommended power fuse selection shall be provided for the medium voltage fuses where applied in the system. Any discrepancies, problems areas, or inadequacies shall be promptly brought to the Designer's attention.

K. The results of the power system study shall be summarized in a final report.

L. Report shall include the following selections:

1. Description, purpose, basis and scope of the study and a single diagram of that portion of the power system which is included within the scope of the study.
2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties, and commentary regarding same.
3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
5. The Electrical Subcontractor shall test, calibrate, and adjust circuit breaker trip devices as recommended in the power system study.
6. The electrical subcontractor shall provide arc fault warning labels including PPE safety rating on all electrical equipment including switchboard, panelboards and disconnect switches based on the power study results. The electrical contractor shall install the PPE warning labels on all electrical equipment.

2.31 GYMNASIUM BASKETBALL SCOREBOARD

A. Furnish and install one Daktronics BB-2101 single-sided LED basketball scoreboard with AllSport wireless 5000 control console or approved equal. Provide two wireless LED shot clocks and controller. Furnish and install a dedicated 20A-1P branch circuit with receptacle from the nearest 120/208V receptacle panel. Daktronics BB-2101 or approved equal single-sided scoreboard scores basketball, volleyball and wrestling. It scores HOME and GUEST to 99, PERIOD to nine, displays game time to 99:59 and during the last minute of the period, it displays time to 1/10 of a second.

B. General information

1. Dimensions: 4'-0" (914 mm) high, 8'-0" (1981 mm) wide, 0'-6" (152 mm) deep
2. Weight: 90 lb (40.9 kg)
3. Power requirement: 200 W
4. Color: Architect to select color from the standard 150 colors per color chart.
5. All-aluminum construction
6. Scoreboard face and perimeter: 0.063" thick
7. Scoreboard back: 0.050" thick
8. Digit faceplates: 0.090" thick
9. Cabinet withstands high-velocity impact from indoor sports balls without the need for protective screens.
10. Vibrating horn: mounts behind scoreboard face
11. Sounds automatically when period clock counts down to zero
12. Sounds manually as directed by operator Power Cord - Cord is 11' (3353 mm) long and is rated for a 20A-120 VAC-3W outlet
13. Double bonus indicators
14. Protective screen
15. Mounting brackets

C. Digits

1. AS Seven bar segments per digit
2. LED digit technology: UniView Digits - A diffuser over the LEDs blends the light achieving a uniform look with 140 degree wide viewing angle.
3. PERIOD digits: 10" (178 mm) high
4. All other Digits: 13" (254 mm) high
5. Clock, PERIOD digits and bonus indicators: amber LEDs
6. All other digits and indicators: red LEDs

D. Captions

1. AMESBURY and GUEST captions: 4" (102 mm) high
2. All other captions: 4" (102 mm) high
3. All captions: white vinyl applied directly to scoreboard face.
4. The caption Home shall be replaced with AMESBURY.

E. SCORING CONSOLE – Furnish and install a wireless Daktronics All Sport 5000 controller or approved equal. Capable of scoring basketball, volleyball and wrestling. Capable of controlling other All Sport controlled scoreboards. Console has a maximum power requirement of 3 watts. Console includes:

1. A rugged aluminum enclosure to house electronics
2. A sealed membrane water-resistant keyboard
3. A 32-character liquid crystal prompting display to verify entries and recall information currently displayed
4. A 6' (1829 mm) power cord to plug into a standard grounded 120 V AC outlet
5. A 20' (6096 mm) control cable to connect to the control receptacle junction box
6. Carrying case for console
7. 2.4 GHz spread spectrum radio for wireless scoreboard control
8. Provide battery pack

F. Power conduit, cables and outlet boxes to be provided and installed by the electrical contractor. Mount scoreboards and interior displays to wall in location designated by the customer and in accordance with manufacturer's instructions. Unit is plumb and level.

G. Test the operation of the scoreboard, controller and all control jacks, leave control unit in carrying case and other loose items with owner's designated representative. Conduct operator training for the owner on the scoreboard/controller operation.

H. Provide one set of LED shot clocks on the main court basketball backstops.

I. The LED scoreboard with wireless control console shall be manufactured by one of the following or approved equal.

Daktronics, Inc. Fair Play

Neveco

2.32 FIRE ALARM SYSTEM

A. The fire alarm system including all peripheral devices shall be the standard product of a single manufacturer. The control panel shall be of the modular construction type with solid state, microprocessor based electronics. The proprietary addressable fire alarm system shall be Notifier NFS2-640V.

B. Approved Equipment Suppliers

Equipment and materials shall be as manufactured by Notifier. Equipment designations and model numbers herein specified are those of Notifier. It shall be the responsibility of the electrical contractor to ensure proper specification adherence for system operation, final connection, test, turnover, warranty compliance, and after-market service. The distributor of the equipment specified shall be factory trained and certified. All equipment shall be provided by one manufacturer – Notifier.

C. All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the fire alarm equipment standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment does in fact equal or exceed the features, functions, performance, and quality of the specified equipment.

General

A. Provide complete power limited analog-addressable fire detection and alarm system with voice controls. System shall include, but not be limited to: Fire Alarm Control (FACP), Remote Fire Command Center, alarm initiating, audio and visual notification appliances, enclosures and all other equipment necessary to furnish fully operational system. Provide complete system programming, installation, testing and documentation in compliance with all applicable contract documents.

B. Provide alarm detection, audio/visual evacuation signaling, status annunciation, municipal notification, and HVAC control per local requirements.

C. Provide an evacuation system in the entire building a code 3 temporal horn signal via the speaker/strobe units. Provide the required amplifiers with 100% spare redundancy. System shall be activated by the fire alarm control system.

General Requirements

A. Refer to Part 1 of this Section for information on Substitutions.

B. Final connections, testing, and adjusting of system shall be done under direct supervision of system supplier. Services of trained technician employed by system supplier shall demonstrate system to specified requirements of Owner's representative, and make additional adjustments to system operation as specified by Owner's representative.

C. System shall be modular to allow future expansion with minimum of hardware additions.

D. It shall be the contractor's responsibility to ensure that all systems are completely functional at the conclusion of this project.

Codes and Standards:

A. System design and installation shall conform to following standards:

1. Equipment shall be UL listed for its intended purpose.
2. NFPA Standards 70 (National Electric Code), 72, 90A, 92A, and 101.
3. Current State Building Code(s).
4. Americans with Disabilities Act (ADA).
5. Requirements of Local Authority Having Jurisdiction.
6. Massachusetts Electrical Code

Quality Assurance:

A. To ensure reliability and complete compatibility, all Items of the Fire Alarm System, including FACPs, power supplies, as well as all initiating and indicating devices, shall be manufactured by Notifier. All system components shall be listed by Underwriters Laboratories inc. (UL) and Factory Mutual International (FMI) and shall bear the respective labeling. Partial listing shall not be acceptable.

Submittals

A. In addition to requirements of Part 1 of this Section, furnish following:

1. Indicate type, size, rating, catalog number, manufacturer's names, and catalog data sheets for all items to ensure compliance with these specifications. Equipment shall be subject to approval and no equipment shall be ordered without prior approval. Equipment and devices are shown on contract drawings.
2. Furnish calculations to support size of power supplies, audio amplifiers and standby batteries submitted. Calculations shall accommodate voltage drop, wire size, and specified spare capacity allowance.
3. Supply details of any special installation procedures.
4. Provide complete description of system operation.
5. Complete point-to-point riser diagram showing equipment and size, type and number of conductors and devices.
6. Provide signal circuit calculations that demonstrate 25 percent spare capacity, adequate wire size and proper consideration of voltage drop characteristics.
7. Large scale drawings of FACP and any other required hardware panels such as auxiliary power supplies, remote panels showing locations, dimensions and field wiring in full detail.
8. Devices and their corresponding addresses shall be shown on floor plans as part of the specified documentation. Point identification lists shall be provided during the submittal phase to ensure proper coordination of alarm message text assignments that include each device type, address number and corresponding LCD message text.

9. Operation and maintenance manuals (4 copies).

10. Confirmation that manufacturer's representatives that are factory-trained, certified, and properly licensed shall provide job site supervision during system installation, perform final testing and documentation, and instruct Owner's operating personnel on system operation.

11. Complete description of system Sequence of Operation.

12. Provide a copy of the Original Manufacturer's Warranty Statement.

Equipment Overview:

A. The successful bidder shall furnish and install a complete Notifier networked fire alarm system, with all wiring, programming, and connections as described on the drawings and this document. The network system shall be wired in a supervised, 2-wire fashion utilizing Style 7 configuration as per NFPA 72.

B. Catalog numbers specified are those of Notifier and constitute type, product quality, material, desired operating features.

C. Fire alarm control panel (FACP) shall be microprocessor-based addressable panel approved per UL 864 for fire alarm applications. System shall support full analog functions, automatic system programming, alarm verification by individual device and serial interface to network panels, remote annunciators, printers, and alphanumeric displays as applicable.

D. Provide microprocessor based addressable fire alarm system as described herein. Fire alarm control, fire command center, network nodes, annunciator, manual stations, automatic fire detectors, smoke detectors, alarm indicating appliances wiring, terminations, and other necessary materials for complete operating system. System shall be capable of on site programming to accommodate expansion and to facilitate changes in operation. Software operations shall be stored in non-volatile programmable memory within fire alarm control panel. Loss of primary and secondary power shall not erase instructions stored in memory. Full flexibility for selective input/output control functions based on ANDing, Oring, NOTing, timing and special coded operations shall also be incorporated in resident software programming of system.

E. Network panels shall provide complete peer-to-peer operation, whereby each panel shall support standalone operation, as well as global annunciation and control of each point across network. The network shall be capable of Style 7 wiring, so that in the event of a single open or short on the network loop, will not affect any system operation.

F. Standby batteries shall be capable of supplying system under full supervision for 60 hours. Following 60-hour period, system shall supply 100 percent general evacuation alarm output for minimum of 15 minutes.

G. When AC power is restored, system shall revert back to AC power without operator intervention or manual restart.

H. FACP shall permit overall system monitoring, testing, display, reporting, and firefighter controls to override automatic actions. Panel shall serve following functions:

I. Monitor initiating devices, annunciate device in alarm and its location, capture elevators, notify local authorities, and initiate alarm notification by audible/strobe signaling.

J. Alarm initiating devices shall automatically respond with their condition. Control relays shall be programmed by system to respond automatically in event of alarm of related sensors. After proper passcode clearance, operator shall be able to manually control outputs, review and acknowledge outstanding events, review FACP event log and review FACP status.

K. Components and systems shall be designed for uninterrupted duty. Equipment, materials, and accessories, shall be provided by single U.S. manufacturer, except as otherwise called for in Contract Documents.

L. Initiating and indicating circuits shall be as follows: Circuits and devices shall be electrically supervised. Addressable loop and monitor circuits shall be Class A - Style D. Signaling circuits shall be Class A - Style Z. Monitor modules must be with 3'-0" of the device being monitored. Programmable outputs shall enable required auxiliary control and manual override functions, with corresponding addressable inputs, which will support status feedback. FACP addressable loops, audio and ADA visual control portions of system shall accommodate initiating circuits, indicating circuits and devices shown, allowing minimum of 25 percent spare capacity throughout.

Sequence of Operation:

A. Furnish and install a new NOTIFIER series control panel with voice evacuation system with microphones and zone selector switches at the building's main entrances.

B. All alarm, trouble and supervisory signals shall be annunciated on the control panel and fire annunciators. The main FACP and the fire annunciators shall provide the fire department complete control of the fire alarm system

C. The new FACP shall trip the digital master box and activate all new A/V notification devices.

D. During an alarm condition, the new NOTIFIER FACP shall activate all new A/V signals, trip the digital master box.

E. During a trouble or supervisory condition, the new FACP shall activate the digital dialer and contact the central station

F. Connect the fire alarm control panel to the 16 zone digital master box, the fire alarm control panel shall trip the digital master box during any alarm condition. Furnish and install a new digital dialer in the new NOTIFIER FACP. Furnish and install two cat 3 telephone cables from the new FACP to the head end room. The new NOTIFIER FACP shall transmit all trouble and supervisory signals for the fire alarm system.

G. Operation of addressable station or activation of any addressable alarm initiating device (smoke, heat, pull station, duct smoke detector, flow switch) shall automatically:

1. Activate speakers using a temporal code 3 signal and synchronized ADA visual alarm strobes throughout building. Upon operation of system silence, audible signals shall silence while visual signals shall continue to operate until system is reset. Restoring circuits to normal after acknowledge button has been operated shall cause lamp to extinguish. Trouble signal shall resound every time new trouble (or supervisory) condition is reported.
2. Display device address, type and location or circuit of initiation via LCD display located at main FACP, remote network panels and system annunciators.
3. Initiate transmission of an alarm signal to Fire Department via the 16 zone master box.
4. Initiate alarm transmission to the BMS network.
5. Visually annunciate device location by building, zone, floor, and device type (per floor).
6. Automatically shut down HVAC units.
7. Operate prioritized outputs to release magnetically held smoke doors and magnetically locked doors in building. Release stair door locks, access controlled door locks and fire shutters.
8. Activate exterior red weatherproof beacon.
9. Upon activation of any analog addressable smoke sensor, system shall reset detector for period of 10 - 15 seconds. After reset, second detector activation during verification period shall initiate alarm response as descried previously with addition of following actions.
10. Operation of system silence switch shall silence all connected audible appliances. In event of subsequent alarm after system silence, FACP shall resound building alarm signals.
11. Audible trouble signal shall be capable of being silenced with trouble signal acknowledge button, but lamp shall not be capable of being extinguished until circuits are normal. Restoring circuits to normal after acknowledge button has been operated shall cause lamp to extinguish. Trouble signal shall resound every time new trouble (or supervisory) condition is reported.

Fire Alarm Control Equipment:

A. Provide a Notifier NF640 Series Addressable Fire Alarm Control Panel (FACP) or approved equal.

B. The fire alarm control, fire command center, and audio control portions of system shall be housed in locking, semi-flush mounted enclosures. Status indicators shall be visible through clear Lexan windows. Access to control panels shall be by keys issued to Fire Department and authorized personnel. System design shall allow simple expansion to increase the number of amplifiers, control switches, power supplies, and batteries, as described herein.

C. Provide a Notifier broadband Series Addressable Fire Alarm Control Panel (FACP). The fire alarm control shall be housed in locking, semi-flush mounted enclosures. Status indicators shall be visible without the need to open cabinet. Access to control panels shall be by keys issued to Fire Department and authorized personnel.

D. Using proper password level, operator shall be capable of monitoring and adjusting analog value of system smoke detectors. Operator may also print log of current smoke detector obscuration ranges.

E. Signaling Line Circuit (Addressable Loop):

1. System shall supply communication with initiating and control devices individually. Devices shall be individually annunciated at control panel. Annunciation shall include following conditions for each point: Alarm, Trouble, Open, Short, Ground, Device Fail/or Incorrect Device, and Device dirty or out of range.
2. Addressable devices shall have capability of being disabled or enabled individually. Up to 198 addressable devices may be multi-dropped from single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable. Communication format shall be poll/response protocol to addressable devices and be binary coded digital.
3. Each detector shall be uniquely identified by unique address, which is established via rotary decade switch on each device at time of installation. Use of jumpers or special programming tools to set device address, or extract device data will not be acceptable. Devices that require addresses to be set in the mounting base are not acceptable to due to reliability concerns.
4. Base shall be common to smoke or heat heads. System shall allow Owner to replace detector heads without need for programming, scanning or downloading into device.
5. System shall allow up to 2,500 feet wire length to furthest addressable device. Provide Class A (Style 7 Signaling Line Circuit as defined by NFPA-72) communications.
6. Provide line fault isolator modules installed in manner that shall limit performance degradation in event of short signaling line circuit. A maximum of twenty-five devices shall be installed between isolator modules. Each addressable loop shall provide a minimum of two individually isolated circuit loop Sections. In the event of failure of one loop Section, the balance of circuit shall continue to operate.

System Annunciation:

A. Provide FACP with 80 character LCD display integral to FACP. In addition, provide dedicated alarm, supervisory, and trouble LED indications and local tone-alert. It shall also contain the following function keys: Alarm Acknowledge, Trouble Acknowledge, Signal Silence, System Reset/Lamp Test and System Drill Test. The FACP shall include zone selector switches and a microphone.

B. Under normal condition, front panel shall display "SYSTEM NORMAL" message and current time and date.

C. Should abnormal condition be detected, appropriate LED (Alarm, Supervisory, or Trouble) shall flash. Panel audible signal shall pulse for alarm conditions and sound steadily for trouble and supervisory conditions.

D. Panel shall display following information relative to abnormal condition of point in system: Custom location label, Type of device (i.e. smoke, pull station), Point status (i.e. alarm, trouble).

E. Provide supervisory indications for: Municipal box reset required, Emergency generator status.

F. Provide status indications for: Elevators recalled to first floor, Elevators recalled to alternate level, Stair doors unlocked, access controlled doors unlocked, Elevator shaft damper release, Fire shutter release, Fire Pump Status.

G. Provide status indication for alarm, trouble and supervisory alarms to the BMS network.

System Power Supplies:

A. Provide 3.75 amps of 24 VDC system power (minimum) within each transponder panel, with integral battery charger and standby batteries. Battery charger shall support lead acid batteries of up to 31 AH. Provide power supplies to operate system under alarm full load condition with 25 percent spare capacity.

B. Supplementary Notification Appliance Circuit (SNAC) Power Supplies shall be located in the primary electrical closets. Provide 6 amps of 24 VDC remote system power audio/visual devices. The system shall provide four Class A circuits which are individually controlled. The SNAC shall have integral synchronization of the strobe devices (as applicable); the use of external synchronization modules shall not be permitted. Up to 10 SNAC power supplies shall be interconnected to ensure device synchronization over large areas. The system shall transmit any fault conditions back to the main FACP via the addressable loop. Battery charger shall support lead acid batteries of up to 31 AH. Provide power supplies to operate system under alarm full load condition with 25 percent spare capacity.

C. Each floor shall be equipped with a minimum of two notification appliance circuits.

System Devices:

A. Provide analog/addressable devices where shown and specified. Each device shall communicate with fire alarm control panel via digital data communications. Where ambient conditions preclude use of addressable devices, equivalent conventional devices shall be used. In this instance, each device shall be monitored by dedicated addressable module that shall be installed in appropriately heated/ventilated space. The following detectors shall be supported:

1. Analog photoelectric smoke detectors
2. Analog thermal 135 F detectors
3. Analog high temperature thermal
4. Analog addressable duct detectors
5. Analog sensors shall have a low profile and be capable of being set at five sensitivity settings of “LOW, LOW MEDIUM, MEDIUM, MEDIUM HIGH, and HIGH” levels.

B. Automatic and manual functional sensitivity and performance tests shall be possible without the need for generating smoke. This method shall test all sensor circuitry and a “Failed Test” indication shall display for any failed test.

C. The system shall check the sensitivity of each sensor periodically. If sensor alarm threshold sensitivity has changed, due to aging and/or dust accumulation, the system shall automatically compensate for this change (drift compensation).

D. Each sensor shall allow for the setting of two sensitivity levels. These levels may be programmed so that when the building is occupied, a sensor will be less sensitive than when the building is unoccupied. This feature permits sensors to be more reliable and at the same time reduces/minimizes unwanted alarms. This feature shall also provide for programmable weekend days, where the sensor will remain at an unoccupied sensitivity level.

E. Sensors shall contain magnetically actuated test switch for easy alarm testing at sensor location. Sensor's electronics shall be immune from false alarms caused by EMI and RFI. The sensor screen and cover assembly shall be removable for field cleaning.

F. Addressable thermal sensors shall have a low profile and operate on the “fixed temperature” principle, or combination fixed temperature rate-of-rise, with the sensor having a set point of 135 o F. They shall contain dual thermistor sensing circuitry for fast response.

G. Provide duct sensor housings where shown. Provide remote test and indicating station near each detector. Provide sampling tubes sized according to duct width. Provide two 10A. 24 VDC contacts in detector. Wire NC contacts in relay to fan motor starter. Where possible, duct detector will be mounted in straight runs of ductwork at least six duct widths downstream from ductwork bends. Coordinate physical location of detector with HVAC and with system equipment representative.

H. The mounting base shall accommodate all models of addressable heat detectors and smoke detectors to ensure matching the proper sensor to the potential hazards of the areas being covered. In all cases the system shall recognize when an improper sensor type has been installed in a previously programmed sensor type location.

I. Addressable Monitor Module, with an initiating circuits wired Class B, Style B shall be furnished to provide two addresses for individual, normally open (N.O.) contact devices.

J. Addressable Monitor Module. An addressable monitor module with an initiating circuit capable of being configured either Class A, Style D shall be furnished to provide an address for an individual, normally open (N.O.) contact de-vice, or a collective address for a group of such devices. The AMM-4 module shall contain a yellow status LED that shall flash when in a quiescent mode and light continuously when in alarm. Use one module for each tamper, flow or pressure switch.

K. Addressable Sub-Loop Module. An addressable sub-loop module with an initiating circuit capable of being configured either Class A, Style D shall be furnished to provide an address for compatible conventional smoke detectors. The AMM-4S module shall contain a yellow status LED that shall flash when in a quiescent mode and light continuously when in alarm. Use one module for each existing detection zone.

L. Addressable Output Module. An addressable output module shall be connected to the same signaling line circuit as the analog/address-able monitor devices and shall provide a DPDT relay output (2 Form “C” 2 amp @ 24 VDC, resistive only) for the AOM-2R. The AOM-2S shall provide a notification appliance circuit output (1 amp @ 24 VDC, requiring separate power input) or a solenoid energizing circuit or releasing service. The AOM-2R/S module shall contain a yellow status LED that shall flash when in a quiescent mode and light continuously when activated. The LED shall be field programmable not to provide quiescent status indication if so desired.

M. Fault Isolator Module. This module enables part of the signaling line circuit to continue operating when a short circuit occurs on a section of it. An LED flashes in the normal condition and lights during a short circuit condition. The module automatically restores the entire circuit to the normal condition when the short circuit is removed. This module may be used in multiple in any combination with other modules, providing circuit operation is similar to that of NFPA Style 7. It does not require an address on the signaling line circuit.

N. Provide double action addressable pull stations with electronics that communicate station's status (alarm, normal) to control panel over two wires which also supply power to pull station. Address shall be set on each station and status LED shall be visible from front of device. Stations shall be manufactured from high impact red Lexan. Lettering shall be raised and painted white. Station shall mechanically latch upon operation and remain so until manually reset by opening with key common to all system locks. A key shall be required to reset and shall be keyed alike with the control cabinet. For weatherproof applications, Model MS-7LOB shall be used with an addressable module.

O. Provide Class A addressable monitoring module where required to supervise conventional initiating devices such as waterflow, tamper switches or beam detectors. Modules shall also be used for status monitoring of related systems such as HVAC units.

P. Provide remote addressable control modules, Notifier AOM Module where required to conduct remote control functions or outputs. Remote control modules shall provide form C contact output rated for 2 amps at 24 VDC.

Q. Provide Notifier combination speaker/strobe units or visual only units where indicated. Visual units shall consist of 24V with Xenon Flasher in clear lens. Word "FIRE" shall be imprinted in bold white lettering. Light output shall be field selectable with settings of 15, 15/75, 30, 75, and 110 candela. Devices that are not field adjustable will not be accepted. Where two or more strobes are within in common field of view, all strobes shall be synchronized. Speaker dBa output at 10 feet shall be 88. Speakers to be tapped at 2 W.

R. Furnish and install magnetic door holders for all fire and smoke doors and all other locations shown on contract drawings.

S. Furnish and install a digital dialer to supervisory and trouble alarms signals to the fire department and a central station via a telephone line.

T. Furnish and install a 16 zone digital master box for alarm and carbon monoxide alarms. The master box shall be compatible with the fire department's system. Furnish and install the required labor, material and programming to install 16 zones between the master box and the FACP using CI rated cables. Furnish and install the IMSA cable between the master box location and the roof antenna. Provide roof antenna and supports. Provide lightning arresters on the IMSA cable.

U. The Electrical Contractor shall provide the required fire alarm control/monitor modules, cable, conduits and fire alarm system programming to provide NFPA 72 required supervisory and monitoring System and signal booster supervisory signals shall include the following:

1. Antenna malfunction
2. Signal booster failure
3. Power supply supervisory signals shall include the following for each signal booster:
4. Loss of normal ac power
5. Failure of battery charger
6. Low-battery capacity, alarming at 70 percent of battery capacity

Spare Parts:

A. The following equipment shall be provided as spare parts to the owner and stored on-site in original sealed containers:

1. Ten smoke detectors with mounting bases

2. Three heat detectors with mounting bases
3. Five addressable pull stations
4. Five Speaker/strobe units with adjustable candela
5. Five strobe only units with adjustable candela

System Accessories:

A. Provide (red) remote LED indicator for detectors located behind locked doors and for elevator shafts. Each LED shall be mounted on stainless steel plate and have permanent label identifying actual device location.

B. Provide two flashing weatherproof strobes where shown, one (red) for alarms and one (amber) for trouble/supervisory. Device shall mount to standard weatherproof box with 1/2 inch NPT pipe mount. Operating range shall be -10 degree to 122 degree F to be suitable for New England weather condition

C. Provide key box repository (minimum size Knox Box 4400 series or approved equal), type and location to be approved by local Fire Department.

D. Furnish and install flush mounted electromagnetic door holders where shown and indicated. Device shall operate on power supplied from fire alarm control panel. Under normal conditions, magnets shall hold door open. Upon activation of building fire alarm system, devices shall be de-energized, thus releasing doors on circuit. Devices shall be designed for wall or floor mounting as specified by location shown on drawings, complete with matching door plate, material and finish to match door hardware. Electromagnet shall operate from 24 VAC.

System Programming:

A. System shall be software configured on site via laptop computer. Complete software configuration shall be constructed on computer without need for connection to system.

B. Fire detection and alarm system shall permit system revision and expansion to be completed on site. Under no circumstances shall system's site specific configuration program be required to be returned to manufacturer for modification as result of system expansion or revision.

C. The electrical contractor shall include two additional programming sessions to make changes to the fire alarm program per the required changes made by the fire department. This scope of work shall include the required labor by the electrical contractor and the Notifier service company.

D. Configuration shall be stored on standard floppy disk for subsequent downloading to Fire Alarm Control Panel (FACP). Floppy disk configuration file shall contain installation name and specific configuration revision number. Revision number shall allow for tracking of system modifications throughout life of system. Provide one copy of the disk with the O&M manuals and one inside the FACP including password. Each revision of system configuration on floppy disk shall include following information.

1. Date/time of modifications to configuration.
2. Description of changes made to system.
3. Identification of programmer who input program revisions.
4. Installation shall be supervised and tested by equipment supplier. Work shall be performed by skilled technicians under direction of experienced engineers, all of whom shall be properly trained and qualified.

Wiring:

A. Wire and cable for fire alarm systems shall be solid color coded, copper conductors, power limited, UL listed type FPL plenum rated, 105 degrees C, with red jacket and labeled as complying with NFPA 70, Article 760, and as recommended by manufacturer.

B. Signaling Line Circuits (Addressable Loop): Twisted, unshielded pair, minimum No. 16 AWG as recommended by system manufacturer.

C. Strobe Circuits: Unshielded pair, minimum No. 14 AWG, as recommended by system manufacturer.

D. Audio Circuits: Twisted, shielded pair, minimum No. 16 AWG, as recommended by system manufacturer.

E. Wiring for system shall be in accordance with Articles 760, 725, and 800 of National Electrical Code and local electrical codes.

F. Where cable is run in pipe or tubing, pull boxes shall be painted red, and four inch wide red stripe shall be painted on pipe or tubing every ten feet such pipe ort tubing is exposed. Fire alarm cable in raceways shall be tagged every 20 feet.

G. Provide plenum fire alarm metal clad cable for runs concealed in ceiling and walls. Cables may be run longitudinally or laterally throughout the ceiling. Provide EMT raceways where run exposed, where run within walls or in inaccessible ceilings.

H. Wiring of audio circuits shall maintain minimum 12 inch separation between supply and return circuits.

I. Provide rigid steel conduit at exterior locations and for all vertical runs between floors.

J. Provide complete wiring and conduit between all equipment. Devices shall be mounted upon and terminations made in UL boxes. Wiring splices and transposing or changing of colors will not be approved.

K. Junction boxes shall be painted red with gasketed cover, and labeled as 'FIRE ALARM SYSTEM'.

L. Fire alarm control systems and equipment shall be connected to separate dedicated branch circuits, sized for proper service. Circuits shall be labeled 'FIRE ALARM'.

Final Test (Pre-acceptance Test):

A. During final testing, sound level measurements shall be taken and recorded in each occupied space. System shall produce 75dbA, or 15dbA above ambient (whichever is greater. Following initial measurement, necessary adjustments shall be made to each speaker setting to ensure compliance with Contract Documents and applicable code.

B. Perform complete final test of system indicating proper functioning of system. Furnish copies of completed NFPA 72 system Certificate of Completion in accordance with NFPA 72 to Owner and Architect for documentation and record purposes.

C. In addition to pre-acceptance test, Contractor shall provide for complete and final Fire Department Acceptance Testing in accordance with requirements of Authority Having Jurisdiction and applicable code.

Fire Alarm Inspection and Testing Contract:

A. Provide Certificate of Completion indicating proper functioning of system as well as certification/acceptance by Fire Department, in accordance with NFPA 72.

B. Prior to making final connections, system supplier shall furnish contract to Owner for fire alarm system inspection and testing contract in compliance with NFPA-72. Testing Contractor shall be trained and certified by original manufacturer to be a holder of a certificate of competency as Fire Alarm System Contractor from Fire Department, and be responsible for inspection, testing, and maintenance of interior fire alarm system for duration of original manufacturer's warranty period. Contract shall be for guarantee period with option to extend by Owner.

C. Submit to Fire Department signed and executed documentation verifying that entire fire alarm system has been tested in accordance with NFPA 72 and Underwriters Laboratories guidelines. Also, copy of signed and executed contract for periodic testing shall be provided to Fire Department prior to requesting their services for acceptance testing.

D. As part of the base bid, a one (1) year service contract shall be included. The manufacturer of the fire alarm system shall guarantee all equipment and the functional operation of the system for a period of one (1) year from the date of final acceptance by the CITY. During the one year guarantee period, the fire alarm system manufacturer or his authorized representative shall respond within twelve (12) hours after notification of any malfunction.

E. The programming of the fire alarm system shall be in accordance with the operational requirements of the School and the Fire Department. After the system has been completely installed and in operation, all parties shall meet to determine if the initial programming should be adjusted for oversights or that changes should be made to the operational procedures. The School shall be provided with two (2) additional programming sessions to make any and all changes to the system accomplish the desired operation. Program changes shall be done without additional cost to the Owner. The Electrical Contractor shall furnish and install self adhesive labels showing the address number for all initiating devices.

F. Test reports shall include following information:

1. Date of test
2. Name and location being tested
3. Number of interior alarm circuits
4. Number of devices tested and type
5. Condition of emergency standby power supply
6. Conditions of analog sensors - report shall identify any analog smoke detectors that are contaminated and approaching a trouble (dirty) state. After first year of operation, each and every analog sensor shall be cleaned and recalibrated in accordance with NFPA 72 testing and maintenance guidelines.
7. Name of company conducting test
8. Name and signature of person conducting test

Training:

A. Provide services of manufacturer's representative for period of up to 8 hours, during normal business hours, to instruct Owner's designated personnel on operation and routine maintenance of system.

2.33 TWO WAY COMMUNICATIONS SYSTEM

A. The electrical contractor shall furnish and install a two way communication system per the State Building Code CMR 780 1009.8. The approved manufacturers shall be Rath, Alpha and Cornell or approved equal. Contractor to engage the services of the manufacturer service company for program and testing the two way communication system. The system shall not be designed for Area of Refuge and shall not use any Area of Refuge signage.

B. The Base Station is to be located at the annunciator location at the main entrance on the first floor or as determined by local Authority Having Jurisdiction. Call boxes are to be located on all floors above and below the first floor, at the elevator landing on each floor.

C. The *Base Station* must be capable of handling a minimum of ten *Call Boxes*. Visual indicators on the *Base Station* allow rescue personnel to know which *Call Box* needs assistance. The *Base Station* must allow rescue personnel to speak to all *Call Boxes* or individual *Call Boxes.*

D. The emergency communication hardware shall comply with the Americans with Disabilities Act (ADA). The *Call Box* shall have the ability to be programmed with up to 5 emergency phone numbers. Upon activation of the emergency push button, a call will be automatically placed to the *Base Station*. If no one answers at the *Base Station*, the *Call Box* must dial a secondary location outside the building to activate two-way off-site person to person voice communication via IP (Rath # 2100-VOIP or approved equal).

E. Submit product data sheets. Include operation manuals. Wiring or shop diagrams detailing wiring schematics, cabling.

F. The *Base Station* (Rath models 2500-205B with #2100-VOIP interface or approved equal) shall have a Stainless Steel plate, recessed mounted, red coil cord emergency handset, be 24vdc or 120vac powered and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time. The *Base Station* must provide an audible and visual indicator that a *Call Box* has been activated. *Base Station* must have a built-in battery backup and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time.

G. The *Call Boxes* (Rath models 2100-958SSSRC2 with cover/#7049 signature/#7044Braile, #7050 custom label “help” phone with handicap wheel chair symbol or approved equal) must be in full compliance with ADA requirements. *Call Boxes* require a hands-free speakerphone with an LED to indicate status of call. *Call Boxes* must have built-in battery backup and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time. If *Call Boxes* require protective covers per local municipal codes, use RATH® 2100-XXXSSRC2 or approved equal. The *Call Boxes* must have a Braille face plate to ensure conformance with the ADA requirements.

H. The *Call Boxes* must allow the programming in of a specific location message of the *Call Box*. This allows rescue personnel to know the location of the activated *Call Box*.

I. The *Call Boxes* are to be located no higher than 48” front reach, or 54” side reach to the center of the push button above ground level to ensure conformance with the ADA requirements.

J. The 24vdc *Power Supply* Rath # 2500-PWR24 or approved equal must be capable of supplying power to a minimum of 10 *Call Boxes* and the *Base Station*.

K. The *Base Station* and all call boxes shall be of the recessed (flush) wall mounting type.

L. *Call Boxes* and *Base Station* are to be powered by RATH 24vdc *Power Supply* part # 2500-PWR24 or approved equal. *Base Station* to have option of 120vac power. Wiring from the *Base Station* to the *Call Boxes* shall be RATH Cable part # RP7500094 or approved equal. If CI 2 hour fire-rated cable is required, use RATH part # RP6600300M or approved equal.

M. System shall be in compliance with all state and local Electrical Codes.

N. Communications – The *Call Boxes* shall have an ADA compliant and vandal resistant speakerphone. The *Call Boxes* shall be hands-free and be a push-button-once to talk system. Once the button has been pushed, the *Call Box* will call the *Base Station*. If no answer at the *Base Station*, it will automatically call pre-programmed emergency numbers. The *Call Box* must be capable of being programmed with up to 5 emergency numbers. *Call Box* shall have location message capability. *Call Box* must have a minimum 18 second recordable message capability, programmable to play 1 or 2 times. *Call Box* shall notify called party of the location of the call upon being received at the emergency dispatch center. *Call Box* shall be capable of allowing the called party to replay the location message if necessary to ensure an understanding of the caller location. If system is not attended 24 hours a day, the *Call Box* must dial a secondary location outside the building to activate *two-way off-site person to person voice communications*. Once call has been made (button pushed), the call can only be terminated by the called party. *Call Box* must have a red LED that will light up upon push of the button. The light shall be a solid color when the *Call Box* is activated, and will flash when call has been answered. The *Call Box* must be capable of being programmed and re-programmed on-site and remotely.

O. Standard *Call Box* features – Five number programming. Operating temperature of between -40˚F to +150˚F (-40˚ to + 65˚ C). Programmable passwords. On-site or remote programmable. EEPROM memory to protect programming.

P. Signage – System shall consist of a minimum of “location” and “instruction” sign (Rath part # 7049SS or approved equal) to clearly indicate location of designated area. A tactile sign (Rath part # 7043/7044 or 7087 or approved equal) with raised letter and Braille shall be located at entrance to area.

Q. *Base Station* must include wording identifying the location of each *Call Box* and light an LED when a particular *Call Box* has been activated. *Call Box* wording must include “Emergency Phone”, International Phone Symbol and raised Braille lettering.

R. Cabling for two-way communication system shall meet the applicable requirements for pathway survivability. Cabling installation shall consist of one or more of the following:

S. The *Base Station* and *Call Boxes* shall have a manufacturer’s warranty for a period of three years.

2.34 SURGE PROTECTION DEVICES (TVSS)

A. Description: This section describes the materials and installation requirements for integrated surge protection devices (SPD) at panels for power to marquee tower.

B. Approved Vendors: Square D Company, Siemens, General Electric or approved equal.

C. Integral Surge Suppressor

1. SPD shall be Listed and Component Recognized in accordance with UL 1449 to include Section 37.3 highest fault current category. SPD shall be UL 1283 listed.
2. SPD shall be installed by and shipped from the electrical distribution equipment manufacturer's factory.
3. SPD shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems.
4. SPD shall be modular in design. SPD for service entrance application shall provide two modules per phase for redundant protection. Each mode including N-G shall be fused with a 200kAIC UL recognized surge rated fuse and incorporate a thermal cutout device.
5. Audible diagnostic monitoring shall be by way of audible alarm. This alarm shall activate upon a fault condition. An alarm on/off switch shall be provided to silence the alarm. An alarm push to test switch shall be provided.
6. If a dedicated breaker for the SPD is not provided, the SPD shall include a UL recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD's
7. SPD shall meet or exceed the following criteria:
   a. Minimum surge current capability (single pulse rated) per phase shall be:
      1) Service entrance switchboard: 240kA per phase
      2) Panelboard/MCC locations: 160kA per phase
   b. UL 1449 Suppression Voltage Ratings:

	VOLTAGE	LOCATION	L-N	L-G	N-G
1)					
2)	208Y/120V	Service Entrance:	330V	330V	330V
		Distribution:	330V	330V	330V
3)	480Y/277V	Service Entrance:	700V	700V	700V
		Distribution:	600V	600V	600V

8. SPD shall have a minimum EMI/RFI filtering of -50dB at 100kHz with an insertion ration of 50:1 using MIL-STD-220A methodology.
9. SPD shall be provided with one set of NO/NC dry contacts.
10. SPD shall have a warranty for a period of five years, incorporating unlimited replacement of suppressor parts. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

2.35 LIGHTNING PROTECTION SYSTEMS

A. The work covered by this section of the specifications consists of furnishing all labor, materials and items of service required for the completion of a functional and unobtrusive lightning protection system as approved by the architect, and in strict accordance with this section of the specifications and the applicable contract drawings.

B. The Electrical Contractor shall submit shop drawings from the lightning manufacturer

C. If any departure from the contract drawings or submittal drawings covered below are deemed necessary by the Contractor, details of such departures and reasons therefore shall be submitted as soon as practicable to the architect for approval. No such departures shall be made without the prior written approval of the architect.

D. The system to be furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest approved design. The equipment manufacturer shall also be an approved manufacturer. All material specified for this work is manufactured by Heary Bros. Lightning Protection Co., Inc. or approved equal. Manufacturer shall be one of the following or approved equal. Heary Brothers, Boston Lightning Rod, Morse Collins.

E. Complete shop drawings showing the type, size, and locations for all equipment, grounds, and cable routings shall be submitted to the architect for approval prior to start of work.

F. All equipment shall be new, the product of a single manufacturer as outlined above, and of a design and construction to suit the application where it is used in accordance with accepted industry standards.

G. The ground resistance of the completed system shall be measured using IEEE "Fall of Potential Method" in the presence of the Architect/Engineer and shall be forwarded to the ESE manufacturer. Ground resistance shall be ten (10) Ohms or less.

H. All materials shall be copper or bronze and of the size, weight, and construction to suit the application where used in accordance with requirements for Class II structures and as per manufacturer recommendations. Conductors shall be of 28 strands 14-gauge minimum diameter. Heary Bros. Cat. No. HB-28-14C or approved equal.

I. Air terminals shall be solid, round copper bar of 1/2" minimum diameter. Heary Bros. Cat. No. HB-302C or approved equal, and shall project 10” minimum above the object to be protected. Locate and space according to requirements. Air terminal bases shall be of cast bronze with bolt pressure cable connections and shall be securely mounted with stainless steel screws or bolts. Crimp type connectors are not acceptable. Heary Bros. Cat. No. HB-32C, 22C, 8SS-C, 25C. or approved equal as specified. Bases on flat roofs or built-up tar and gravel roofs shall be secured with a proper adhesive and shall have a minimum surface contact area of 18.5 sq. inches. Cat. No. HB-23C or approved equal. Ground rods shall be a minimum 3/4" in diameter and 10'-0" long. Heary Bros. Cat. No. HB107GR or approved equal. They shall be connected to the system with a two-bolt cast bronze clamp, No. HB1112 or approved equal, having a minimum length of 1-1/2" and employing stainless steel cap screws.

J. Cable fasteners shall be substantial in construction, electrolytically compatible with the conductor and mounting surface and shall be spaced according to requirements. Heary Bros. Cat. No. HB66C, 72C, or 64C or approved equal.

K. Bonding devices, cable splicers and miscellaneous connectors shall be of cast bronze with bolt pressure connections to cable. Cast or stamped crimp fittings are not acceptable. Splicers shall be similar to Heary Cat. No. HB-44C, 26C. or approved equal, Bonding devices shall be similar to Heary Cat. No. HB-54C, 97C, 42XC, 42C, or approved equal.

L. Equipment on stacks and chimneys shall be protected from corrosion in accordance with requirements. Air terminals shall be ½” x 24” corrosion resistant copper Heary #HB-304CR or approved equal. All miscellaneous bolts, nuts and screws shall be brass, bronze or stainless steel.

M. The installation shall be accomplished by an experienced installer. The installer shall work under the direct supervision of a manufacturer as listed above or his authorized representative.

N. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof including all air terminals, splicers and bonds with cable downleads routed concealed in the building construction in PVC conduit to ground.

O. Downlead cables shall not be brought directly through the roof. Thru-roof connectors with solid rods or conduit through proper roof flashings shall be utilized for this purpose.

P. The electrical contractor shall furnish and install all necessary PVC conduit for concealed down conductors. All roof flashings shall be provided by the Roofing Contractor.

Q. Copper equipment shall not be connected to aluminum surfaces except by means of a bimetal transition-fitting. Lead coating is not to be accepted as a bimetal transition.

R. The electrical contractor shall work with other trades to insure a correct, neat and unobtrusive installation.

S. It shall be the responsibility of the electrical contractor to assure a sound bond to the main water service and to assure interconnection with other building ground systems, including both telephone and electrical. Proper arresters shall be installed on the power and telephone service by either the utility or the electrical contractor as applicable.

T. The electrical contractor shall secure and deliver the as-built shop drawings to the architect for the owner upon completion of the installation.

2.36 ELECTRIC SUB-METERING SYSTEM

A. DESCRIPTION OF WORK

1. Provide a complete Electronic Submetering System to measure, store and export recorded KWH and real time KW data for the electrical feeders consumption data to intelligent and intuitive software to display pertinent data in a dashboard fashion via Internet web browser via password access. The data collection shall be collected on a 15 minute intervals and shall be programmed to automatically export the data via email to the Project's LEED Consultant as part of the necessary data gathering for the LEED credit Measurement and Verification process. The meter readings shall be transmitted to the metering software and to the building management software.
2. The Metering System shall meet all requirements of LEED v4 including but not limited to the following:
    a. Meters must be permanently installed, record at intervals of one hour or less, and transmit data to a remote location.
    b. Electricity meters must record both consumption and demand. Whole-building electricity meters should record the power factor, if appropriate.
    c. The data collection system must use a local area network, building automation system, wireless network, or comparable communication infrastructure.
    d. The system must be capable of storing all meter data for at least 36 months.
    e. The data must be remotely accessible.
    f. All meters in the system must be capable of reporting hourly, daily, monthly, and annual energy use
3. Retain the services of the electronic submetering factory authorized service and sales representative to provide all meter, equipment, software, wiring and conduit, low voltage communications cabling, programming of the dashboard displays, commissioning of the systems and final connections supervision.
4. Exact quantities and equipment configurations shall be coordinated with the equipment manufacturer based on plans, specifications and control schedules.
5. Provide dedicated 120volt 20amp branch circuits from the normal power distribution to complete power installation to the equipment.

6. The specifications and drawings describe the minimum requirements that must be met by the Electrical Subcontractor for the installation of all work as shown on the drawings and as specified herein under.

B. REFERENCES – The equipment shall be UL listed. The system shall comply with all applicable Codes regarding electrical wiring standards. The system shall comply with all applicable portions of the NEMA standards regarding the types of electrical equipment enclosures.

C. SUBMITTALS – Submit complete manufacturer's product data of all materials and systems to the Architect for approval, consisting of complete product description and specifications, bill of material, warranty, one-line diagrams, system operation description complete performance test data, complete preparation and installation instructions, and all other pertinent technical data required for complete product and product use information.

D. ELECTRONIC SUBMETERING SYSTEM

1. Provide electronic submetering metering system with digital LCD display. Meters shall be UL Listed and shall be E-mon D-mon series 2000 or approved equal. Meters shall be capable of transmitting energy data simultaneously to the Building BMS system via bacNET IP protocol and to the metering software system. Provide all required wiring for metering installation. Provide the required cabling to the nearest BMS control panel. All meters shall be installed in one enclosure. Meters shall be furnished and installed on the following:

   a. Switchboard – Main – 100% bldg. load

   b. Switchboard – HVAC – 100% HVAC load

   c. Switchboard – Lighting – 100% lighting load

   d. Switchboard – Misc – 100% all other loads that are not lighting and HVAC

   e. Panel DP1 – 100% receptacle load

   f. Panels KP1, EKP1 – Kitchen load

   g. Panels KP2 – Kitchen load

   h. Panels PP2 and PP4 – HVAC ventilation system

   i. Panels PP1 and PP3 – HVAC ventilation

   j. Panels SPP1 and SPP3 – HVAC ventilation system

   k. Panels SPP2 and SPP4 – HVAC ventilation

   l. Panel STPD1 – entire building data network

   m. Building water meter

   n. Building gas meet

2. Sub metering equipment features shall include, but not limited to;

   System Configuration

   a. Voltage Input Configuration: 3 phase, 4 wire.

b. Voltage Input Rating: Up to 480 volts rms AC

c. Current Range: Up to 3200 Amperes rms AC

d. Power Factor: 0.5 leading or lagging

e. Frequency Range: 50 Hz to 400 Hz

f. Accuracy: Certified to ANSI C12.1/C12.20

g. Humidity: 0-95% non condensing

h. Temp Range: -20degrees C to +50 degrees C

i. Voltage Overload: +25% continuously

j. 4 line LCD display

k. Read kWh and kW Demand peak (date and time)

l. Power factor per phase

m. Amps per phase

n. Real time kW load

o. Volts per phase

p. MV-90 compatible

Meters

a. Meters shall be fully electronic with digital 8-digit LCD display without multiplier displaying cumulative kWH and Real time kW load. Meter shall provide rate of consumption indication and also a Segment test button (CPU) to ensure integrity of the display.

b. Meters shall provide revenue grade accurate and be certified to ANSI C12.1 and C12.20 electronic meter National Accuracy Standards (+/- 0.2% from 1%-100% of rated load).

c. Meters shall be equipped with non-volatile memory to maintain reading during power outages.

d. Meter shall provide a load indicator to indicate real-time consumption levels for field testing and certification.

e. Meters shall be equipped with a current sensor diagnostics indicator for installation verification.

f. Meters shall be equipped with terminal block for fixed-value pulse output to building automation system.

g. Meters shall be suitable to receive gas and water metering pulse input data.

Metering Enclosures

a. All stand-alone meters shall be installed within one single NEMA 12 or 4X enclosure. Enclosures shall be pad lockable to prevent unauthorized access.

Split core Current Sensors

a. Meter shall utilize 0-2 volt output current sensors to allow paralleling and/or mounting up to 2,000 feet away from the meter.

b. Sensors shall be split-core configuration to all for installation without disconnection of conductors and powering down equipment. Provide sensors ratings as specified to match the feeders or loads being

c. Meter shall be capable of paralleling up to three (3) set of current sensors for cumulative reading of multiple loads fed from a common transformer.

Data Recorder Devices

a. Data recorders shall be capable of reading and recording data for all the meters.

b. Shall be capable of retaining data for 72 days at 15 minute intervals.

c. Shall have a selectable baud up to 19,200 bps.

d. Shall be capable of reading meters individually or in groups.

e. Shall be MV-90 compatible.

f. Shall have built in communication interface with building automation systems.

Meter Communications

a. Meters shall be wired to common Data Recorder located or daisy chained within main electric room. Data recorder may be mounted within main electric room. Data recorded may be mounted within common multimeter unit enclosures with other meters.

b. Data Recorders shall be Dual Protocol equipped with RS-232/RS-485, Ethernet communications and bacNET standards.

Software

a. Provide system with license free energy management software from equipment manufacturer that allows users to read and monitor energy consumption via on-site and off-site non-dedicated computers. Software be capable of generating itemized electric bills for departmental allocation and user verification.

b. Software shall be loaded into a personal computers running Windows 7 operating systems.

Software shall export data to spreadsheets for analysis (*cvs files).

c. Software shall export data MV-90 systems (*.hhf files) and CSV files for data analysis.

d. The software shall be loaded into the Owner’s 10 personal computers and set up accordingly.

E. USER INTERFACE DASHBOARD

1. Provide user interface equipment for one –page snapshots of historical and real- time energy usage accessible via any standard web-browser either on an IP LAN and/or IP WAN network. Easy-to-read energy dashboards shall include kWh, KW demand as well as carbon footprints of estimated C02.

2. Energy data shall be able to display for various time periods including: Today Last 7 days Last 30 days

   Up to two years of kW history and 15 minute demand.

3. Advanced meter functions shall be displayed real-time for:

   - KW Load
   - Volts (Phase to Phase)
   - Amps by Phase
   - Power Factor
   - And more

4. The system shall include the following features.

   a. User friendly, password protected web user interface allows to view live energy data, charts and graphs via any standard web browser.

   b. Interface with all metering points including gas and water pulse output metering.

   c. Meters shall communicate with the owner's IBMS system via BACnet/IP protocol

   d. Internal memory stores up to two years days of 15-minute interval data.

   e. Ethernet connection to internet supports static IP address.

   f. AC power transformer to power unit.

   g. Trend building feature allows comparison of all recorded parameters of each meter.

   h. Export .csv data to MS Excel or Adobe PDF formats.

   i. Records weather temperature conditions for up to 5 days from local NOAA websites.

   j. KW demand and daily kWh usage alarm points send alarms via e-mail if set points are exceeded.

F SYSTEM COMMISSIONING

1. Manufacturer shall provide on-site service and support. All devices must be tested at their optional location under normal operational conditions to assure reception of signal.

2. Provide the required labor and materials to install, program and test the electric meter signal connections to the Integrated Building Management System.

3. The system manufacturer shall provide on-site, factory technicians to thoroughly inspect, make final connections, program the electronic submetering system to verify proper operation. The commissioning shall the required number of site visits to train the owner staff. Include at least one day for staff training. Also include 4 hours for a programming meeting with the owner, architect and engineer prior to programming to determine the means of operation.

PART 3 – EXECUTION

3.01 GENERAL NOTES

A. All materials specified in this Section occurring in acoustical ceilings shall be supported directly from the building structure. The acoustical ceiling system shall not be required to support any item specified in this Section of these Specifications.

B. No wire shall be pulled into the conduit system until it is complete in all details. In the case of concealed work, no wire shall be pulled into the conduit system until all rough plastering is completed. The ends of the conduit shall be tightly plugged to exclude dust, moisture, plaster or mortar while the building is under the process of construction.

C. Knockouts in a junction box on any electrical system shall not be left open and junction boxes not having equipment mounted on them shall be capped.

D. Furnish black laminated (white center) identification markers for each disconnect switch, motor starter, panelboard, remote control switch and any other electrical item requiring identification as to its use. Type all panel schedules to indicate utility of each circuit. All nameplates shall be fastened to each piece of equipment with screws.

E. All branch circuit wiring for light and power shall be #12 AWG, unless otherwise indicated.

F. Verify all measurements and job conditions at the building and report any discrepancies before starting the work. The responsibility for coordinating the electrical work with that of the other mechanical trades shall be part of this Section.

G. All conduit shall be of the size required by the Massachusetts Electrical Code for the number of wires indicated.

H. Conduit runs are shown diagrammatically. The exact locations shall be determined on the job. Exposed conduit shall be installed parallel with or at right angles to the building walls and beams. No diagonal runs shall be allowed on exposed work.

I. The Plans indicate the desired location of lighting fixtures. If an indicated fixture location proves to be impractical because of interferences of other mechanical trades, the Architect shall be consulted to determine an alternate location.

J. The exact mounting height of all exit signs and stem-supported lighting fixtures shall be determined on the job by the Architect.

K. A pulling-in wire consisting of a nylon cord of sufficient strength shall be installed in each spare or future conduit for the convenience of installing future cables.

L. Where 120-volt lighting branch circuit home runs exceed fifty (50) feet and where 277-volt lighting branch circuit home runs exceed one hundred (100) feet to the first outlet, #10 AWG shall be installed.

M. Check all door swings on the Architectural Drawings and if not in accordance with those shown on the Electrical Drawings, the switches for control of the lights shall be located to conform to the door swings shown on the Architectural Drawings.

N. Furnish and install all line safety switches, all necessary mechanical support channel for the mounting of starters and disconnect switches, for heating, ventilating, air conditioning and plumbing equipment.

O. Receptacles in toilets and dishwashing areas shall have gasketed covers.

P. Refer to all Architectural Detailed Drawings for exact location and mounting height of wall receptacles and outlets.

Q. All junction and pull boxes indicated on the Drawings or required for the installation of the work shall be of a size required for the particular installation. Boxes shall be code gauge and shall be painted to match the surrounding architecture wherever specified by the Architect.

R. All conduit that is installed exposed on the structural ceiling or above hung or furred ceilings shall be properly supported with approved type supports from the building structure. Conduits supported from pipes or ducts will not be allowed.

S. Expansion fittings shall be installed where conduits are concealed in concrete and cross a building expansion joint. These fitting shall be manufactured by O.Z. Gedney Company or approved equal.

T. Electric metallic tubing (EMT) shall be installed only in furred ceilings and shall be used on exposed work only where such exposed work is protected from mechanical injury. Electric metallic tubing shall not be used in concrete work or in wet areas. Electric metallic tubing turning down from suspended ceilings into block or plaster walls shall be continued to the outlets.

U. Rigid steel conduit shall be installed in wet areas, underground, on exposed work where such work is subjected to mechanical injury and concrete encased ductlines wherever indicated on the Electrical Drawings. All conduit installed in mechanical areas shall be rigid steel. Rigid steel conduits turning up thru concrete slabs into block, plaster or gypsum walls shall be continued to the first outlet. No rigid steel conduit will be allowed in any concrete floor slab. All branch circuit conduits installed under the first floor concrete slab on grade shall be rigid steel. PVC conduits containing branch circuit wiring will not be allowed under any floor slab. No conduits shall be installed within in any concrete floor slab.

V. All motors shall be furnished and set in place by the Contractor furnishing the same. The Electrical Subcontractor shall furnish and install all magnetic starters, all disconnect switches, and all power wiring from the power panels to the motors. Connections to the motors shall be made with liquid-tight, flexible metal conduit.

W. Refer to the architectural and kitchen equipment drawings for the exact location of all kitchen equipment. Furnish and install all line wiring, receptacles, flexible conduits and connections as specified for each piece of kitchen equipment.

X. Refer to the Architectural Reflected Ceilings Plans for the exact location of recessed fixtures in tile ceilings.

Y. In all finished areas, the Architect shall determine the exact location and mounting of each item of electrical equipment.

Z. Any access doors that may be required to provide access to any concealed pull box, junction box shall be furnished by the Electrical Subcontractor for installation by the appropriate Contractor.

AA. The Electrical Subcontractor shall touch up with matching paint, all electrical equipment scratched or chipped during installation.

BB. Openings around electrical penetrations through fire-resistance rated walls, partitions, floors, or ceilings shall be firestopped by the Electrical Subcontractor using approved methods to maintain the fire-resistance rating.

CC. It is the intent of these drawings for all rigid steel conduit or electrical metallic tubing installed in finished areas without ceiling shall be coordinated with the Architect prior to installation.

DD. The electrical contractor shall install self-adhesive labels on all receptacles and switches that provide the panel and circuit number for that device.

3.02 LIGHTING SYSTEM

A. Provide and install a complete lighting system from the lighting panels to the outlets on the lighting system, including wire, conduit, feeders, outlet boxes, junction boxes, receptacles, switches, lighting fixtures and lamps; all as specified for a complete lighting system as shown on the Drawings and as described in these Specifications.

B. The branch circuit wire shall be #12 AWG or larger from the lighting cabinets to the outlets and shall be concealed in the building structure where provisions have been made in the structure for the installation of the conduit.

C. All standard catalogue listed lighting fixtures shall meet all the requirements of the Underwriters' Laboratories, Inc., as to heat limitations, wiring, and general construction and shall be so labeled. All special lighting fixtures shall be manufactured to satisfy the requirements of the Underwriters' Laboratories, Inc., with respect to heat limitations, wiring and general construction

D. The switches and receptacles shall be of the type and capacity called for on the Drawings and specified under the "Products" Section of these Specifications. The exact location of all switches and receptacles shall be determined from the Architectural Detailed Drawings. The drawings indicate the type of lighting fixtures and equipment required at each location.

E. Where recessed lighting fixtures are to be installed in gypsum wall board or acoustic ceilings, plaster frames, finish trim, fittings, and supports shall be furnished and installed under this Section to meet the architectural and structural conditions at the location.

F. Included in the installation of lighting fixtures and lighting equipment shall be the adjustment of the positions of the lighting fixtures, and modifications to reflectors and lamps for appearance, quality, intensity, direction and effect to the specified requirements of the Architect.

G. Fixture parts shall be made of aluminum, brass, bronze, copper, steel or other materials as specified by the manufacturing processes involved in each particular fixture part. In cases where aluminum members are fastened to steel or other dissimilar metal parts, the aluminum shall be separated from such parts by a heavy coating of aluminum paint on the contact surfaces of the metal and allowed to dry before assembling.

H. Aluminum sheet, when placed in contact with brick, gypsum, concrete or similar construction shall be back-painted before the installation.

I. Consult the Architectural Drawings to determine the ceiling heights where hanging fixtures are to be installed. Stems shall be cut to the proper length before installation.

J. Upon completion of this installation of the lighting fixtures and lighting equipment and at the time of final inspection, all fixtures and equipment must be clear and free from defects; and any reflectors or glassware broken prior to the final inspection shall be replaced.

K. All flush fixtures shall be centered in the architectural treatment and leveled exactly with the finished ceiling. If the lighting fixtures do not center properly, they shall be relocated to conform to the architectural design of the area. Where flush fixtures are indicated on the Drawings, access outlet boxes shall be furnished and the necessary wire installed in flexible metal conduit between the recessed fixture and the outlet box to make a complete metallic connection between the fixture and the outlet box.

L. All lighting fixtures specified in this Section occurring in acoustical ceilings shall be supported directly from the building structure. The ceiling system shall not be required to support any lighting fixtures, unless otherwise shown on the Drawings.

M. All lighting fixtures shall meet the requirements of the Massachusetts Energy Code.

N. Electrical Subcontractor shall assume all responsibility for the safe handling of all lighting fixtures which are furnished under this SECTION and other accessories and lamps until the final inspection has been made by the Architect.

O. Special fittings and materials that may be required to support fixtures shall be supplied as well as supports or grounds required to secure surface or pendant mounted fixtures on suspended ceilings unless otherwise noted. Fixtures shall be supported from the structural floor or roof above, independent of furred or suspended ceilings, unless otherwise indicated. This support shall be in addition to regular fixture support bars, saddles. Fixtures mounted in association with suspended or integrated ceiling systems shall be supported above ceiling by threaded 1/4 diameter continuous galvanized steel hanger rods or #12 jack chain. Each such fixture shall have two supports per fixtures. Where duct work, pipes, type of building construction materials and structural framing members provide obstructions or difficult support means, hanger rods shall be used in association with horizontal sections of steel support channels in an approved manner. Steel support channels shall be Unistrut, Kindorf, Huskey Products, or equal. Rigid steel conduit may be used instead of steel support channels as approved by Architect for size and method of support. Exact mounting height of all stem supported lighting fixtures shall be determined on the job by Architect.

P. Fixtures, part or parts thereof (including LED driver) determined defective upon completion of electrical installation shall be replaced by Electrical Subcontractor, at no cost to Owner.

Q. Consult with General contractor regarding arrangement of framing members to permit centering of recessed fixtures.

R. Consult with ceiling subcontractor and coordinate fixture locations and supports with suspended ceiling system.

S. Electrical Subcontractor shall be responsible for furnishing the specified recessed fixtures with proper mounting arrangement to be compatible with the type of ceiling construction in which fixture is to be mounted. If necessary, the type mounting arrangement shall be changed from that specified or indicated on fixtures schedule to conform to this requirement, at no additional cost to Owner. Submission of shop drawings of such recessed fixtures shall be interpreted to indicate that Electrical Subcontractor has verified ceiling construction, type and material with the Architect for the various areas of the project in which these fixtures shall be mounted. Shop drawings of such fixtures shall be accompanied by a written statement indicating Electrical Subcontractor has verified such mounting arrangements with Architect and the date verified.

3.03 POWER SYSTEM

A. The power system wiring shall consist of THWN insulated wires of the size specified on the Electrical Drawings and the type specified in the "Products" Section of these Specifications. Install these wires in conduit from the power panels to the motors, including connections to the magnetic starters and disconnect switches.

B. All automatic temperature control wiring, including wiring for all control devices shall be furnished and installed under the Heating, Ventilating and Air Conditioning Sections of these Specifications, unless otherwise indicated on the Electrical Drawings.

C. All electrical interlock wiring and remote control wiring required for the Heating, Ventilating, Air Conditioning and Plumbing Systems shall be furnished and installed under the Electrical Section to the extent shown on the Electrical Drawings. All interlock and control wiring not specifically shown on the Electrical Drawings, but required for a correct operation of the Heating, Ventilating, Air Conditioning and Plumbing Systems shall be included as work under the Heating, Ventilating, Air Conditioning and Plumbing Section of these Specifications.

D. All control devices, including thermostats, aquastats, fire detection thermostats, flow switches, freeze protection controls and alternators required for the automatic temperature control system shall be furnished and installed under the Heating, Ventilating and Air Conditioning Section of these Specifications, unless otherwise indicated on the Electrical Drawings.

E. The Electrical Subcontractor shall obtain wiring diagrams of all pieces of equipment to which he must wire. Any discrepancies between these wiring diagrams and the wiring indicated on the Electrical Drawings shall be called to the attention of the Engineer as soon as possible.

F. Furnish and install the power system as indicated on the Electrical Drawings from the power panels to the roof exhaust fans, exhaust fans, air handling units, energy recovery, roof top units, return fans, pumps, chilled water pumps, condenser water pumps, hot water pumps, supply fans, electric unit heaters, unit heaters, cabinet unit heaters, boiler burner motors, duplex sewage ejector pumps, duplex sump pumps, hot water circulating pumps, duplex domestic water heaters including feeders, power panels, motor disconnect switches and motor starters (except that where starters are an integral part of a motor "Package Unit" these starters shall be furnished by the supplier of the motor and installed by the Electrical Subcontractor).

G. Furnish and install all power wiring, magnetic or manual starters and disconnect switches for all pumps, roof exhaust fans, hot water pumps, chilled water pumps, return fans, air handling units, supply fans, unit heaters, air handling units and cabinet unit heaters. All electrical interlock wiring and remote control wiring shall be furnished and installed by the Electrical Subcontractor, unless otherwise noted on the Electrical Drawings. All automatic temperature control wiring for these units shall be furnished and installed under the Heating, Ventilating and Air Conditioning Section of these Specifications.

H. Furnish and install all power wiring and disconnect switches for roof top units supply and return fans. Furnish and install all power wiring and disconnect switches for air handling units supply and return fans. Furnish and install all power wiring and disconnect switches for heat recovery units supply and return fans.

I. The variable frequency drives (VFD) for HVAC equipment shall be furnished under the HVAC section and installed and wired under the Electrical Subcontract. If VFD’s are not furnished by HVAC for any HVAC equipment, the Electrical Subcontractor shall furnish and install all specified magnetic starters.

J. Furnish and install the power wiring and fused disconnect switch for the chiller unit. All control panels and magnetic starters for this unit shall be furnished and installed by the Heating, Ventilating and Air Conditioning Subcontractor and wired by the Electrical Subcontractor.

K. Furnish and install all power wiring and disconnect switches for the duplex domestic hot water heater and hot water circulating pumps, including connections to the respective aquastats. The control wiring for all plumbing motors shall be included in the electrical work to the extent shown on the Electrical Drawings. All control wiring not specifically shown on the Electrical Drawings but required for the correct operation of the plumbing system shall be included as work under the Plumbing Section of these Specifications. Also provide a 120-volt control circuit for each water heater.

L. Furnish and install all power wiring, disconnect switches and magnetic starters for the boiler burner motors. All control panels shall be furnished and installed by the HVAC Subcontractor and wired by the Electrical Subcontractor. Also provide a 120 volt control circuit for each boiler control panel.

M. Furnish and install the power wiring and disconnect switches for each of the electric unit heaters. The electric unit heaters and associated line voltage thermostats shall be furnished and installed by the HVAC Subcontractor and wired by the Electrical Subcontractor.

N. Provide and install a motor disconnect switch for each motor furnished on the job by the other Subcontractors and sized for the particular motor unless otherwise indicated on the Electrical Drawings.

O. Furnish and install the power wiring, two fused disconnect switch with auxiliary switches for the elevator motor including the signal circuit fused disconnect switch. Provide and install wiring from the load side of the elevator disconnect switch to the line side of the elevator control panel. Provide and install a junction box in the elevator machine room for lighting and telephone connections. Furnish and install a duplex ground fault receptacle and a wall mounted lighting fixture with guard in the elevator pit. The permanent electric service shall be installed in a timely manner so that the permanent electric service can be used to install the elevator.

P. Power wiring shall terminate in a junction box adjacent to each motor. Furnish and install power wiring in a liquid-tight flexible conduit from this junction box to the power terminals of each motor with flexible length not to exceed six (6) feet.

Q. The emergency system feeders shall be installed in accordance with the requirements of the Massachusetts Electrical Code, Article 700-10. The emergency system feeders shall be mineral insulated type MI cable with a 2-hour fire resistive rating.

3.04 LIGHT AND POWER DISTRIBUTION SYSTEM

A. Furnish and install a complete light and power distribution system from the main secondary switchboard to the power and lighting panels, including wire, conduit, power and lighting panelboards and cabinets.

B. Provide and install the power and lighting panels of the type specified under the "Products" Section of these Specifications and with the number and ratings of circuits shown on the Schedules.

C. Provide and install the power and lighting feeders to the power and lighting panels. Feeder conduits installed in concrete, wet areas, underground or subjected to mechanical injury shall be rigid steel. Feeder conduits installed in furred ceiling areas, partitions or exposed on walls, and ceilings in dry areas, shall be electrical metallic tubing. PVC conduits containing light and power feeders may be installed under the first floor concrete slab. PVC feeder conduits will not be allowed in any concrete floor slab.

3.05 ELECTRICAL CHARACTERISTICS

A. The electrical characteristics of the primary electric service will be 15 KV, 3-phase, 3-wire, 60-hertz.

B. The electrical characteristics of the secondary electric service shall be 208/120 volts, 3-phase, 4-wire, 60-hertz and 480/277 volts, 3-phase, 4-wire, 60-hertz.

C. All motors furnished under the Heating, Ventilating, Air Conditioning, Plumbing and Elevator Sections of these Specifications ½ HP and larger shall be designed to operate on the 480 volts, 3-phase, 3-wire, 60-hertz service. All motors under ½ HP shall be designed to operate on the 120 volt, single phase, 60-hertz service.

D. All kitchen equipment shall be designed to operate on the 120/208 volts, 3-phase, 4-wire, 60-hertz system and 277/480 volts, 3-phase, 4-wire, 60-hertz system.

E. All LED lighting fixtures shall be designed to operate on the 480/277-volt, 3-phase, 4-wire, 60-hertz system.

F. All receptacles shall be designed to operate on the 208/120 volt, 3-phase, 4-wire, 60-hertz system.

3.06 GROUNDING

A. The electrical installation shall be a continuously bonded system through the conduit system from the equipment ground bus in the main switchboard. All couplings, locknuts, and bushings shall be drawn-up tight to the specified requirements of the authority enforcing the Massachusetts Electrical Code. All cabinets and equipment shall become a part of the bonded system. It shall be the responsibility of the Electrical Subcontractor to test the continuity of the bonding system.

B. Furnish and install a 1-1/2" x 1/4" copper ground bus in the electric room and generator room as shown on the Electrical Drawings. This ground bus shall be supported off the walls with 3/4" spacers installed two (2) feet on centers. All electrical equipment in the electric and generator room shall be properly bonded to the ground bus with #6 AWG copper wire. Connect the ground buses together with an insulated copper conductor.

C. Furnish and install a #4/0 AWG copper insulated ground wire in 1-1/4" conduit from the neutral bus in the main switchboard to the street side of the main water shut-off. Properly terminate both the ground wire and the conduit in approved type ground clamps. The resistance to ground shall not exceed twenty-five (25) OHMS.

D. The main switchboard equipment ground bus shall be connected to the electric room ground bus with a #4/0 AWG copper insulated ground wire in 1-1/4" conduit.

E. The Electrical Subcontractor shall furnish and install the pad-mounted transformer ground grid as detailed on the Electrical Drawings. The transformer ground grid shall be connected to the main switchboard equipment ground bus within the building with a #4/0 AWG copper insulated ground wire.

F. Wherever indicated on the Electrical Drawings, receptacles shall be properly bonded to the green insulated copper ground wire installed in the conduit containing the circuit conductors. This ground wire shall be connected to the equipment ground bus in the respective panelboards and shall be #12 AWG unless otherwise noted on the Electrical Drawings.

G. Wherever indicated on the Electrical Drawings, the equipment ground bus located in the various panelboards shall be connected to the equipment ground bus in the main switchboard located in the electric room with an insulated copper wire of the size shown on the Electrical Drawings. This ground wire shall be installed in the conduit containing the feeder conductors.

3.07 TEMPORARY LIGHT AND POWER

A. The Electrical Subcontractor shall provide temporary electric service feeders of sufficient capacity from the Utility Company's primary electric service from the nearest street for the light and power requirements of this building during the construction period. All poles, high voltage cable, transformers, metering equipment, disconnect switches, panelboards, cables and junction boxes required for the temporary electric service shall be furnished and installed by the Electrical Subcontractor. The Electrical Subcontractor shall consult with the Utility Company to determine the best location to install the temporary electric service feeders and metering equipment. All charges of the utility company pertaining to the temporary electric service installation shall be paid for by the Electrical Subcontractor.

B. Temporary lighting and power shall be not less than the following:

1. Lighting - 200 watts per 100 square feet of floor area, plus 60 watts for each stair landing. All temporary lighting lamps shall be either LED or metal halide in large spaces such as gymnasiums, library.
2. Receptacles - At least one 20 ampere duplex for each 1,000 square feet of floor space, and such others as will accommodate extension cords not greater than 50 feet in length to reach all work.

3. Fused switches for special construction equipment - On each floor of each building, at least one 30 ampere, 2 pole fused switch for equipment connection. Cables, and connection from switch to the special equipment, shall be provided, maintained and paid for by the trade requiring same.

4. Feeders - On each floor of each building, a feeder or feeders of sufficient capacity for the requirements of each entire floor.

C. The installation, maintaining and removal of temporary electric service including wiring and lamps required for this general lighting shall be paid for by the Electrical Subcontractor, including the cost of lamp replacement.

D. Subcontractors of all other trades shall furnish their own extension cords, sockets, lamps as may be required for their work, and shall also pay the cost of all temporary wiring of construction offices or trailers used by them.

E. All temporary electrical work shall be furnished and installed in conformity with the Electrical Code and in accordance with the requirements of the local ordinances.

F. Any temporary wiring of a special nature that is required for the building during the construction period other than mentioned above shall be paid for by the Contractor using same.

G. The General contractor shall pay the cost of the electrical energy consumed by all trades during the construction period.

H. As soon as the permanent electric service has been installed, the temporary electric service from the Utility Company's power lines may be removed and the permanent service may be used. The General contractor shall continue to pay the cost of electrical energy until the building has been accepted by the City.

I. All temporary electric work installed during the construction of this building shall be removed by the Electrical Subcontractor. This includes all poles, transformers, meters, cables, conduit, panelboards, disconnect switches, branch circuit wiring.

J. All temporary portable lighting fixtures required to provide adequate lighting for the painting of the numerous rooms throughout the building shall be furnished by the Painting Subcontractor. These portable lighting units shall be furnish with extension cords of not more than fifty (50) feet in length.

K. Refer to Section 015000.

3.08 EMERGENCY ELECTRICAL SYSTEM

A. Furnish and install a complete emergency system, including wire, conduit, outlets, lighting fixtures, exit lights, panelboards and cabinets, transfer switches, contactors, supervisory relays, engine generator units, and distribution panelboards.

B. The engine generator unit shall automatically start and supply energy to those lights and items of equipment designated to be on the emergency system, whenever the normal source of energy to the building has failed and when any of the area protection relays have operated.

C. Provide and install the emergency engine driven generator, automatic transfer switch and panelboards as specified under the "Products" Section of these Specifications.

D. Lighting fixtures designated to be on the emergency system shall not be subjected to any type of switch control when operating on the emergency generator, except the transfer arrangement and branch circuit protective devices.

E. The emergency lighting branch circuits shall be connected to the emergency lighting panels via single pole switches, three and four way switches and the by-pass relays. Furnish and install relay cabinets with contactors to by-pass all switches during emergency conditions. The relay cabinet shall monitor the normal lighting circuit in the area being served by emergency lighting. Whenever the contactors in the relay cabinets are closed, all emergency lighting fixtures shall come "ON" if "OFF" and remain "ON" if already "ON". Refer to the emergency relay cabinet detail and schedule on the Electrical Drawings."

F. The Electrical Drawings show certain lighting fixtures to be on both the "Normal" and "emergency" systems. Under "Normal" conditions, these lights may be subject to dimmer or manual switch control. If the normal power should fail, the emergency generator shall automatically start and all "Normal-Emergency" lights shall automatically become energized to full brilliancy whether or not they were before the emergency existed.

G. Emergency lighting fixtures, panelboards, cabinets, switches, conduit and wire shall be as specified for the normal lighting system.

H. All emergency electrical system feeders located outside of the emergency generator room shall be part of an assembly which has a 2-hour fire resistive rating and shall be in conformance with Article 700-10 of the Massachusetts Electrical Code. All emergency system feeders shall be type MI, mineral insulated, metal sheathed cable with solid copper conductors. The cable shall be classified by Underwriter's Laboratories, Inc. as having a two (2) hour fire resistive rating. To comply with UL requirements, cable supports shall be provided every three (3) feet on horizontal runs and every six (6) feet on vertical runs.

I. The complete legally required standby systems and standby systems electric systems including transfer switches, distribution panels, transformers, power panels, feeder, conduit and wire shall be installed in accordance with Massachusetts Electrical Code Article 700 and Article 702.

3.09 SWITCHGEAR ACCEPTANCE TESTS

A. The testing of the main switchboard shall be done by a testing company and shall be part of the Electrical Subcontract. All charges of the testing company shall be paid for by the Electrical Subcontractor and shall be included in his bid.

B. Acceptance tests as herein specified are defined as those test and inspections required to determine that the equipment involved is acceptable as delivered to the job site, that the equipment may be energized for final operational tests and is accordance with the Electrical Contract Specifications.

C. The testing firm shall be responsible for all tests and tests records. Testing shall be performed by and under the immediate supervision of the test firm and shall be made only by qualified personnel, specifically trained and fully experienced in this type of testing.

D. It is the intent of this Specification that all of the following listed equipment and associated components shall be thoroughly tested in accordance with the National Electrical Testing Association's recommendations:

1. Ground resistance
2. Circuit breakers
3. Insulation resistance
4. Electric and generator room grounding system
5. Switchgear grounding systems
6. Switchgear assemblies
7. Meter and instruments
8. Protective relays
9. Instruments and control transformers
10. Dry type step-down transformers
11. Switchboard ground fault system

E. It is the intent of the work described herein to have all switchgear for this project as noted thoroughly tested, complete certified reports filed on the testing company's forms, all major deficiencies found by these tests to be corrected by the Electrical Subcontractor and all minor deficiencies found by tests to be corrected by the testing company.

F. The testing company shall be responsible for all work required for bringing in, setting up and removal of his equipment, and all temporary power required for his testing. **All testing shall be performed at the job site after the equipment has been properly installed.**

G. The testing company shall notify the switchgear manufacturer of dates of his testing in order that the switchgear manufacturer may have representation during the testing

H. If any equipment that is tested proves to be defective and cannot be adjusted on the job, the defective equipment shall be returned to the switchgear manufacturer by the Electrical Subcontractor and repaired or replaced. This equipment shall be retested by the testing company.

I. The Electrical Subcontractor through the switchgear manufacturer shall furnish the circuit breaker time-current curves and relay characteristic curves to the testing company and any other pertinent data that is required to properly perform these tests.

J. After the switchgear has been tested and retested, if equipment parts have been found defective, the testing company shall submit four (4) brochures of all test data to the Architect through the Electrical Subcontractor. These brochures shall list all deficiencies found during the acceptance tests and all corrective work performed by the testing company. Also, these brochures shall include a list of the testing company's recommendations for any deficiencies not corrected by them.

K. The testing company shall perform a short circuit study and coordination study on all circuit breakers in the main switchboard and all panelboards to determine the settings of the trip elements. The settings for the main insulated case circuit breaker solid-state tripping devices shall be properly coordinated with the utility company's primary 15 KV fuses as well as the molded case circuit breakers in the 480 volt section of the switchboard.

L. After the coordination study has been completed, the testing company shall properly set all circuit breaker tripping elements in accordance with the results of this study.

M. The testing of the electrical switchgear shall be performed by one of the following or approved equal:

United Power Group, Inc. Three “C” Electrical Testing Co.

American Electrical Testing Co., Inc.

3.10 UNDERGROUND PRIMARY AND SECONDARY SERVICE

A. The underground primary electric service for the pad-mounted transformer will be 13.8 KV and shall originate from the utility company primary service. All 13.8 KV primary cables required for the pad mounted transformer shall be furnished and installed by the utility company. The pad-mounted transformer shall be furnished and set in place by the utility company. All primary and secondary connections to the pad mounted transformer shall be done by the utility company.

B. The Electrical Subcontractor shall furnish and install the multiple secondary electric service cables in conduit from the pad mounted transformer to the main switchboard located in the Electric Room. Refer to the Electrical Drawings for the exact number and size of the secondary service cables. The Electrical Subcontractor shall furnish the required secondary terminal connectors for connecting the multiple service cables to the pad mounted transformer "spades". The Electrical Subcontractor shall connect all secondary cables to these terminal connectors and the Utility Company will connect the terminal connectors to the transformer secondary "spades".

C. The concrete transformer pad shall be constructed by the General contractor as detailed on the Electrical Drawings and in accordance with Utility Company standards. Before constructing the transformer pad, the Electrical Subcontractor shall verify all pad dimensions with the Utility Company.

D. The Electrical Subcontractor shall furnish and install the transformer pad ground ring detailed on the Electrical Drawings. The ground ring shall consist of two (2) 3/4" by 10' copper weld ground rods connected together with a 4/0 bare copper wire. Bond this ground wire to all exposed primary and secondary steel conduits and leave 10 ft. of wire above pad in the primary and secondary conduit openings for grounding the transformer. The ground ring shall be connected to the equipment ground bus located in the Main Switchboard. All connections and joints shall be done with heavy duty ground clamps (Burndy or equal). The resistance to ground shall not exceed 25 OHMS and the ground ring shall be inspected by the utility company.

E. All ducts shall be mechanically fastened in place during construction and progress of the work, and shall be plugged to prevent seepage of grout, water or dirt into them and the ends shall be made water tight. Any duct section having a defective joint or broken end shall not be installed. The underground ductline raceways shall consist of plastic conduit or rigid steel conduit. All bends in the ductline shall be made with long sweeps and all elbows shall have a minimum of thirty-six (36) inch radius. A 3/16" nylon pull line shall be installed in all ducts.

F. Wood forms shall be installed by the General contractor on each side of the duct sections before pouring concrete. Ducts shall be placed on a layer of concrete prior to their initial set of not less than three (3) inches thickness and thicker where details on the Electrical Drawings require additional thickness. The ductline shall be graded for drainage to prevent pockets where moisture may accumulate.

G. Ducts shall be spaced as shown on the Electrical Drawings using approved pre-cast spacers. These spacers shall be left in the concrete. The concrete encasement and steel reinforcing rods shall be furnished and installed as shown on the Electrical Drawings. The concrete shall be reinforced on the top and the bottom of the encasement with steel reinforcing rods by the General contractor.

H. The Electrical Subcontractor shall extend one 4" galvanized rigid steel conduit up the riser pole to a distance of 10 feet above finished grade. A spare 4" conduit shall be capped at the base of the riser pole. All rigid steel elbows at base of pole shall be furnished with a minimum radius of 36". All conduit work at the primary riser poles shall be in accordance with Utility Company Construction Standard.

I. The Electrical Subcontractor shall keep the Utility Company fully informed at all times as the different phases of the work associated with the new primary electric service are completed. This will allow the Utility Company to properly schedule the installation of the pad-mounted transformer and primary service cables. Also prior to the installation of the new electric service and pad mounted transformer, the Electrical Subcontractor shall review with and receive written permission from the utility company.

J. All charges of the Utility Companies in connection with the primary electric service, telephone and CATV services and the installation of the pad-mounted transformer shall be paid solely by the Owner. In addition, any backcharges by the other utility companies shall also be paid for by the owner.

3.11 ELECTRIC SERVICE METERING

A. The EVERSOURCE Electric Company will furnish and install the kilowatt-hour meters, and the wiring from the current transformers located adjacent to the pad mounted transformer to the meter locations.

C. The Electrical Subcontractor shall furnish and install the meter socket on a pedestal adjacent to the CT cabinet. The meter socket and CT cabinet shall conform to the requirements of the EVERSOURCE Electric Company.

D. The EVERSOURCE Electric Company will furnish and install the metering current and potential transformers in the CT cabinet.

E. Before the installation of any equipment associated with the electric service metering, the Electrical Subcontractor shall consult with the EVERSOURCE Electric Company Metering Division and obtain their approval.

F. All charges of the EVERSOURCE Electric Company in connection with the electric service metering shall be paid solely by the Owner. See 3.10 “Underground Primary and Secondary Service” (paragraph J).

3.12 SEISMIC SUPPORTS, SUPPLEMENTARY STEEL AND CHANNELS

A. Provide all supports, supplementary steel and channels required for the proper Seismic installation, mounting and support of all work installed under this Section.

B. All supports, supplementary steel and channels shall be furnished, installed and secured with all fittings, support rods and appurtenances required for a complete support or mounting system.

C. Supplementary steel and channels shall be firmly connected to the building construction in a manner approved by the Architect prior to the installation of same. Submit to the Architect, via the General contractor, the locations proposed for using supplementary steel and channels for the support of equipment, fixtures and raceways. The submittal shall indicate the mounting methods, size and details of the supports, channels and steel; it shall indicate also that weight which the supports, channels and supplementary steel is to carry.

D. The type and size of the supporting channels and supplementary steel shall be of sufficient strength and size for seismic restraint and to allow only a minimum deflection in conformance with the channel and supplementary steel manufacturer's requirements for loading.

E. All supplementary steel and channels shall be installed in a neat and workmanlike manner parallel to the walls, floor and ceiling construction. All turns shall be made with 90 degrees and 45 degrees fittings, as specified to suit the construction and installation conditions.

F. All supplementary steel, channels, supports, and fittings, shall be Underwriters' Laboratories, Incorporated, approved, be galvanized steel and be manufactured by Steel City, Unistrut, Power-Strut, T. J. Cope, Chalfant or approved equal.

G. Provide supports to meet the required Seismic rating as specified. Equipment and work shall meet the restraint requirements for a Seismic Zone - 2 location including installation and connections of material and equipment to the building structure.

H. Provide beam clamps with set screws (C-clamp type).

I. Work under this Section shall be held in place by Seismic rated methods.

J. Supporting from the roof decking will not be acceptable.

K. Provide expansion anchors on masonry units or brick work. Power actuated supports will not be accepted.

L. Provide stainless steel or corrosion resistant supports in corrosive areas on wet or damp areas.

M. Support work from the building structure, independent of suspended ceilings, roof deck or other trades work. Where duct work, pipes, pipe racks, type of building construction materials or structural framing members provide obstruction or difficult support means, hanger rods shall be used in association with horizontal sections of steel support channels, in an approved manner.

N. All work shall be installed in a rigid and satisfactory manner and shall be supported by bar hangers in frame construction or shall be fastened directly with wood screws on wood, bolts with expansion shields on concrete or brick toggle bolts on hollow masonry units, and machine screws or welded threaded studs on metal. Threaded studs of the proper type and holding capacity driven in by a power charge and provided with lock washers and nuts are acceptable for mounting of equipment on solid concrete walls or slabs.

O. Obtain written permission from the General contractor allowing use of power activated charges. Use only properly trained and licensed operators.

P. Do not use power charge driven supports for any work that is to be hung from a horizontal surface without written permission from the Architect.

Q. Preset inserts of the proper type and holding capacity shall be used in overhead slab construction wherever possible.

R. Provide lateral supports for work to prevent excessive movement during a seismic event using rods, braces or galvanized or stainless steel cables.

S. Pendants, supports or hanging rods longer than 12 inches (300mm) shall be laterally braced.

T. Where installed in damp, wet and areas requiring wash down, all surface mounted panels, boxes, junction boxes, conduit shall be supported by spacers to provide a clearance between wall and equipment.

3.13 FIRE STOPPING

A. Electrical installations in hollow spaces, vertical shafts and ventilation or air handling ducts shall be so made that the possible spread of fire or products of combustion will not be increased. Openings around electrical penetrations through fire-resistance rated walls, partitions, floors or ceilings shall be fire stopped using approved methods to maintain the fire- resistance rating. Fire stopping of all penetrations shall be by the Electrical Contractor. The electrical contractor shall provide all required fire/smoke stopping on all corridor walls for all electrical penetrations. The electrical contractor shall provide all required firestopping and smoke stopping per code including local CITY codes.

3.14 SPECIAL COORDINATION INSTRUCTIONS

A. Coordination with the work of other trades is referred to within various parts of this SECTION. The following special instructions shall also be carefully noted:

1. The Electrical Subcontractor shall obtain from the HVAC contractor copies of all shop drawing prints showing the ductwork installation as it will be put in place on the project. These drawings shall be thoroughly checked by the Electrical Subcontractor and the routing of all conduits and installation of all outlets and electrical equipment shall be coordinated with the ductwork so as to prevent any installation conflict. Such coordination shall be done prior to roughing-in conduits, outlets and electrical equipment.
2. Locations of all wall outlets shall be verified with the Architect prior to roughing in conduits. Refer to details and wall elevations on the architectural drawings; mounting heights indicated on these architectural drawings and/or specific dimensional information given to the Electrical Subcontractor by the Architect shall take precedence over such information indicated on the electrical drawings.
3. Refer to all other drawings associated with this project. Any equipment which requires an electrical supply circuit, switch, controls and connections, even though not indicated on the electrical drawings, shall be furnished and installed as directed by the Architect. Locations of lighting fixtures shall conform to the architectural reflected ceiling plans.
4. No conduits shall be installed within any concrete slab at grade or above grade.

3.15 INSTALLATION OF OUTLETS

A. If any discrepancy is found to exist between the electrical plans and any other Drawings associated with the project, notify the Architect at once and have location verified before outlets are installed. Any reasonable change in location of outlets and equipment prior to roughing shall not involve additional expense to the Owner.

B. Consult with the ceiling tile subcontractor regarding the centering of outlets in ceiling tile. Whenever outlets of any system are installed in brick, masonry or concrete construction, furnish and install the necessary boxes and conduit in connection therewith so that the General contractor may build them in as the work progresses. Box offsets shall be made at all outlets to provide for proper adjustment to finished surfaces.

C. Through-wall boxes will not be permitted. Outlet boxes shall not be mounted back to back, but shall be staggered a minimum of 12" on center.

D. Knockouts in any boxes shall not be left open and all boxes not having equipment mounted on them shall be provided with blank covers.

E. Bar hanger type outlets shall be used in hollow framed partitions other than those of the masonry or construction block type, with bar hanger supported from two partition studs. Bar hangers shall be secured to metal type partition studs with self- threading metal screws, or drill through hangers with caddy or approved equal clips shall be used.

3.16 PHYSICAL SEPARATION OF NORMAL, OPTIONAL STANDBY, AND EMERGENCY

A. All Article 700 and 701 emergency system generation and distribution equipment shall be installed within dedicated two-hour fire rated rooms, closets or shafts per the Massachusetts Electrical Code. All equipment, conduit, piping, ductwork., alien to the emergency system shall not be located within these rooms, closets, or shafts except the equipment that serves these rooms, closets or shafts.

B. All Article 700 and 701 emergency equipment such as transfer switches, switchboards, transformers, and panelboards, shall be installed in two-hour fire rated rooms. The two-hour fire rated rooms shall be provided by the General contractor.

C. All portions of the emergency system, such as feeders, located outside of rooms, closets or shafts described in paragraph B., shall also be enclosed within two-hour fire rated enclosures, provided by the Electrical Subcontractor. The Electrical Subcontractor use UL listed two-hour fire rated MI cable system for article 700 and 701 feeders outside of the two hour rated emergency electric rooms. The Electrical Subcontractor shall be responsible for sizing, routing, installation, supports of this cable in accordance with manufacturer's requirements. Submit to designer conductor sizing calculations, voltage drop calculations, for review and approval.

D. Emergency system shall be kept entirely independent of all other wiring, devices and equipment, and shall not enter the same raceways, boxes or cabinets with each other or other wiring, except in transfer switches.

3.17 UNDERGROUND CONDUIT

A. The electrical work required in conjunction with underground conduit banks shall include providing all conduits.

B. Conduits for underground banks shall be:

1. Trade diameter size as indicated but in no case less than one inch.
2. Polyvinyl chloride Schedule 40 (approved for encased burial) duct, rigid steel conduit for vertical elbows and straight sections used to penetrate equipment pads, building foundation walls and concrete slabs.
3. All conduits indicated as being incorporated into conduit banks unless specifically noted as rigid steel conduits shall be encased in a concrete envelope which accommodates the indicated configuration of conduits and which encompasses dimensions as follows:
4. Outside surfaces of conduits to outside surface of envelope where reinforcement of encasement is required - 6" minimum.
5. Outside surfaces of conduits to outside surface of envelope where no reinforcement of encasement is required - 3" minimum.
6. Spacing between centerlines of conduits assigned to different categories of use primary feeders, secondary feeders, communications and signaling - 10-1/2" minimum.
7. Spacing between centerlines of conduits assigned to the same category of use - 7-1/2" minimum.
8. Reinforcement of the concrete encasement for conduit banks where required shall consist of No. 4 longitudinal reinforcing bars located 3" in from the outside surface of the envelope and spaced 6" on centers all around. No. 8 wire reinforcing hoops set 8" apart shall be used to tie the longitudinal bars together.
9. Install conduit in such a manner as to provide a minimum cover of 30 inches:
    a. Tie into existing work.
    b. Pass over other underground utilities.
    c. Pass over underground obstructions.
    d. Assist in the avoidance of low points.
    e. Increase the minimum cover where required by field conditions.
    f. Lay conduit to avoid low points during run. Pitch at a minimum of three inches per 100 feet away from building.

C. Provide reinforcement for the concrete encasement of a conduit bank where:

1. It passes under or over other underground utilities.
2. It passes under or over underground obstructions.
3. Its cover is reduced to less than 30 inches.
4. It runs through foundation walls and other building construction.

D. Concrete encasement reinforcing shall extend in each case five feet beyond the points at which the determining conditions terminate.

E. Bends in conduit shall have minimum radii as follows:

1. For primary feeder 15'-0" except where specifically indicated otherwise or where turning up at termination point.
2. For primary feeder turning up at termination point - 4'-0".

F. Install conduit so that adjacent joints are staggered at least six inches from one another.

G. Offsets to accommodate field conditions shall be accomplished with two bends of not more than ten degrees each.

H. Plug both ends of all conduit stubs.

I. Seal the end of each conduit run terminating inside a building utilizing a water and gas-tight sealant manufactured specifically for the purpose.

J. After conduit has been installed with concrete encasement completed, clear each conduit of all obstructions and foreign matter by pulling a flexible mandrel (12" minimum length and a diameter 1/4" less than that of the conduit) and brush through it. In the event that obstructions are encountered in any conduit which will not permit the mandrel to pass, remove and replace the blocked section. Include in the electric work all excavation, backfilling, repair of concrete encasement and restoration of surface at grade involved in the conduit replacement.

K. Provide a nylon cord for the pulling of cable in each conduit in which no cable is to be installed as part of the electric work.

L. The Electrical Sub-Contractor shall provide all insulated racks as specified for proper support of all cables and wires.

M. Provide a continuous nylon warning tape above each full length of duct bank 12 inches below grade.

3.18 IDENTIFICATION AND TAGGING

A. Identify individually:

1. Each transformer.
2. Each panelboard.
3. Each switch and circuit breaker.
4. Each feeder, wire or cable of all systems.
5. Each switchboard.
6. Each end of nylon pull wire in empty conduit.

B. Each wire or cable in a feeder shall be identified at its terminal points of connection and in each pullbox, junction box and panel gutter through which it passes.

C. The nomenclature used to identify panelboards or load center shall designate the numbers assigned to them, also include voltage, where power source emanates from and “normal’ or “emergency”.

D. The nomenclature used to identify switches or circuit breakers shall:

1. Where they disconnect mains or services designate this fact.
2. Where they control feeders, designate the feeder number and the name of the load supplied.
3. Where they control lighting and appliance branch circuitry, designate the name of the space and the load supplied.

E. The nomenclature used to identify feeder wires and cables shall designate the feeder number.

F. Identification for panelboards or load centers shall be by means of engraved lamacoid nameplates showing 1/4" high white lettering on a black background fastened to the outside face of the front.

G. Identification for switches or circuit breakers shall be by means of the following:

1. Where individually enclosed -- engraved lamacoid nameplates showing 1/8" high white lettering on a black background fastened on the outside front face of the enclosure.
2. Where in panelboards or load centers without doors -- same as for individually enclosed.
3. Where in panelboards or load centers with doors -- typewritten directories mounted behind transparent plastic covers, in metal frames fastened on the inside face of the doors.

H. Identification for wires and cables shall be by means of wrap around "brady" type labels.

I. Device plates for local toggle switches, toggle switch type motor starters, pilot lights and the like, whose function is not readily apparent shall be engraved with 1/8" high letters suitably describing the equipment controlled or indicated.

J. Phase identification letters shall be stamped into the metal of the bus bars of each phase of the main busses of each switchboard and each panelboard. The letters shall be visible from at least one "normal posture" location without having to demount any current carrying or supporting elements.

K. Equip the front face of all switchboard pull boxes junction boxes and the like containing cables, busing or devices operating in excess of 600 volts with enameled sheet metal "red on white" signs reading "DANGER--HIGH VOLTAGE."

L. Provide a sign at the service entrance equipment room indicating the type and location of all on site emergency or standby power sources.

M. Identify each outlet box, junction box, and cabinet used in conjunction with empty raceway for wires of a future system by means of indelible markings on the inside denoting the system.

N. Prior to installing identifying tags and nameplates, submit their nomenclature for approval. Conform to all revisions issued by the Designer.

3.19 SUPPORTS AND FASTENINGS

A. Support work in accordance with best industry standards, Mass. Electric Code and the following:

B. Include supporting frames or racks for equipment, intended for vertical surface mounting, which is required in a free standing position.

C. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members. They shall be rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

D. No work intended for exposed installation shall be mounted directly on any building surface. In such locations, flat bar members or spacers shall be used to create a minimum of 1/4" air space between the building surfaces and the work. Provide 3/4" thick exterior grade plywood painted with two coats of fire-retardant grey paint for mounting of panelboards.

E. Nothing (including outlet, pull and junction boxes and fittings) shall depend on electric conduits, raceways or cables for support.

F. Nothing shall rest on, or depend for support on, suspended ceiling media.

G. Support less than 2" trade size, vertically run, conduits at intervals no greater than 8 Ft. Support such conduits, 2-1/2" trade size or larger, at intervals no greater than the story height, or 15 Ft, whichever is smaller.

H. Where they are not embedded in concrete, support less than 1" trade size, horizontally run, conduits at intervals no greater than 7 ft.. Support such conduits, 1" trade size or larger, at intervals no greater than 10 ft.

I. Support all lighting fixtures directly from structural slab, deck or framing member.

J. Where fixtures and ceilings are such as to require fixture support from ceiling openings frames, include in the electric work the members necessary to tie back the ceiling opening frames to ceiling suspension members or slabs so as to provide actual support for the fixtures noted above.

K. Fasten electric work to building structure in accordance with the best industry practice.

L. Floor mounted equipment shall not be held in place solely by its own dead weight. Include floor anchor fastenings in all cases.

M. For items which are shown as being ceiling mounted at locations where fastenings to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to building structural elements.

N. As a minimum procedure, where weight applied to the attachment points is 100 lbs. or less, fasten to concrete and solid masonry with bolts and expansion shields.

O. As a minimum procedure, where weight applied to building attachment points exceeds 100 lbs., but is 300 lbs. or less, conform to the following:

P. At field poured concrete slabs, utilize inserts with 20' minimum length slip-through steel rods, set transverse to reinforcing steel.

3.20 SPLICING AND TERMINATING WIRES AND CABLES

A. Maintain all splices and joints in removable cover boxes or cabinets where they may be easily inspected.

B. Locate each completed conductor splice or joint in the outlet box, junction box, or pull box containing it, so that it is accessible from the removal cover side of the box.

C. Join solid conductors No. 8 AWG and smaller by securely twisting them together and soldering, or by using insulated coiled steel spring "wire nut" type connectors. Exclude "wire nuts" employing non-expandable springs. Terminate conductors No. 8 AWG and smaller by means of a neat and fast holding application of the conductors directly to the binding screws or terminals of the equipment or devices to be connected.

D. Join, tap and terminate stranded conductors No. 6 AWG and larger by means of solder sleeves, taps; and lugs with applied solder or by means of bolted saddle type or pressure indent type connectors, taps and lugs. Exclude connectors and lugs of the types which apply set screws directly to conductors. Where equipment or devices are equipped with set screw type terminals which are impossible to change, replace the factory supplied set screws with a type having a ball bearing tip. Apply pressure indent type connectors, taps and lugs utilizing tools manufactured specifically for the purpose and having features preventing their release until the full pressure has been exerted on the lug or connector.

E. Except where wire nuts are used, build up insulation over conductor joints to a value, equal both in thickness and dielectric strength, to that of the factory applied conductor insulation. Insulation of conductor taps and joints shall be by means of half-lapped layers of rubber tape, with an outer layer of friction tape; by means of half-lapped layers of approved plastic electric insulating tape; or by means of split insulating casings manufactured specifically to insulate the particular connector and conductor, and fastened with stainless steel or non-metallic snaps or clips.

F. Exclude splicing procedures for neutral conductors in lighting and appliance branch circuitry which utilize device terminals as the splicing points.

G. Exclude joints or terminations utilizing solder in any conductors used for grounding or bonding purposes.

H. Exclude all but solder or pressure indent type joints in conductors used for signaling or communications purposes.

I. Lugs for conductors used to make phase leg connections on the line side of the main service overcurrent and switching device shall be of the limiter type.

3.21 PULLING WIRES INTO CONDUITS AND RACEWAYS

A. Delay pulling wires or cables in until the project has progressed to a point when general construction procedures are not liable to injure wires and cables, and when moisture is excluded from raceways.

B. Utilize nylon snakes or metallic fish tapes with ball type heads to set up for pulling. In raceways 2" trade size and larger, utilize a pulling assembly ahead of wires consisting of a suitable brush followed by an 3-1/2" diameter ball mandrel.

C. Leave sufficient slack on all runs of wire and cable to permit the secure connection of devices and equipment.

D. Include circular wedge-type cable supports for wires and cables at the top of any vertical raceway longer than 20 feet. Also include additional supports spaced at intervals which are no greater than 10'. Supports shall be located in accessible pull boxes. Supports shall be of a nondeteriorating insulating material manufactured specifically for the purpose.

E. Pulling lubricants shall be used. They shall be products manufactured specifically for the purpose.

F. Slack on wires and cables located in cabinets and pull boxes shall be formed and set in place in groupings corresponding to their occupancy of raceways. They shall also be arranged, with insulators and supports provided where necessary, such that cable shims or other such temporary expedients do not have to be left permanently in place to prevent the wires and cables from shifting when covers or trims are removed.

3.22 REQUIREMENTS FOR THE INSTALLATION OF JUNCTION BOXES, OUTLET BOXES AND PULL BOXES

A. Flush wall mounted outlet boxes shall not be set back to back but shall be offset at least 12" horizontally regardless of any indication on the drawings.

B. Locate all boxes so that their removable covers are accessible without necessitating the removal of parts of permanent building structure, including piping, ductwork, and other permanent mechanical elements.

C. In conjunction with concealed circuitry, abide by one of the following instructions (as may be applicable to the conditions) in order to assure the aforementioned accessibility. (Not required for circuitry concealed by removable suspended ceiling tiles.)

1. For a small (outlet size) box on circuitry concealed in a partition or wall, locate box or fitting so that its removable cover side (or the face of any applied raised cover) penetrates through to within 1/8" a of the exposed surface of the building materials concealing the circuitry and apply a blank or device plate to suit the functional requirements.
2. For a large box on circuitry concealed in a partition, suspended ceiling, or wall, locate box totally hidden but with its removable cover directly behind an architectural access door or panel (included for the purpose, separate from the electric work) in the building construction which conceals the circuitry.
3. For a small (outlet size) box on circuitry concealed above and intended as an outlet for a surface mounted lighting fixture or other such electrical item, locate box so that its removable cover side penetrates through to the exposed surface of the building materials concealing the circuitry. Arrange the mounting of the lighting fixture or other item so that it completely covers the opening in the building construction caused by the box.
4. For a small (outlet size) box on circuitry concealed in a suspended ceiling, and intended as an outlet for a non-demountable type of recessed lighting fixtures or other such electrical items, locate box totally hidden but with its removable cover not more than one foot away from the building construction opening occupied by the demountable items.

D. Apply junction and pull boxes in accordance with the following:

1. Include pull boxes in long straight runs of raceway to assure that cables are not damaged when they are pulled in.
2. Include junction and pull boxes to assure a neat and workmanlike installation of raceways.
3. Include junction and pull boxes to fulfill requirements pertaining to the limitations to the number of bends permitted in raceway between cable access points, the accessibility of cable joints and splices, and the application of cable supports.
4. Include all required junction and pull boxes regardless of indications on the drawings (which, due to symbolic methods of notation, may omit to show some of them).

E. Apply outlet boxes in accordance with the following:

1. Unless noted below or otherwise specifically indicated, include a separate outlet box for each individual wiring device, lighting fixture and signal or communication system outlet component. Outlet boxes supplied attached to lighting fixtures shall not be used as replacements for the boxes specified herein.

2. A continuous row of fixtures of the end-to-end channel type, designed for "through wiring," and wired in accordance with the specification hereinafter pertaining to circuitry through a series of lighting fixtures, may be supplied through a single outlet box.

3. A series of separate fixtures, designed for "through wiring," spaced not more than 4' apart, and inter- connected with conduit or raceway and circuitry which is in accordance with the specifications hereinafter pertaining to circuitry through a series of lighting fixtures, may be supplied through a single outlet box.

4. Connection to recessed ceiling fixtures supplied with pigtails may be arranged so that more than one, but not more than four, such fixtures are connected into a single outlet box. When adopting this procedure:

F. Utilize an outlet box no smaller than 5" square by 2-1/2" deep.

G. Allow no fixture to be supplied from an outlet box in another room.

1. Multiple local switches indicated at a single location shall be gang mounted in a single outlet box.

2. Include all required outlet boxes regardless of indications on the drawings (which due to symbolic methods of notation, may omit to show some of them).

H. Install junction boxes, pull boxes and outlet boxes in accordance with the following:

1. Exclude surface mounted outlet boxes in conjunction with concealed circuitry.

2. Exclude unused circuitry openings in junction and pull boxes. In larger boxes each such opening shall be closed with a galvanized sheet steel plate fastened with a continuous weld all around. In small outlet type boxes, utilize plugs as specified for such boxes.

3. Close up all unused circuitry openings in outlet boxes. Unused openings in cast boxes shall be closed with approved cast metal threaded plugs. Unused openings in sheet metal boxes shall be closed with sheet metal knock-out plugs.

4. Outlet boxes for switches shall be located at the strike side of doors. Indicated door swings are subject to field change. Outlet boxes shall be located on the basis of final door swing arrangements.

5. Boxes and plaster covers for duplex receptacles shall be arranged for vertical mounting of the receptacle.

6. Equip outlet boxes used for devices which are connected to wires of systems supplied by more than one set of voltage characteristics with barriers to separate the different systems.

I. Barriers in junction and pull boxes of outlet size shall be of the same metal as the box.

J. Barriers in junction and pull boxes which are larger than outlet size shall be of the polyester resin fiberglass of adequate thickness for mechanical strength, but in no case less than 1/4" thick. Each barrier shall be mounted, without fastenings, between angle iron guides so that they may be readily removed.

3.23 LOCATING AND ROUTING OF CIRCUITRY

A. In general, all circuitry shall be run concealed except that it shall be run exposed where the following conditions occur:

1. Horizontally at the ceiling of permanently unfinished spaces which are not assigned to mechanical or electrical equipment.
2. Horizontally and vertically in mechanical equipment spaces.
3. Horizontally and vertically in electric equipment rooms.

B. Concealed circuitry shall be so located that building construction materials can be applied over its thickest elements without being subject to spalling or cracking.

C. All circuitry and raceways shall NOT be run within any concrete slabs.

D. Circuitry run exposed shall be routed parallel to building walls and column lines.

E. Circuitry for miscellaneous systems indicated without notation as to location and routing shall be run as per the requirements and notations governing the adjacent light and power circuitry.

F. Exposed circuitry located overhead shall be run in a completely accessible manner on the underside of all piping and ductwork.

G. Circuitry run in suspended ceilings shall be routed parallel to building walls, column lines.

H. Circuitry shall be routed so as to prevent electric conductors from being subject to high ambient temperature. Minimum clearances from heated lines or surfaces shall be maintained as follows:

1.	Crossing where uninsulated	3"
2.	Crossing where insulated	1"
3.	Running parallel where uninsulated	36"
4.	Running parallel where insulated	6"

I. Circuitry shall not be run in elevator shafts, hoistways, and the like. Where outlets for trail cables, pit lights, run be level lights, and the like, are involved, only the "final connection" outlet boxes themselves shall be located within or open into, the confines of the shaft.

3.24 COMMISSIONING

A. Pre-function Check List

1. Pre-functional checklists assist in the process to document that the equipment and systems are installed properly.

2. The contractor shall be provided with construction checklists from the CA for completion. The contractor shall complete the checklists as provide the CA with completed copies in accordance with Section 019113 Commissioning.

3. See attached for a sample pre-functional performance test checklist, attached is included only to provide sample of a typical process and scope.

B. FUNCTIONAL PERFORMANCE TESTING

1. Intent of functional performance testing is to prove thru functional test procedures proper system operation.

2. The contractor shall be provided with functional performance test procedures to perform while CA witnesses. The contractor shall perform functional tests in accordance with 019113 Commissioning.

3. See attached for a sample functional performance test checklist, attached is included only to provide sample of a typical process and scope.

C. PREFUNCTIONAL CHECKLISTS AND FUNCTIONAL PREFORMANCE TESTING

1. Pre-Functional Checklists and Functional performance testing procedures shall be performed on the following system types. (Pre Functional and Functional performance testing requirements are in addition to and do not replace any testing required elsewhere in section 260001 or by applicable codes.) Equipment specifically marked as such below shall be provided with start-up of equipment by factory-authorized service representative.

a. Emergency Generator and associated transfer panels

b. Electrical Service and Switchgear, Transformers, Motor Control Centers, Distribution Systems, Low Voltage Systems, Grounding and Bonding Systems

c. Lighting and Lighting Control Systems

d. Fire Alarm and Interfaces with the Building Automation System

D. SAMPLE CHECKLISTS – See Attached.

Functional Test

Lighting Systems –Exterior/Interior

IMPORTANT:

Please refer to the Master Deficiency and Resolution Log for numbers referenced in parentheses, which will indicate deficiencies discovered and resolved. For quick reference you will find, in the front of this section a list of Master Deficiency and Resolution Log items pertaining only to this section.

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. A Statement of Correction shall be submitted upon completion of any outstanding areas.

2. Prerequisite Checklist

a. All associated equipment has been started up, is operational and is ready for functional testing.

b. All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.

c. All A/E punchlist items for this equipment corrected.

d. Safeties and operating ranges reviewed.

e. Schedules and setpoints attached.

f. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures.

g. Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).

h. Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.

3. Installation Checks

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag➔	Lighting	Comments
Lighting		
Devices installed per manufacturer's instructions and specifications		
Lighting control system installed per plans, specifications and manufacturer's recommendations		
Switches and occupancy sensors installed at correct height and have correct cover / escutcheon plate		

The checklist items of Part 3 are all successfully completed for given trade ☐ ***YES*** ☐ ***NO***

4. Operational Checks

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag➔	Lighting	Comments
Operational		
Lights are all functioning. No bulbs are burned out		
Lights are not turning on and off frequently causing a disruptions		

The checklist items of Part 4 are all successfully completed for given trade ☐ ***YES*** ☐ ***NO***

5. Functional Testing Record

Lighting Systems

Test#	Mode ID	Test Procedure	Expected Response	Pass Y/N	Note
1	Interior Lighting – Occupancy Sensors	With the room unoccupied and the lights off, enter the space	The occupancy sensor shall see you and the lights shall energize on. While in the space, the lights shall not continually turn off and on.		
2	Interior Lighting – Daylight Dimming	With the room occupied, and the lights on, shine a flashlight on the photocell	The lights should dim as they sense more light in the space.		
2	Exterior Lights On	Engage the time clock/photocell function to simulate a need for the exterior lighting. Cover the Photocell to simulate darkness and override the time clock to simulate a suitable time to be on	All exterior lights should energize on including pole lights, wall packs.		
3	Exterior Lights Off	Set the time clock back to normal schedules and remove the covering from the photocell	All exterior lights should turn off including polelights, wall packs.		
4	Stage / Theatrical Lighting	Try out all functions of the theatrical lighting to ensure that it is working per specification	System should operate the theatrical lighting as setup in accordance with the owners request		

The Functional Tests of Part 5 have all passed for given trade ☐ ***YES*** ☐ ***NO***

END OF SECTION

SECTION 260943

NETWORK LIGHTING CONTROL SYSTEM
(This Section to be included in Sub-Bid Section 260001-Electrical)

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this trade.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure a steady progress of all work under Contract.

D. When referred to, standard specifications of technical societies, manufacturer's associations, and federal agencies shall include all amendments current as of the date of issue of these Specifications.

E. This section is a sub-section to Section 260001 – Electrical and this section shall be installed in accordance with the requirements of Section 260001.

1.02 SCOPE OF WORK

A. The scope of the work under this Section, without limiting the generality thereof, includes all materials, labor, equipment, services and transportation, unless otherwise specified, necessary to complete all systems of electrical wiring and equipment specified by the Drawings and/or specified herein. It is the intent of this Section of these Specifications and accompanying Electrical Drawings to cause these Systems to be furnished complete in every respect. The Electrical Subcontractor shall furnish all wiring, equipment, staging, access panels, and labor needed and usually furnished in connection with such work, whether specifically mentioned of not.

B. Provide a network lighting control system for all site and interior lighting fixtures. System Software Interfaces shall include:

1. Management Interface
2. Historical Database and Analytics Interface
3. Visualization Interface
4. Personal Control Applications
5. Smartphone Programming Interface for wired devices
6. System Backbone and Integration Equipment, System Controller

7. Lighting demand management

Wired Networked Devices

1. Wall Stations
2. Graphic Wall Stations
3. Digital Key Switches
4. Auxiliary Input/Output Devices
5. Occupancy and Photocell Sensors
6. Wall Switch Sensors
7. Embedded Sensors
8. Power Packs and Secondary Packs
9. Networked Luminaires
10. Relay and Dimming Panel
11. Bluetooth® Low Energy Programming Device
12. Communication Bridge

C. The fire stopping of all electrical penetrations through fire resistance rated wall, partitions, floors and ceilings shall be a part of the Electrical Subcontract. The electrical contractor shall provide all required fire/smoke stopping on all corridor walls for all electrical penetrations.

D. The 260001 electrical contractor shall furnish, install and maintain in a safe adequate condition all staging and scaffolding that is necessary for the proper executing of the work of this Section 260943.

E. The 260001 electrical contractor shall perform all cutting, coring and channeling for holes 5” in diameter or less required for the work of this Section 260943.

F. All required commissioning, programming and testing per this section, and Section 260001 Electrical shall be performed by the electrical contractor

G. All requirements of Section 260001-ELECTRICAL, Part 1 General shall be included in this Section 260943.

H. Sustainability Requirements:

1. The work of this section includes LEED v4 Schools material and submittal requirements. LEEDv4-S requirements for the work of this Section are detailed herein, and additionally in Section 018113 of this Project Manual.
2. For all adhesives, sealants, paints, coatings, and insulation, meet the LEED requirements for IEQ Credit 2 Low Emitting Materials and as defined in Section 018113 - SUSTAINABLE DESIGN REQUIREMENTS.

3. Light fixtures and lighting controls shall meet the LEED requirements for Sustainable Sites Credit 6 for Light Pollution Reduction.

4. The Work shall meet the energy performance requirements for LEED Energy and Atmosphere Prerequisite 2 and Credit 1.

5. Light fixtures and lighting controls shall meet the LEED requirements for Indoor Environmental Quality Credit 6 for Interior Lighting.

1.03 RELATED WORK UNDER OTHER SECTIONS

A. Section 018110 – General Commissioning.

B. All electrical systems required for this section shall be provide by the section 260001 contractor per the requirements of the Section 260001 specifications.

C. Painting of electrical conduits, surface metal raceways, pull boxes, hangers, panelboard doors and trim, and all other electrical equipment to match the surrounding finish as directed by the Architect, shall be done by the Section 090007 - Painting.

D. The General Contractor shall install all access panels furnished by the Electrical Subcontractor for Section 260943.

1.04 SHOP DRAWINGS

A. Prepare and submit complete shop drawings in accordance with requirements of Section 013300 - Submittals and in the manner described herein.

B. Submittal shall be provided including the following items.

1. Bill of Materials necessary to install the networked lighting control system.

2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.

3. Riser Diagrams showing device wiring connections of system backbone and typical per room/area type.

4. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.

5. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).

6. Contractor Startup/Commissioning Worksheet (must be completed prior to factory start-up).

7. Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.

8. Hardware and Software Operation Manuals.

C. Sustainability Submittals: (Refer to SECTION 013300 - Submittals):

1. Relevant supporting documentation, as specified by LEED for Schools v4 and as detailed in Section 018133 – Sustainable Design Requirements.
2. A completed LEED MATERIALS REPORTING FORM, per Section 018113 – Sustainable Design Requirements.
3. Product substitution requests are subject to additional LEED-S submittal requirements, see SECTION 012500 – SUBSTITUTION PROCEDURES.

1.05 QUALITY ASSURANCE

A. Product Qualifications

1. System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
2. System shall be listed as qualified under DesignLights Consortium Networked Lighting Control System Specification V2.0.
3. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
4. All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
5. All components and the manufacturing facility where product was manufactured must be RoHS compliant.

B. Installation and Startup Qualifications

1. System startup shall be performed by qualified personnel approved or certified by the manufacturer.

C. Service and Support Requirements

1. Phone Support: Toll free technical support shall be available.
2. Remote Support: The bidder shall offer a remote support capability.
3. Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
4. Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

1.06 WARRANTY

A. The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of shipment.

B. The hardware warranty shall cover repair or replacement any defective products within the warranty period.

1.07 MAINTENANCE & SUSTAINABILITY

A. The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following installation.

1.08 COMMISSIONING OF SYSTEM EQUIPMENT

A. The Network Lighting Control System shall be tested, programmed and commissioned by the electrical contractor per the requirements of this section, Section 2600001 – Electrical, Section 018110 – Commissioning for additional requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Materials specified for the work on all systems in this building shall be new and shall comply with the National Electrical Manufacturers Association's specifications (NEMA), the Massachusetts Electrical Code (MEC) and the American National Standards Institute (ANSI). Where materials are not specified, these materials shall be the best of their respective kinds. Submit a list of all materials to the Architect for approval within thirty (30) days after the contract is signed and before any orders are placed. Wiring materials, stock fixtures and equipment shall bear the label of the Underwriters' Laboratories, Inc. (UL), or shall be accompanied by a duly signed certificate from an approved inspection organization which states that the requirements of the Underwriters' Laboratories, Inc. (UL) for such materials and/or equipment have been complied with, but such label or certificate shall not obligate the Architect to approve said materials, fixtures and/or equipment.

B. All electrical equipment specified by this section shall be furnished and installed by the electrical contractor per the requirements of the Electrical – 260001 Section.

C. SUSTAINABILITY REQUIREMENTS

1. Products and materials used for this section of work are required to meet the following criteria for LEEDv4-S materials Credits, and a completed LEEDv4 MATERIALS REPORTING FORM shall be submitted for all materials in this SECTION:

   Furnish any adhesives, sealants, paints and coatings, meet the requirements for IEQ Credit 2 as defined in Section 018113 – SUSTAINABLE DESIGN REQUIREMENTS.

2. For SS Credit 6 Light Pollution Reduction, submit product data for all exterior lighting fixtures and fill out all templates specified in the LEED submission forms.

3. For IEQ Credit 6 Interior Lighting, submit product data for all exterior lighting fixtures and fill out all templates specified in the LEED submission forms.

2.02 MANUFACTURERS

A. The Network Lighting Control System including all peripheral devices shall be the standard product of a single manufacturer. The Manufacturer of the basis of design system is Acuity nLight system and the part numbers specified within are nLight. Approved equals are Wattstopper and Lutron.

B. Approved Equipment Suppliers - Equipment and materials shall be as manufactured by one of the approved manufacturers. Equipment designations and model numbers herein specified are those of Acuity nLight. It will be the responsibility of the electrical contractor to ensure proper specification adherence for system operation, final connection, test, turnover, warranty compliance, and after-market service. The distributor of the equipment specified shall be factory trained and certified. All equipment shall be provided by one manufacturer.

C. All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the fire alarm equipment standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment does in fact equal or exceed the features, functions, performance, and quality of the specified equipment.

2.03 SYSTEM COMPLIANCE

A. System components shall comply with UL 916 and UL 924 standards where applicable.

B. System components shall comply with CFR Title 47, Part 15 standards where applicable.

C. All equipment shall be installed and connected in compliance with NFPA 70.

2.04 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (1) networkable intelligent lighting control devices, (2) standalone lighting control zones using distributed intelligence, (3) optional system backbone for remote, time based and global operation between control zones.

2. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.

3. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see *Control Zone Characteristics* sections for each type of network connection, wired or wireless).

4. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.” Lighting control zones of at least 128 devices per zone shall be supported.

5. Networked luminaires and intelligent lighting control devices shall support individual (unique) configuration of device settings and properties, with such configuration residing within the networked luminaires and intelligent control devices.

6. Networked luminaires and intelligent lighting control devices shall have distributed intelligence programming stored in non-volatile memory, such that following any loss of power the lighting control zones shall operate according to their defined default settings and sequence of operations.

7. Lighting control zones shall be capable of being networked with a higher-level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software interface.

8. The system may include one or more system controllers that provide time-based control and global system control across multiple control zones and backbone network segments. The system controller shall provide a means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP protocol.

9. The system may include “communication bridge” devices that route communication from lighting control zones (wired or wireless) to and from the system controller, for purposes of decreasing system wiring requirements.

10. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.

B. Wired Networked Control Zone Characteristics

1. Connections to devices within a wired networked lighting control zone and to backbone components shall be with a single type of low voltage network cable, which shall be compliant with CAT5e specifications or higher. To prevent wiring errors and provide cost savings, the use of mixed types of low voltage network cables shall not be permitted.

2. Devices in an area shall be connected via a “daisy-chain” topology; requiring all individual networked devices to be connected back to a central component in a “hub-and-spoke” topology shall not be permitted, so as to reduce the total amount of network cable required for each control zone.

3. System shall provide the option of having pre-terminated plenum rated low voltage network cabling supplied with hardware so as to reduce the opportunity for improper wiring and communication errors during system installation.

4. Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.

5. Once software is installed, system shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.

6. All networked devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.

7. Networked control devices intended for control of egress and/or emergency light sources shall not require the use of additional, externally mounted UL924 shunting and/or 0-10V disconnect devices, so as to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay and provide 100% light output upon detection of loss of power sensed via line voltage connection to normal power.

C. System Integration Capabilities

1. The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP. The following system integration capabilities shall be available via BACnet/IP protocols:

   a. The system shall support control of individual devices, including, but not limited to, control of relay and dimming output.

   b. The system shall support reading of individual device status information. The available status will depend on the individual device type and capabilities, which may include but not be limited to, relay state, dimming output, power measurement, occupancy sensor status, and photocell sensor states or readings. All system devices shall be available for polling for devices status.

   c. The system shall support activation of pre-defined system Global Profiles

2. The system shall support activation of Profiles (local or global) and Preset Scenes from third party systems by receiving dry contact closure output signals or digital commands via bacnet IP.

D. Supported Sequence of Operations

1. Characteristics and performance requirements herein shall be supported by the networked lighting control system.

2. Control Zones

a. Networked luminaires and intelligent lighting control devices installed in an area (also referred to as a group of devices) shall be capable of transmitting and tracking occupancy sensor, photocell sensor, and manual switch information within at least 48 unique control zones to support different and reconfigurable sequences of operation within the area. These shall also be referred to as local control zones.

b. Networked luminaires and intelligent lighting control devices located in different areas shall be able to transmit and track information within at least 128 system-wide control zones to support specified sequences of operation that may span across multiple areas. Occupancy and photocell commands shall be available across a single controller, and switch commands shall be available across single or multiple controllers. These shall also be referred to as global control zones.

3. Wall station Capabilities

a. Wall stations shall be provided to support the following capabilities:

1) On/Off of a local control zone and global control zone simultaneously, as specified.

2) Continuous dimming control of light level of a local control zone and global control zone simultaneously, as specified.

3) Preset Scenes that can activate a specific combination of light levels across multiple local and global channels, as specified.

4) Profile Scenes that can modify the sequence of operation for the devices in the area (group) in response to a button press. This capability is defined as supporting “Local Profiles” and is used to dynamically optimize the occupant experience and lighting energy usage. Wall stations shall be able to manually start and stop Local Profiles, or the local profile shall be capable of ending after a specific duration of time between 5 minutes and 12 hours. Parameters that shall be configurable and assigned to a Local Profile shall include, but not be limited to, fixture light level, occupancy time delay, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wall stations.

b. 3-way / multi-way control: multiple wall stations shall be capable of controlling the same local and global control zones, so as to support “multi-way” switching, dimming, preset scene, and profile scene control.

4. Occupancy Sensing Capabilities

a. Local and global control: Occupancy sensors shall be configurable to control a local and global zone simultaneously, as specified.

b. Multi-sensor control: multiple occupancy sensors shall be capable of controlling the same local and global control zones. This capability combines occupancy sensing coverage from multiple sensors without consuming multiple control zones.

c. System shall support the following types of occupancy sensing sequence of operations:

1) On/Off Occupancy Sensing

2) Partial-On Occupancy Sensing

3) Partial-Off Occupancy Sensing

4) Vacancy Sensing (Manual-On / Automatic-Off)

d. On/Off, Partial-On, and Partial-Off Occupancy Sensing modes shall function according to the following sequence of operation:

1) Occupancy sensors shall automatically turn lights on to a designated level when occupancy is detected. To support fine tuning of Partial-On sequences the designated occupied light level shall support at least 100 dimming levels.

2) Occupancy sensors shall automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels. To provide additional energy savings and an enhanced occupant experience, the system shall also be capable of dimming the lights when vacant and then turning the lights off completely after an additional amount of time.

3) Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under *Photocell Sensing Capabilities.*

4) At any time, the use of a wall station shall change the dimming level or turn lights off as selected by the occupant. The lights shall optionally remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.

e. Vacancy Sensing mode (also referred to as Manual-On / Automatic-Off) shall function according to the following sequence of operation:

1) The use of a wall station is specified turn lights on. The system shall be capable of programming the zone to turn on to either to a designated light level or the previous user light level. Initially occupying the space without using a wall station shall not result in lights turning on.

2) Occupancy sensors shall automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels. To provide additional energy savings and an enhanced occupant experience, the system shall also be capable of dimming the lights when vacant and then turning the lights off completely after an additional amount of time.

3) To minimize occupant impact in case the area or zone is still physically occupied following dimming or shutoff of the lights due to detection of vacancy, the system shall support an “automatic grace period” immediately following detection of vacancy, during which time any detected occupancy shall result in the lights reverting to the previous level. After the grace period has expired, the use of a wall station is specified to turn lights on.

4) Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under *Photocell Sensing Capabilities.*

5) At any time, the use of a wall station shall change the dimming level or turn lights off as selected by the occupant. The lights shall optionally remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.

f. To accommodate different types of environments, occupancy time delays before dimming or shutting off lights shall be specifiable for control zones between 15 seconds to 2 hours.

5. Photocell Sensing Capabilities (Automatic Daylight Sensing)

a. Photocell sensing devices shall be configurable to control a local and global zone simultaneously, as specified.

b. The system shall support the following types of photocell-based control:

1) On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. An adjustable time delay or adaptive setpoint behavior may be used to prevent the system from exhibiting nuisance on/off switching, as well as a dead band to prevent on/off cycling.

2) Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

6. Schedule and Global Profile Capabilities

   a. The system shall be capable of automatically modifying the sequence of operation for selected devices in response to any of the following: a time-of-day schedule, contact closure input state, manually triggered wall station input, RS-232/RS-485 command, and BACnet input command. This capability is defined as supporting “Global Profiles” and is used to dynamically optimize the occupant experience and lighting energy usage.

   b. Global profiles may be scheduled with the following capabilities:

      1) Global Profiles shall be stored within and executed from the system controller (via internal timeclock) such that a dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.

      2) Global Profile time of day schedules shall be capable of being given the following recurrence settings: daily, specific days of week, every “n” number of days, weekly, monthly, and yearly. Lighting control profile schedules shall support definition of start date, end date, end after “n” recurrences, or never ending. Daylight savings time adjustments shall be capable of being performed automatically, if desired.

      3) Global Profile Holiday Schedules should follow recurrent settings for specific US holiday dates regardless if they always occur on a specific date or are determined by the day/week of the month.

      4) Global Profiles shall be capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.

      5) System shall support blink warning and timed extension capabilities. At the end of a scheduled period, the system shall be capable of providing a visible “blink warning” 5 minutes prior to the end of the schedule. Wall stations may be programmed to provide timed overrides that turn the lights on for an additional period of time. Timed override duration shall be programmable for each individual device, zone of devices, or customized group of devices, ranging from 5 minutes to 12 hours.

      6) Software management interface shall be capable of displaying a graphic calendar view of profile schedules for each control zone.

c. System Global Profiles shall have the following additional capabilities:

1) Global Profiles shall be capable of being manually activated directly from the system controller, specially programmed input devices, scene capable wall stations, and the software management interface.

2) Global Profiles shall be selectable to apply to a single device, zone of devices, or customized group of devices.

3) Parameters that shall be configurable and assigned to a Global Profile shall include, but not be limited to, fixture light level, occupancy time delay, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wall stations.

d. A backup of Local and Global Profiles shall be stored on the software's host server such that the Profile backup can be applied to a replacement system controller or wall station.

7. System shall support automated demand response capabilities with automatic reduction of light level to at least three levels of demand response.

2.05 SYSTEM SOFTWARE INTERFACES

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.

2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer, Apple Safari, Google Chrome, Mozilla Firefox.

3. Management interface shall require all users to login with a User Name and Password, and shall support creation of at least 100 unique user accounts.

4. Management interface shall support at least three permission levels for users: read-only, read & change settings, and full administrative system access.

5. Management interface shall be capable of restricting access for user accounts to specific devices within the system.

6. All system devices shall be capable of being given user-defined names.

7. The following device identification information shall be displayed in the Management interface: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.

8. Management interface shall be able to read the live status of a networked luminaire or intelligent control device and shall be capable of displaying luminaire on/off status, dim level, power measurement, device temperature, PIR occupancy sensor status, microphonic occupancy sensor status, remaining occupancy time delay, photocell reading, and active Scenes or Profiles.

9. Management interface shall be able to read the current active settings of a networked luminaire or intelligent control device and shall be capable of displaying dimming trim levels, occupancy sensor and photocell enable/disable, occupancy sensor time delay and light level settings, occupancy sensor response (normal or vacancy), and photocell setpoints and transition time delays.

10. Management interface shall be able to change the current active settings and default settings for an individual networked luminaire or intelligent control device.

11. Management interface shall be capable of applying settings changes for a zone of devices or a group of selected devices using a single “save” action that does not require the user to save settings changes for each individual device.

12. A printable network inventory report shall be available via the management interface.

13. A printable report detailing all system profiles shall be available via the management interface.

14. All sensitive information stored by the software shall be encrypted.

15. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface

1. System shall provide a historical database that stores device operational history and calculates energy usage for all networked luminaires and intelligent control devices.

2. System shall be capable of reporting lighting system events and performance data back to the historical database for display and analysis.

3. Historical database shall be capable of recording historical data for up to 20,000 networked devices for a period of at least 1 calendar year.

4. An “Energy Scorecard” shall be displayed that shows calculated energy savings in dollars, kWh, or CO2.

5. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching).

6. Energy savings data shall be calculated for the system as a whole or for individual zones.

7. A time scaled graph showing all relay transitions shall be presented.
8. A time scaled graph showing a zones occupancy time delay shall be presented
9. A time scaled graph showing the total light level shall be presented.
10. User shall be able to customize the baseline run-time hours for a space.
11. User shall be able to customize up to four time-of-day billing rates and schedules.
12. Historical data shall be exportable from the Historical Database via a “CSV” type of file format.

C. Visualization and Programming Interfaces

1. Provide a system using a web-based visualization interface that displays graphical floorplan.
2. Graphical floorplan shall offer the following types of system visualization:
    a. Full Device Option - A master graphic of the entire building, by floor, showing each control device installed in the project with zones outlined. This shall include, but not be limited to, the following:
        1) Controls embedded light fixtures
        2) Controls devices not embedded in light fixtures
        3) Daylight Sensors
        4) Occupancy Sensors
        5) Wall Switches and Dimmers
        6) Scene Controllers
        7) Networked Relays
        8) Bridges
        9) System Controllers
        10) Panels
        11) Zone outlines
    b. Zone Only Option - A master graphic of the entire building, by floor, showing only control zones outlined.
    c. Allow for pan and zoom commands so smaller areas can be displayed on a larger scale simply by panning and zooming each floor’s master graphic.
    d. A mouse click on any control device shall display the following information (as applicable):
        1) The device catalog number.

2) The device name and custom label.

3) Device diagnostic information.

4) Information about the device status or current configuration is available with an additional mouse click.

D. Personal Control Applications

1. Software interface shall support personal control software applications that provide user-specific control of individual luminaires/control devices, control zones, global scene presets, and scene selector virtual button presses.

2. The system administrator shall be capable of defining personal control permissions for each user account.

3. Software interface shall provide a Microsoft Windows® operating system taskbar application for personal lighting control.

4. Software interface shall provide an Apple iOS ® operating system application (supported by mobile phones and mobile tablet devices) for personal lighting control.

E. Smartphone Programming Interface for Wired Devices

1. Application interface shall be provided for both Apple iOS® and Android operating systems that allows configuration of lighting control settings.

2. The application shall support the configuration and control of wired networked control devices via a Bluetooth® Low Energy (BLE) Programming Device.

a. Application shall support a security pin-code to access the zone of lighting control devices.

b. The application shall provide indication of signal strength where multiple Bluetooth Low Energy Programming Devices are available for configuration.

c. The application shall indicate the number of wired networked control devices connected to the local daisy-chain zone.

d. The application shall provide on/off/dimming control of all control groups.

e. The application shall provide the ability to identify all individual luminaires and control devices.

3. Programming capabilities through the application shall include, but not be limited to, the following:

a. Switch/occupancy/photosensor group configuration

b. Manual/automatic on modes

c. Turn-on dim level

d. Occupancy sensor time delays

e. Dual technology occupancy sensors sensitivity

f. Photosensor calibration adjustment and auto-setpoint

g. Trim level settings

h. Preset scene creation and copy for scene capable devices.

i. Application of a custom device label.

2.06 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller

1. Provide Acuity nLight nECY or approved equal

2. System Controller shall be multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.

3. System Controller shall have 32-bit microprocessor operating at a minimum of 1 GHz.

4. System Controller shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and databases.

5. System Controller shall perform the following functions:

a. Time-based control of downstream wired and wireless network devices.

b. Facilitation of global network switch communication between different system controllers.

c. Linking into an Ethernet network.

d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment. Refer to electrical drawings.

e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.

6. System Controller shall have an integral web server to support configuration, diagnostics and hosting of software interfaces.

7. Device shall have option for a graphical touch screen to support configuration and diagnostics.

8. Device shall have three RJ-45 networked lighting control ports for connection to any of the following:

a. The graphical touch screen

b. Wired communication bridges

c. Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port)

9. Device shall be capable of communicating with wireless network bridges and software interfaces via LAN connection.

10. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.

11. Device shall have a standard and astronomical internal time clock.

12. Device shall have 2 switched RJ-45 10/100 BaseT Ethernet ports for local area network (LAN) connection. Ethernet connection shall support daisy chain wiring to other lighting control system LAN devices, such as other system controllers and wireless networked communication bridges. Ethernet connection shall support IPv4 and shall be capable of using a dedicated static or DHCP assigned IP address.

13. Device shall have 2 x USB 2.0 Expansion ports for 802.11 Wi-Fi Adapter enabling wireless connectivity including: Hot Spot, Access Point, Client

14. Each System Controller shall be capable of managing and operating at least 750 networked devices. Multiple System Controllers may be networked together via LAN connection to scale the system up to 20,000 networked devices.

15. System Controller shall support BACnet/IP and BACnet MS/TP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways. BACnet MS/TP shall support 9600 to 115200 baud rate. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.

16. System controller shall contain a “FIPS 140-2 Level 1 Inside” cryptographic module.

17. System controller shall be available within a NEMA 1 enclosure with Class 1 and Class 2 separation. Enclosure shall support power input power of 120-277VAC

2.08 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers

1. Provide Acuity nLight nPODM, nPODM xS, nPODM xL or approved equal.

2. Devices shall recess into single-gang switch box and fit a standard GFI opening.

3. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.

4. All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.

5. Devices with mechanical push-buttons shall provide tactile and LED user feedback.

6. Devices with mechanical push-buttons shall be made available with custom button labeling.

7. Wall switches & dimmers shall support the following device options:

    a. Number of control zones: 1, 2 or 4

    b. Control Types Supported:

        1) On/Off

        2) On/Off/Dimming

        3) On/Off/Dimming/Correlated Color Temperature Control for specific luminaire types

    c. Colors: Ivory, White, Light Almond, Gray, Black, Red

8. Scene controllers shall support the following device options:

    a. Number of scenes: 1, 2 or 4

    b. Control Types Supported:

        1) On/Off

        2) On/Off/Dimming

        3) Preset Level Scene Type

        4) On/Off/Dimming/Preset Level for Correlated Color Temperature

        5) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.

        6) Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.

    c. Colors: Ivory, White, Light Almond, Gray, Black, Red

B. Wired Networked Graphic Wall Stations

1. Provide Acuity nLight nPOD-GFX or approved equal.

2. Device shall surface mount to single-gang switch box.

3. Device shall have a 3.5” full color touch screen.

4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.

5. Device shall have a micro-USB style connector for local computer connectivity.

6. Communication shall be over standard low voltage network cabling with RJ-45 connectors.

7. Device shall enable user supplied screen saver image to be uploaded within one of the following formats: jpg, png, gif, bmp, tif.

8. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.

9. Graphic wall stations shall support the following device options:

    a. Number of control zones: Up to 16

    b. Number of scenes: Up to 16

    c. Profile type scene duration: User configurable from 5 minutes to 12 hours

    d. Colors: Ivory, White, Light Almond, Gray, Black

C. Wired Networked Digital Key Switches

1. Provide Acuity nLight nPOD KEY, nPOD KEY MNTN or approved equal

2. Devices shall recess into single-gang switch box and fit a standard GFI opening.

3. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.

4. All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.

5. Devices shall have LED user feedback to provide indication of on/off status of the programmed lights or scene, as well as indication of device power.

6. Digital key switches shall support the following device options:

    a. Control Types Supported:

        1) On/Off

        2) On/Off/Dimming

        3) Preset Level Scene Type

4) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.

5) Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.

b. Colors: Ivory, White, Light Almond, Stainless Steel

D. Wired Networked Auxiliary Input / Output (I/O) Devices

1. Provide Acuity nLight nIO-1S, nIO-RLX, nIO-MLO-5STEPA, nIO-MLO-AB, nIO-NLI, nIO-X, nIO-D, nIO-EZ-PH, nIO-EZD or approved equal.

2. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.

3. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.

4. Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:

a. Contact closure or Pull High input. Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, activate lights at a preconfigured level, ramp light level up or down, or toggle lights on/off. 0-10V analog input. Input shall be programmable to function as a daylight sensor.

b. RS-232/RS-485 digital input. Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones. 0-10V dimming control output, capable of sinking up to 20mA of current. Output shall be programmable to support all standard sequence of operations supported by system.

c. Digital control output via EldoLED LEDcode communication. Output shall be programmable to support light intensity control, as well as optional correlated color temperature (CCT) control, of the connected luminaire.

E. Wired Networked Occupancy and Photosensors

1. Provide Acuity nLight nCM, nCMB, nRM, nWV, nHW or approved equal

2. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.

3. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.

4. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.

5. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.

6. All sensing technologies shall be acoustically passive, meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.

7. System shall have ceiling, fixture, recessed & corner mounted sensors available, with multiple lens options available customized for specific applications.

8. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.

9. All sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.

10. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device push-button.

11. Ceiling mount occupancy sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).

12. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.

13. Sensors shall have optional features for photosensor/daylight override, automatic dimming control, and low temperature/high humidity operation.

14. Photosensor shall provide for an on/off set-point, and a dead band to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

15. Photosensor and dimming sensor's set-point and dead band shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.

16. Dead band setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).

17. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The secondary daylight zone shall be capable of being controlled as an "offset" from the primary zone.

F. Wired Networked Wall Switch Sensors

1. Provide Acuity nLight nWSX or approved equal

2. Devices shall recess into single-gang switch box and fit a standard GFI opening.

3. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.

4. All wall switch sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.

5. Devices with mechanical push-buttons shall provide tactile user feedback.

6. Wall switches sensors shall support the following device options: User Input Control Types Supported: On/Off or On/Off/Dimming. Occupancy Sensing Technology: PIR only or Dual Tech acoustic. Daylight Sensing Option: Inhibit Photosensor. Colors: Ivory, White, Light Almond, Gray

G. Wired Networked Embedded Sensors

1. Product Series: Acuity nLight nES or approved equal.

2. Network system shall have embedded sensors consisting of occupancy sensors and/or dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.

3. Occupancy sensor detection pattern shall be suitable for 7.5' to 20' mounting heights.

4. Embedded sensors shall support the following device options. Occupancy Sensing technology: PIR only or Dual Tech acoustic. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor

H. Wired Networked Power Packs and Secondary Packs

1. Provide Acuity nLight nPP16, nPP16-ER, nPP20-PL, nSP16, nSP5-PCD, nSP5-2P-LVR, nSHADE, nAR40, nEPS 60, nPS-80 or approved equal.
2. Power Packs shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
3. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC) and carry a plenum rating.
4. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power.
5. Power Supplies shall provide system power only, but are not required to switch line voltage circuit.
6. Auxiliary Relay Packs shall switch low voltage circuits only, capable of switching 1 amp at 40 VAC/VDC (resistive only).
7. Communication shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors. Secondary packs shall receive low voltage power via standard low voltage network cable.
8. Power Pack programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
9. Power Pack shall securely mount through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast/driver channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
10. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
11. Power/Secondary Packs shall be available with the following options:
    a. Power Pack capable of full 16-Amp switching of all normal power lighting load types, with optional 0-10V dimming output capable of up to 100mA of sink current.
    b. Secondary Pack with UL924 listing for switching of full 16-Amp Emergency Power circuits, with optional 0-10V dimming output capable of up to 100mA of sink current.
    c. Power and Secondary Packs capable of full 20-Amp switching of general purpose receptacle (plug-load) control.

d. Secondary Pack capable of full 16-Amp switching of all normal power lighting load types.

e. Secondary Pack capable of 5-Amps switching and dimming 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).

f. Secondary Pack capable of 5-Amps switching and dimming of 120/277 VAC magnetic low voltage transformers.

g. Secondary Pack capable of 4-Amps switching and dimming of 120 VAC electronic low voltage transformers.

h. Secondary Pack capable of louver/damper motor control for skylights.

i. Secondary Pack capable of providing a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

j. Secondary Pack capable of switching 1 amp at 40 VAC/VDC (resistive only) with the intent to provide relay signal to auxiliary system (e.g. BMS).

k. Power Supply capable of providing auxiliary bus power (no switched or dimmed load).

12. System shall be able to turn on/off specific LED luminaires without using a relay, if LED driver supports “sleep mode.”

13. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation. System shall indicate (via a blink warning) when the LED luminaire is no longer able to compensate for lumen depreciation.

14. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.

15. System shall be able to provide control of luminaire intensity, in additional to dynamic features, such as grayscale and color accent of specific LED luminaires.

I. Wired Networked Relay and Dimming Panel

1. Provide Acuity nLight ARP or approved equal

2. Relay and dimming panel shall be available with 4, 8, 12 or 16 individual relays per panel, with an equal number of individual 0-10V dimming outputs.

3. Optional Field Configurable Relays (FCR) used shall have the following required properties: Configurable in the field to operate with single-, double-, or triple-pole relay groupings. Configurable in the field to operate with normally closed or normally open behavior. Provides visual status of current state and manual override control of each relay.

a. Listed for the following minimum ratings:

1) 40A @ 120-480VAC Ballast

2) 16A @ 120-277VAC Electronic

3) 20A @ 120-277VAC Tungsten

4) 20A @ 48VDC Resistive

5) 2HP @ 120VAC

6) 3HP @ 240-277VAC

7) 65kA SCCR @ 480VAC

4. 0-10 dimming outputs shall support a minimum of 100mA sink current per output.

5. Relay and dimming outputs shall be individually programmable to support all standard sequence of operations as defined in this specification.

6. Panel shall be UL924 listed for control of emergency lighting circuits.

7. Panel shall power itself from an integrated 120-277 VAC or optional 347VAC supply.

8. Panel shall provide a configurable low-voltage sensor input with the following properties: Configurable to support any of the following input types:

a. Indoor Photocell

b. Outdoor Photocell

c. Occupancy Sensor

d. Contact Closure

1) Low voltage sensor input shall provide +24VDC power for the sensor so that additional auxiliary power supplies are not required.

2) Sensor input supports all standard sequence of operations as defined in this specification.

9. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel. This input is intended to provide an interface to alarm systems, fire panels, or BMS system to override the panel.

10. Panel shall supply current limited low voltage power to other networked devices connected via low voltage network cable.

11. Panel shall be available with NEMA 1 rated enclosure with the following properties. Surface-mounted or flush-mounted enclosure back box. Screw-fastened cover or hinged cover with keyed lock

12. Panel shall be rated from 0-50C.

J. Wired Networked Bluetooth Low Energy Programming Device

1. Provide Acuity nLight nIO BT or approved equal
2. Device shall be plenum rated and be inline wired, screw mountable.
3. Communication and low voltage power shall be delivered to device via standard low voltage network cabling with RJ-45 connectors.
4. Bluetooth Low Energy connection shall allow connection from smartphone application for programming device settings within the local daisy-chain zone. Device shall provide visual indication of remote Bluetooth connection via LED integrated into device enclosure such that it is visible from all angles while the zone is being programmed.

K. Wired Networked Communication Bridge

1. Product Series: Acuity nLight nBRG or approved equal.
2. Device shall surface mount to a standard 4" x 4" square junction box.
3. Device shall have 8 RJ-45 ports for connection to lighting control zones (up to 127 devices per port), additional network bridges, and System Controller.
4. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
5. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply, or powered via low voltage network connections from powered lighting control devices (e.g. power packs).
6. Wired Bridge shall be capable of redistributing power from its local supply and connected lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.09 ECLYSPE ENERGY SYTE

A. Provide Acuity nLight IP nLight ECLYPSE™ Controller or approved equal. The IP-NE-CTRL shall be 32 bit microprocessor-based operating at a minimum of 1 GHz. They shall be multi-tasking, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point list.

B. Each IP-NE-CTRL shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and databases, including: Control processes, Alarm management applications, Maintenance support applications, Custom processes, Web Based interface via integral HTML5 Web Server, Shall have a graphical interface with a common library of nLight system images.

C. The IP-NE-CTRL shall have a Real Time clock. The IP-NE-CTRL will support the following communications protocols: BACnet/IP, Supporting IPv4 addressing, DHCP support and Auto DNS, 2 - RJ45 ports each capable of supporting 10/100 Base-T. Supporting controller daisy chaining on the Ethernet network via integral switch functionality. If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.

D. Network Lighting Control (NLC). Supporting up to 1500 NLC devices. 3 – RJ45 ports supporting NLC networks. If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality. BACnet IP supporting up to minimum of 50 additional BACnet IP controllers in addition to the Expansion I/O modules. 2 x USB 2.0 Expansion ports for: 802.11 Wi-Fi Adapter enabling wireless connectivity including: 'Hot Spot', Client Access Point. Shall contain a "FIPS 140-2 Level 1 Inside" cryptographic module. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.

E. The system shall provide the owner with a graphic user interface using floor plans. The graphic user interface shall provide complete control of the lighting control system for read, write options, and all specified programming features and functions.

PART 3 – EXECUTION

3.01 GENERAL NOTES

A. All materials specified in this Section occurring in acoustical ceilings shall be supported directly from the building structure. The acoustical ceiling system shall not be required to support any item specified in this Section of these Specifications.

B. Provide the required labor to provide, install, test and program Network Lighting Control System listed above in part 2 per the installation requirements listed in section 260001 – Electrical.

C. Installation Procedures and Verification - The electrical contractor shall review all specified installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings. The electrical contractor shall install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications. The electrical contractor shall test all low voltage network cable installed for the networked lighting control system. The electrical contractor shall test all wiring to verify that the wiring is within the manufacturer's parameters for operation. The electrical contractor is responsible for verification of the following minimum parameters:

1. Wire Map (continuity, pin termination, shorts and open connections)
2. Length
3. Insertion Loss

D. Coordination with Owner's IT Network Infrastructure - The electrical contractor is required to coordinate with the owner's representative to secure all specified network connections to the owner's IT network infrastructure. The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system. The bidder shall provide to the manufacturer's representative all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.

E. Documentation and Deliverables - The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device address barcodes corresponding to locations of installed equipment.

F. The installing contractor is also responsible for the specified additional documentation to the manufacturer's representative for the visualization / graphical floorplan software being provided as part of bid package:

1. As-Built floor plan drawings showing daisy-chain wired network control zones outlined, in addition to device address locations specified above. All documentation shall remain legible when reproducing\scanning drawing files for electronic submission.
2. As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.
3. CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
   Titleblock
4. Text – Inclusive of room names and numbers, fixture tags and drawings notes
   Fixture wiring and homeruns Control devices. Hatching or poché of light fixtures or architectural elements
5. CAD files shall be of AutoCAD 2016 or earlier. Revit file overall floor plan views shall be exported to AutoCAD 2016.

3.02 SYSTEM START UP

A. The electrical contractor shall provide all required labor and material to furnish, install, program, test and provide owner training for the Network Lighting Control System.

B. Upon completion of installation by the installer, including completion of all required verification and documentation specified by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer. Low voltage network cable testing shall be performed prior to system startup by the electrical contractor per manufacturer's testing requirements.

C. System start-up and programming shall include:

1. Verifying operational communication to all system devices.
2. Programming the network devices into functional control zones to meet the Owner's specified sequence of operation.
3. Programming and verifying all sequence of operations.
4. Customization of owner's software interfaces and applications.
5. Integration of the complete lighting control system program into the building management software system.

D. Initial start-up, all programming and instruction is to occur on-site.

E. Graphic interface – The electrical contractor shall program the graphic interface per the owner's requirements. The graphic interface shall provide the owner with complete control of the lighting control system including but not limited to read, write, program schedules.

F. All specified programing, testing and integration required to integrate the lighting controls into the BMS network. Refer to the electrical drawings, HVAC drawings and the Building Management System Specifications. The lighting graphic interface shall be integrated into the BMS graphic interface so that the owner has complete control of the lighting control system.

G. Program – All programming to be coordinate with the owner prior to program installation.

1. Classroom sensors shall be Vacancy Sensors. Lights shall turn on manually by wall switch and shut off automatically upon detection of absence of movements for 15 minutes (adj.)
2. Hallway and restroom sensors shall be Occupancy Sensors. Lights shall turn on automatically upon detection of motion and turn off automatically up detection of absence of movements for 20 minutes (adj.)
3. When overridden off from BMS, lights shall be off and remain off regardless of wall switch, motion detection or schedule. Exception: Hallway lights shall always turn on upon detection of motion.
4. When overridden on from BMS, lights shall turn on and remain on regardless of wall switch, motion detection or schedule.
5. Demand load shedding schedule shall have a higher priority than operation schedule such that when demand load shedding schedule is active, all dimmable lights shall be commanded to a BMS adjustable dimmer level (%) regardless of wall switch adjustment. In the absence of motion detection or when normal schedule commands lights to be off, lights shall go off while in demand load shed mode.
6. Override shall have higher priority than demand load shed.
7. When building fire alarm is activated, all lights shall turn on. Once FACP is reset, all lights shall be off following 10 minutes time delay. In the event that building fire alarm is activated during lighting occupied hours, lights shall remain on after FACP is reset."

3.03 PROJECT TURNOVER

A. System Documentation - Submit software database file with desired device labels and notes completed. Changes to this file will not be made by the factory.

B. Allow sixteen hours onsite each for the electrical contractor and the manufacturer's service company to meet with, and coordinate with the owner the lighting control system operation prior to programming. Testing of the lighting controls is not included in this time. The contractor shall meet with the Owner and architect prior to any programming.

C. After the initial meeting with the owner, the electrical contractor and manufacturer's service company shall program the system per the owner's requirements. Once programing is completed the electrical contractor and manufacturer's service company shall test the entire system including all but not limited to schedules, control stations, sensors, and daylighting controls to ensure the system is 100% operational. The electrical contractor shall replace, repair, re-wire and/or re-program any device found not to be functioning as specified by the drawings, specifications and owner requirements. Once the testing is complete and the system is 100% operational per the owner's programming requirements, the electrical contractor shall submit a report to the architect documenting all testing and all remedial corrections that were required.

D. Owner Training - Provisions for onsite training for owner and designated attendees to be included in submittal package. Provide twenty fours of onsite owner training in three separate training sessions.

E. Provide sixteen hours onsite for owner meetings, coordination and owner program changes to the original programming after the original programming is complete. The electrical contractor shall make any and all required revisions to the network lighting control programming based on these additional meetings.

3.04 SERVICE CONTRACT

A. Provide a 1-year service contract to be. Renewable at the end of the term. To include onsite service upon request with 24 hour notice, Midterm system performance evaluation, Unlimited phone support. Service contract does not eliminate or replace any of the contractor's or manufacturer's requirements listed above.

END OF SECTION

SECTION 265561

EMERGENCY RADIO COMMUNICATION SYSTEM
(This Section to be included in Sub-Bid Section 260001 - Electrical)

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this trade.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure a steady progress of all work under Contract.

D. When referred to, standard specifications of technical societies, manufacturer's associations, and federal agencies shall include all amendments current as of the date of issue of these Specifications.

E. This section is a sub-section to Section 260001 – Electrical and this section shall be installed in accordance with the requirements of Section 260001.

1.02 SCOPE OF WORK

A. The scope of the work under this Section, without limiting the generality thereof, includes all materials, labor, equipment, services and transportation, unless otherwise specified, necessary to complete all systems of electrical wiring and equipment required by the Drawings and/or specified herein. It is the intent of this Section of these Specifications and accompanying Electrical Drawings to cause these Systems to be furnished complete in every respect. The Electrical Subcontractor shall furnish all wiring, equipment, staging, access panels, and labor needed and usually furnished in connection with such work, whether specifically mentioned of not.

B. Provide an emergency radio communication system in the building for the fire department, and police department radio communication systems. The system shall meet all requirements of UL, NFPA and state building code section 915.

C. The fire stopping of all electrical penetrations through fire resistance rated wall, partitions, floors and ceilings shall be a part of the Electrical Subcontract. The electrical contractor shall provide all required fire/smoke stopping on all corridor walls for all electrical penetrations.

D. The 260001 electrical contractor shall furnish, install and maintain in a safe adequate condition all staging and scaffolding that is necessary for the proper executing of the work of this Section 265561.

E. The 260001 electrical contractor shall perform all cutting, coring and channeling required for the work of this Section 265561, for holes 5' in diameter or less.

F. The Commissioning process requires the participation of Section 265561 – Emergency radio Communication System, to ensure that all systems fulfill the functional and pre-functional requirements set forth in these construction documents. The general commissioning requirements and coordination are detailed in Section 019113 - General Commissioning Requirements. Section 260001-Electrical, shall fulfill commissioning responsibilities assigned to Section 265561 in accordance with Section 019113 - Commissioning.

1.03 RELATED WORK UNDER OTHER SECTIONS

A. Section 01 91 13 – General Commissioning Requirements.

B. All electrical systems required for this section shall be provide by the section 260001 contractor per the requirements of the Section 260001 specifications.

C. Painting of electrical conduits, surface metal raceways, pull boxes, hangers, panelboard doors and trim, and all other electrical equipment to match the surrounding finish as specified by the Architect, shall be done by the Section 090007 - Painting.

D. The flashing of all electrical conduits passing through roofs shall be done under Section 070002 - Roofing and Flashing.

E. The General Contractor shall pay the cost of the electrical energy consumed by all trades during the construction period and this contractor shall provide temporary lighting and power. Refer to Section 015000 - Temporary Facilities and Controls.

F. The General Contractor shall install all access panels furnished by the Electrical Subcontractor for Section 265561.

1.04 SHOP DRAWINGS

A. Prepare and submit complete shop drawings in accordance with requirements of Section 013300 - Submittals and in the manner described herein.

B. Shop drawings and catalog cuts shall indicate Specification Section and paragraph requiring equipment submitted.

C. Shop Drawings shall include all necessary wiring diagrams of all equipment. Shop drawings shall include floor plans indicating the location of all equipment, cables and antennas. The shop drawings shall include all require dba sound levels. Shop drawings shall be required for all equipment required for the emergency radio communication system.

D. Shop drawings of heavy equipment shall specify requirements, loads imposed upon the building structure, and all other information necessary to, and affecting the work of others, and the building structure.

E. Provide complete manufacturer's operating equipment manuals, diagrams and other data to such persons as specified for the operation and maintenance of this equipment.

F. All shop drawings, spec sheets, brochures shall be incorporated into the operating and maintenance manuals.

G. LEED for Schools Submittals: (Refer to SECTION 013300 - Submittals):

1. Relevant supporting documentation, as required by LEED for Schools v4 and as detailed in Section 018133 – Sustainable Design Requirements.
2. A completed LEED MATERIALS REPORTING FORM, per Section 018113 – Sustainable Design Requirements.
3. Product substitution requests are subject to additional LEED-S submittal requirements, see SECTION 012500 – SUBSTITUTION PROCEDURES.

1.05 SAMPLES

A. Submit samples of all materials as requested by the Architect.

B. Samples shall be prepared and submitted in accordance with requirements of Section 013300 - Submittals with all postage and transportation costs paid by the Contractor submitting same.

1.06 PERMITS, LAWS AND ORDINANCES AND CODES

A. The work shall be executed in full accordance with the current rulings of the latest edition of the Massachusetts Electrical Code and all state and local rulings. Where codes conflict, the more stringent shall apply. Any changes necessary to the Drawings and Specifications, as submitted for bid, required to make conformity to any of the above state authorities shall be called to the attention of the Architect by this Subcontractor at the time of his Bid, otherwise he shall be held financially responsible for all work necessary for an approved installation. If this Subcontractor performs any such work knowing it to be contrary to any such laws, rules or regulations, he shall assume all costs arising therefrom to make conformity to such above rulings.

B. This Subcontractor shall obtain the necessary permits for construction and approval of the plans by the necessary authorities and shall obtain all other permits, licenses or certificates of approval, arrange for all inspections and pay all fees and charges connected therewith. This Subcontractor shall, at the completion of the job, furnish the Architect with a certificate of inspection of the work from the authorities having jurisdiction.

C. No work shall be covered before examination and approval by the Architect and by all inspectors and authorities having jurisdiction. Replace any imperfect or condemned work with work conforming to requirements and satisfactory to the Architect, without extra cost to the Owner. If work is covered before due inspection and approval, this Subcontractor shall pay all costs of uncovering and reinstalling such work.

D. The BDA system shall be fully compliant with all requirements of NFPA 72 – National Fire Alarm and Signaling Code and the Fire Department. In addition to the Massachusetts Electrical Code and the local inspection authorities, the electrical work shall be executed in full accordance with the Occupational Safety and Health Administration's latest requirements for "Safety and Health Regulations for Construction".

1.07 RECORD DRAWINGS

A. In accordance with requirements of Section 011000 – Summary of Work and Section 017839 - Project Record Documentation of these Specifications, this Subcontractor shall furnish and keep on the job at all times, one (1) complete and separate set of blackline prints of the electrical work on which shall be clearly, neatly and accurately noted, promptly as the work progresses, all architectural and electrical changes, revisions and additions to the Project. The Electrical Subcontractor shall incorporate all electrical and architectural revisions issued by the Architect. The Electrical Subcontractor shall document his work on these drawings during construction. Wherever work is installed otherwise than as shown on the Contract Drawings, such changes shall be noted.

B. Indicate daily progress on these prints by coloring in various conduits, fixtures, apparatus and associated appurtenances as they are erected.

C. No approval of requisition for work installed will be given unless supported by record prints as specified above.

D. At the conclusion of work, prepare Record Drawings in accordance with the requirements Section 017839 - Project Record Documentation. The Electrical Subcontractor shall submit to the Architect a complete set of Electrical Record Drawing using CAD. Submit one set of drawings and a thumb drive with a complete set of drawings files. Drawings files shall be in the DWG format and shall be Autocad 2018 compatible.

1.08 OPERATING INSTRUCTION AND MAINTENANCE MANUALS

A. This Subcontractor shall instruct to the Owner's approval such persons as the Owner designates, in the proper operation and maintenance of the systems and their parts. Submit to the Architect, a letter naming the person or persons so instructed and the dates of such instruction.

B. This Subcontractor shall video tape all instructions given to the Owner on the proper operation and maintenance of the electrical systems installed under the electrical subcontract. Provide up to four (4) hours of video taped instructions and three (3) copies of the video taped instructions shall be given to the Architect for transmittal to the Owner. All video taped instructions shall be done in accordance with the requirements of Section 017700, Project Closeout.

C. Furnish operating and maintenance manuals in accordance with Section 01700 - Project Closeout and forward same to the Architect for transmittal to the Owner. These manuals shall be bound.

D. The operating instructions shall include a detailed narrative of the system, written sequence of operation, operator instructions for basic system operations, and detailed description of maintenance and testing.

E. For maintenance purposes, provide shop drawings, parts lists, specifications and manufacturer's bulletins for each piece of equipment.

F. Provide name, address, and telephone number of the manufacturer's representative and service company for each piece of equipment so that service or spare parts can be readily obtained.

1.09 GUARANTEE

A. Attention is directed to provisions of the General Conditions regarding guarantees and warranties for work under this Contract.

B. The manufacturer shall provide their standard guarantee for work under this Section; however, such guarantees shall be in addition to and not in lieu of all liabilities which the manufacturer and contractor may have by law or by other provisions of the Contract Documents.

C. All materials, items of equipment and workmanship furnished under this Section shall carry the standard warranty against all defects in materials and workmanship for a period of not less than one (1) year. Any fault due to defective or improper material, equipment, workmanship or design which may develop within that period shall be made good, forthwith, by and at the expense of the Electrical Subcontractor, including all other damage done to areas, materials and other systems resulting from this failure.

D. The Electrical Subcontractor shall guarantee that all elements of the systems are of sufficient as set forth or as indicated.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Electrical Subcontractor.

F. Furnish before the final payment is made, a written guarantee covering the above requirements.

1.10 EXAMINATION OF SITE AND CONTRACT DRAWINGS

A. Before submitting prices or beginning work, thoroughly make an examination of the site and Contract Documents.

B. Bidders are advised to visit the site and inform themselves as to the conditions under which this work shall be performed. Failure to do so shall in no way relieve the successful bidder from the responsibility of furnishing any material or performing any work in accordance with the true intent and meaning of the Drawings and Specifications.

C. No claim for extra compensation will be recognized if difficulties are encountered which an examination of site conditions and Contract Documents prior to executing the Contract would have revealed.

D. The Electrical Subcontractor should inspect the location and length of conduit and duct runs, and the location of equipment installation mentioned in these Specifications.

E. The Electrical Subcontractor shall be responsible for ordering and furnishing the correct length of material required. The lengths shown on the Drawings are approximate only and are not warranted to be accurate.

1.11 WORKMANSHIP

A. The entire work provided in this Specification shall be constructed and finished in every respect in a workmanlike and substantial manner. It is not intended that the Drawings shall show every pipe, fitting and appliance, but the Electrical Subcontractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best trades practice.

B. This Subcontractor shall keep other Subcontractors fully informed as to shape, size and position of all openings required for his apparatus and shall give full information to the General Contractor and other Subcontractors sufficiently in advance of the work so that all openings may be built in advance. Furnish and install all sleeves, support, hereinafter specified.

C. In the case of failure on the part of this Subcontractor to give proper notice and timely information as noted above, the Electrical Subcontractor shall do his own cutting and patching or have same done by the General Contractor, but in any case, without extra expense to the Owner.

D. This Subcontractor shall obtain detailed information from the manufacturers of apparatus as to the proper method of installation and connecting same. He shall also obtain all information from the General Contractor and the other Subcontractors which may be necessary to facilitate his work and the completion of the whole project.

E. Remove daily to a central location on site, all rubbish and debris and all refuse from workmen' lunches and at completion, remove all surplus materials, temporary works and construction plant and leave all work in clean condition, acceptable to the Architect.

1.12 PROTECTION

A. Each Subcontractor shall be responsible for his work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

B. Each Subcontractor shall protect work and material of other trades from damage that might be caused by his work or workmen and make good damage thus caused.

1.13 TESTS

A. Furnish all labor, material, instruments, supplies and services and bear all costs from the accomplishment of the tests herein specified. Correct all defects appearing under test, and repeat the tests until no defects are disclosed; leave the equipment clean and ready for use.

B. All grounds, crosses, shorts must be eliminated from the wiring.

C. The Electrical Subcontractor shall perform all tests other than herein specified which may be required by legal authorities or by agencies to whose requirements this work is to conform.

1.14 ABBREVIATIONS

UL Underwriters' Laboratories, Inc.

NFPA National Fire Protection Association

IEEE Institute of Electrical & Electronic Engineers

ASTM American Society for Testing and Materials

NEMA National Electrical Manufacturers Association

IES Illuminating Engineering Society

CBM Certified Ballast Manufacturers

ANSI American National Standards Institute

ICEA Insulated Cable Engineers Association

NEC National Electrical Code

MEC Massachusetts Electrical Code

AEIC Association of Edison Illuminating Companies

A. "E.C." as used hereinafter in this SECTION shall mean the "Electrical Subcontractor," i.e., the filed bid subcontractor under this SECTION 265561 and SECTION 260001.

B. "Concealed" shall be defined as areas where conduit and wiring is located in chases, walls, partitions, shafts, and above finished ceilings.

C. "Underground" shall mean conduit and wiring exterior to or within the building that is buried. All other conduit and wiring shall be considered "exposed."

D. "Exposed" shall mean conduit and wiring run on the surface of the building construction.

E. "Conduit" shall mean in addition to conduit, all fittings, hangers and other accessories relating to such conduit systems.

F. "Provide" shall mean "provided complete in place," that is, "furnished and installed."

1.15 CLEANING

A. Upon completion of the electrical installation, remove all debris, clean, polish and leave all work in perfect operating condition.

1.16 EQUIPMENT DIRECTORIES AND NAMEPLATES

A. Furnish and install typed directories under .020" clear plastic in directory cardholder in each panelboards, showing the utility of each circuit.

B. Identify each item of equipment, including disconnect switches, motor starters, panelboards, circuit breakers on switchboard, relays, contactors and cabinets, by a permanently attached nameplate made of a black surface, white core, laminated micarta with indented letters. Nameplates shall be a minimum of 2" long by 3/4" wide and shall bear the equipment name as designated in the schedules, specifications, or on shop drawings. All nameplates shall be fastened to each piece of equipment with screws.

1.17 ACCEPTANCE OF INSTALLATION CONDITIONS

A. This Subcontractor shall be fully responsible for the proper execution and performance of the work described herein. It shall be his responsibility to inspect all installation conditions and request the General Contractor to correct any conditions which may affect his work adversely. He shall report to the Architect, prior to commencing any portion of his work, any failure of the General Contractor to provide suitable installation conditions for his portion of the work.

1.18 APPROVED EQUAL

A. Approved equal shall mean that the use of all materials shall be submitted to the Architect for approval, and that such approval shall be the sole discretion of the Architect.

B. The term "submit for approval" or similar expressions shall mean that work shall be contingent upon the specific approval of shop drawings by the Architect in writing.

1.19 GIVING INFORMATION

A. The contractor shall provide the required coordination per the Section 260001 specifications.

1.20 COORDINATION DRAWINGS

A. Before materials are purchased or work is begun the Subcontractor shall prepare Coordination Drawings showing the size and location of his equipment and lines in the manner described under Section 013300 - Submittals.

1.21 COMMISSIONING OF SYSTEM EQUIPMENT

A. The Electrical Subcontractor and the manufacturer’s representative shall witness all testing of the emergency radio communication system. The contractor shall prepare a final performance acceptance reports in accordance with the code requirements and in a form acceptable to the local code officials. The actual testing shall be performed by the Electrical Subcontractor. All costs associated with testing, witnessing of the testing and preparation of reports shall be included in the Electrical Subcontractor bid and shall be a part of the base contract bid.

B. At the completion of the electrical installation, the Electrical Subcontractor shall demonstrate to the Owner and to the Engineer the proper operation of this system. Allow minimum of 1 full day (6 hours) for this demonstration.

C. Provide Owner and Engineer at least one week notice before demonstration is to begin. Electrical contractor shall ensure the presence of personnel from local manufacturer’s representative. All testing and training shall be performed and coordinated with the third party commissioning agent.

D. If any piece of equipment does not operate as specified then this contractor shall remedy the deficiency and repeat the demonstration in the Owner's and Engineer's presence at no additional cost.

E. Refer to Section 01 91 13 – General Commissioning for additional requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Materials specified for the work on all systems in this building shall be new and shall comply with the National Electrical Manufacturers Association's specifications (NEMA), the Massachusetts Electrical Code (MEC) and the American National Standards Institute (ANSI). Where materials are not specified, these materials shall be the best of their respective kinds. Submit a list of all materials to the Architect for approval within thirty (30) days after the contract is signed and before any orders are placed. Wiring materials, stock fixtures and equipment shall bear the label of the Underwriters' Laboratories, Inc. (UL), or shall be accompanied by a duly signed certificate from an approved inspection organization which states that the requirements of the Underwriters' Laboratories, Inc. (UL) for such materials and/or equipment have been complied with, but such label or certificate shall not obligate the Architect to approve said materials, fixtures and/or equipment.

B. All electrical equipment specified by this section shall be furnished and installed by the electrical contractor per the requirements of the Electrical – 260001 Section.

C. LEEDv4-S REQUIREMENTS

1. Products and materials used for this section of work are required to meet the following criteria for LEEDv4-S materials Credits, and a completed LEEDv4 MATERIALS REPORTING FORM shall be submitted for all materials in this SECTION:

   Furnish any adhesives, sealants, paints and coatings, meet the requirements for IEQ Credit 2 as defined in Section 018113 – SUSTAINABLE DESIGN REQUIREMENTS.

2. For SS Credit 6 Light Pollution Reduction, submit product data for all exterior lighting fixtures and fill out all templates required in the LEED submission forms.

3. For IEQ Credit 6 Interior Lighting, submit product data for all exterior lighting fixtures and fill out all templates required in the LEED submission forms.

2.02 EMERGENCY RADIO COMMUNICATION SYSTEM

A. Provide an emergency radio communication system in the building for the fire department, and police department radio communication systems. The system shall meet all requirements of UL, NFPA and state building code section 915.

B. The bi-directional amplifier (BDA) system for the fire department, and police department shall include the following:

1. Provide an in-building radio system to provide reliable firefighter, and police communications at the specified signal strength within the building
2. Configure the system to provide a minimum signal strength of -95 dBm available in 95 percent of the area of each floor when transmitted from the Fire Department, Police Department and a minimum signal strength of -95 dBm received at the Fire, and Police Department Systems from 95 percent of the area of each floor of the building.
3. Coordinate the frequencies with the designated representative of the Fire Department, and Police Department.
4. Ensure that the system complies with all applicable sections of FCC Rules Part 22, Part 90 and Part 101.
5. Provide backup battery power to ensure that the system is capable of operating on an independent battery for at least 24 hours. The battery system shall automatically charge in the presence of external power.
6. Conduct complete compliance testing based on the requirements of the Fire Department, and Police Department. Coordinate tests with the designated representative of the Fire and Police Departments and notify the architect and project manager when the testing has been scheduled.

C. The fire, and police department BDA for the emergency radio communication system shall include the following;

1. Bird Technologies TXRX RescueLine Signal Booster 61-70-50-N Bi-directional amplifier(s) or approved equal. Approved equals – Axell, Fiplex
2. Bird Technologies TXRX battery back up unit 6160-H-24-NG DC power supply or approved equal including battery and charger. Battery rated for 24 hours minimum. Approved equals Fiplex, Werker.
3. Red NEMA 4 enclosure marked “Amesbury Fire Dept”
4. Andrew LDF4-50, Heliax ½” Fire Retardant Riser rated 50 ohm non radiating coaxial cable or approved equal. Approved equals Trilogy
5. Trilogy ½” plenum rated 50 ohm non radiating coaxial cable or approved equal. Approved equals Trilogy, Andrew
6. Male/female connector kits – Andrew 540EZNMV2 ½” connectors or approved equal as specified. Approved equals Trilogy
7. Splitter and termination devices as specified by code and installation.
8. Coaxial cable supports
9. PCTEL MLPV450 in building antennas or approved equal – as specified by code. Approved equal – Laird, PCTEL

10. Laird FG4700 or approved equal exterior roof mounted Yagi antenna(s). Approved equal – PCTEL, Maxrad

11. Bird Technology Splitter 85-58-01-LT or approved equal. Approved equal – Laird, PCTEL

12. Remote BDA annunciator adjacent to the fire alarm annunciator.

13. Interconnection with the fire alarm system for monitoring and supervision per NFPA 72.

14. Disable switch located at the fire alarm system control panel to allow remote BDA system shut down

D. The system shall include all required equipment, cabling, labor, testing and programming required for a complete and fully functional system.

E. Signal Strength – The in-building radio system is an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable firefighter, and police department communications at the required signal strength within the specified areas. The system is specified to provide coverage at the specific level within 95% of a building's floor area and also 95% of the stairwells. In-building systems specified by this specification must provide a signal strength that includes all of the following: A minimum signal strength of –95 dba available in 95% of the area of each floor when transmitted from the Fire, and Police Department(s). A minimum signal strength of –95 dba received at the firefighter, and police communications from 95% of the area of each floor of the building.

F. Permissible In-Building Radiation Systems – Buildings and structures shall be equipped with an FCC Certified Class B Bi-Directional Amplifier(s) as needed. The distribution system shall utilize an internal multiple antenna system. The downlink and uplink (from FD and PD) pass band of the BDA shall match the FD or PD radio signal KHZ. The system, as installed, must comply with all applicable sections of FCC Rules part 22, Part 90 and Part 101.

G. Backup Power – The system shall be capable of operating on an independent battery for at least 24 hours. The battery system shall automatically charge in the presence of external power input.

H. Compliance Testing – Compliance testing for an in-building radiation system is specified, upon completion of installation. The contractor shall test the in-building system to insure that two-way coverage on each floor of the building meets or exceeds the 95dBa in 95% of the building requirement. Each floor of the building shall be divided into a grid of approximately twenty (20) equal areas. A maximum of one (1) area will be allowed to fail the test per floor. A spot located approximately in the center of a grid area will be selected for the test. Once the spot has been selected, prospecting for a better spot within the grid area will not be permitted. Field strength testing instruments are to be recently calibrated (1 year) and of the frequency selective type incorporating a flexible antenna similar to the ones used on the hand held transceivers. All compliance testing to be scheduled and completed with the Fire Department. The Fire Department is to be notified prior to any testing. The gain values of all amplifiers shall be measured and the results kept on file with the building owner so that the measurements can be verified each year during the annual tests. In the event that the measurement results become lost, the contractor shall be required to rerun the acceptance test to re-establish the gain values.

I. Delivered audio quality (DAQ) testing will be conducted by FD/PD radio personnel during sample testing of the accuracy of the FD/PD Compliance Test Report. All test results and as built drawings are to be submitted when the sample test date is requested. At least five (5) business days notice is required prior to the test being conducted.

J. Qualifications of Testing Personnel - All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radiotelephone Operator License or equivalent. The installing personnel must be certified and trained by the manufacturer of the BDA device being provided. Proof of certification shall be provided with application.

K. Fire and Police Department Inspections - Fire Department personnel, after receiving a request for a final acceptance test from the system installer shall schedule a time to conduct field testing to be certain that the required level of radio coverage is present and verify all components, battery stand by and supervisory signals are 100% operational.

L. Primary Power - Connection to primary power shall be connected with metallic conduit. Each bi-directional amplifier shall be powered by its own twenty (20) ampere circuit. An internal trouble alarm will sound in the event of primary power loss or system malfunction.

M. The BDA(S) shall be located in the third floor BDA room. The electrical contractor shall provide the electrical power, grounding and telephone connections required. Provide conduit and penetration thru roof for antennas.

N. The Electrical Contractor shall provide the specified fire alarm control/monitor modules, cable, conduits and fire alarm system programming to provide NFPA 72 required supervisory and monitoring System and signal booster supervisory signals shall include the following:

1. Antenna malfunction
2. Signal booster failure
3. Power supply supervisory signals shall include the following for each signal booster:
4. Loss of normal ac power
5. Failure of battery charger
6. Low-battery capacity, alarming at 70 percent of battery capacity

O. Signage shall be installed every 4 feet on all BDA system antenna coax and at all terminations. The signage shall consist of a 4" long x 2" high with a red background and white inch high letters with the following text "AMESBURY FIRE DEPT RADIO SYSTEM ANTENNA" A sample sign is available upon request to the Fire Department.

PART 3 – EXECUTION

3.01 GENERAL NOTES

A. All materials specified in this Section occurring in acoustical ceilings shall be supported directly from the building structure. The acoustical ceiling system shall not be required to support any item specified in this Section of these Specifications.

B. Provide the required labor to provide, install, test and program the emergency radio communication system listed above in part 2 per the installation requirements listed in section 260001 – Electrical.

C. All BDA coaxial cable shall be supported directly from building using the required coaxial cable supports. BDA coaxial cable shall be installed independent from other systems and shall not share any structural supports, unistrut or cable racks with any other electrical system conduit and cabling.

END OF SECTION

Division 27
Communications

SECTION 270100

STRUCTURED CABLING SYSTEMS

(THIS SECTION TO BE INCLUDED IN SUB-BID FOR SECTION 260001 - ELECTRICAL)

PART 1 GENERAL

1.00 SUB-SUB-BID REQUIREMENTS

A. Filed Sub-Sub Bids:

1. Sub-sub-bid requiring a paragraph “E” listing on the form for sub-bid required per M.G.L. Chapter 149 Section 44F, as amended to date. The Electrical Sub-Contractor shall be responsible for all related building preparation and coordination. See specification for additional Paragraph “E” listing requirements of the listed contractor, and coordination of responsibilities. Failure to meet or exceed the requirements of the Contractor, as detailed in this specification, shall be grounds to reject the applicable bidder.
2. It is the sole intent of this Paragraph "E" listing to ensure to the end-user, single source responsibility from a single qualified Structured Cabling System Installer listed as the Paragraph “E” sub-subbidder for this Class of Work.
3. The Paragraph ”E” sub-subbidder listed shall not sub-contract any portion of this specification.
4. The Structured Cabling System Installer shall be DCAM Certified by the State of Massachusetts Division of Capital Asset Management in the Category of **TELECOMMUNICATION SYSTEMS**.

B. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this Section.

B. Examine all Project Specifications and Drawings for requirements which affect this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with all trades affecting or affected by work of this Section. Cooperate with such trades to assure a steady progress of all work under Contract.

1.02 SUMMARY OF WORK

A. This Section includes, but is not limited to the following:

1. Data and Voice Communications Systems cabling, including but not limited to:

a. Category 6A Data and Voice Station Cabling

b. Category 6A Cabling to support surveillance cameras IP cameras

c. Category 5 Voice Riser Backbone Cabling

c. Category 6A RJ-45 Style Data Jacks

d. Category 6A RJ-45 Style Voice Jacks

e. Category 6A RJ-45/110 Style Voice and Data Patch Panels

f. Category 6A Patch Cords

g. Technology Outlet Faceplates

h. Category 5e 110-style Voice Termination Blocks

i. Intra-Building Fiber Optic Cabling

j. Inter-Building Fiber Optic Cabling

k. Light Pole Camera Fiber Optic Cabling

l. Fiber Optic terminations and Patch Panels

m. Equipment Racks

n. Rack Mount Power Distribution Units and Uninterruptable Power Supplies

o. Horizontal Cable Managers

p. Vertical Cable Managers

B. Commissioning of Installed Systems

C. Work to be done under this SECTION is shown on the Electrical Drawings.

D. Work to be done under this SECTION shall be performed by the Paragraph E sub-subbidder meeting the requirements of this SECTION and listed on the Bid Form for this Class of Work, and referred to as the Structured Cabling System Installer herein.

1.03 RELATED WORK IN OTHER SECTIONS

A. Coordinate work with that of all other trades affecting or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the contract.

B. Technology workboxes, back boxes, floor boxes, conduits, sleeves, cable tray, corridor cable support, grounding systems, and fire safing are per SECTION 260001 -ELECTRICAL.

C. Blocking for attaching Communication Systems Components: ROUGH CARPENTRY, SECTION 061000

D. SECTION 274000 - AUDIO-VIDEO COMMUNICATION SYSTEMS

E. SECTION 275000 - DISTRIBUTED COMMUNICATION SYSTEM

F. SECTION 281000 - INTEGRATED SECURITY SYSTEM

G. SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

1.04 TECHNICAL REFERENCES

A. The product specifications, design considerations, and installation guidelines provided in this document are in part derived from recommendations found in recognized telecommunications industry standards. In cases where product specifications, design considerations, and installation guidelines provided in this document are in conflict with the references listed below, the more stringent requirements shall apply. The bidder is responsible for determining and referencing the most recent releases of all specifications during bidding and installation. Design, manufacture, test, and install all structured cabling systems per manufacturer's requirements and in accordance with NFPA 70 (National Electric Code), state codes, local codes, Underwriters Laboratories (U.L.), requirements of authorities having jurisdiction, ADA requirements, and the following specifications:

1. TIA-526-7 (OFSTP-7)-2002+A1:2008, *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*.
2. TIA-526-14-B-2010 (OFSTP-14), *Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 Edition 2, Fibre-Optic Communications Subsystem Test Procedure- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement*.
3. ANSI/TIA-568-C.0–2009+A1:2010+A2:2012, *Generic Telecommunications Cabling for Customer Premises.*
4. ANSI/TIA-568-C.1–2009+A1:2012, *Commercial Building Telecommunications Cabling Standard.*
5. ANSI/TIA-568-C.2–2009+A1:2010, *Balanced Twisted-Pair Telecommunications Cabling and Components Standard.*
6. ANSI/TIA-568-C.3–2009+A1:2011, *Optical Fiber Cabling Components Standard.*
7. ANSI/TIA-568-C.4–2011, *Broadband Coaxial Cabling and Components Standard.*

8. ANSI/TIA-569-C–2012, *Telecommunications Pathways and Spaces.*

9. Building Industries Consulting Services International (BICSI) *Telecommunications Distribution Methods Manual* (TDMM)

10. BICSI *Information Transport Systems Installation Manual (ITSIM)*

11. ISO/IEC 18010, *Pathways and Spaces for Customer Premises Cabling*

12. TIA-942-A-1, *Telecommunications Infrastructure Standard for Data Centers*

13. ANSI-J-STD-607-A, *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*

14. ISO/IEC 11801, *Information Technology – Generic cabling for Customer Premises*

15. TIA-862, *Building Automation Systems Cabling Standard for Commercial Buildings*

16. ISO/IEC 14763, *Implementation and Operation of Customer Premises Cabling*

17. TIA/EIA-606-A, *Administration Standard for Commercial Telecommunications Infrastructure*

18. EE Standard 802.3an – *10GBASE-T* over copper twisted pair cable

19. National Electric Code (NEC)

20. Massachusetts Electric Code

21. All relevant American National Standards Institute (ANSI) Committee

B. In cases where product specifications, design considerations, and installation guidelines provided in this document are in conflict with the references listed above, the more stringent requirements shall apply. All references listed above were current during development of this publication. The bidder is responsible for referencing to the most recent releases when developing bid proposals.

C. This document does not take precedence over any code, either partially or wholly.

1.05 SUBMITTALS

A. Refer also to Section 013300 SUBMITTALS

B. General: Submit shop drawings, samples, and related submittals all together, at the same time, for coordinated review. Isolated items submitted will not be reviewed until all items have been submitted for review.

C. Equipment List: Provide a detailed Equipment List showing quantities by manufacturer and model number of all major items of equipment and installation material to be used in the system as specified herein.

D. Product Data: Include complete sets of indexed cut sheets, in quantity as dictated by the project, of all major pieces of equipment, cable and connectors being supplied. Arrange these sheets in the order the equipment appears in the Specification. Clearly highlight information showing compliance with this and/or all applicable Specifications. In the event that the manufacturer or representatives' cut sheet contains more than one item, clearly indicate which items of the cut sheet are intended for installation.

E. Firestop: Include cut sheets on all firestopping materials.

F. Shop Drawings: Submit a set of complete Shop Drawings, by system, showing equipment to be installed, including but not limited to:

1. System configuration block diagrams of all equipment, indicating equipment type and model numbers. Show each and every component, system and subsystem, as well as all proposed connections between system components, and cable types connecting components.
2. Proposed layouts and elevations of equipment racks.
3. Provide scaled room layout drawings of all tel/data closets showing rack positions in relation to all other equipment.

G. Samples: Provide one complete sample of each Technology Outlet plate type with connectors, cable, and labels installed. Faceplates shall be fully assembled with voice, data and video cables terminated onto the jacks. Unassembled faceplates will be returned for resubmittal. These samples must be submitted for approval prior to ordering and installation, at the Structured Cabling System Installer's expense. Failure to submit Technology Outlet faceplate samples can result in Outlet plates being rejected and all previously installed Outlets to be replaced at Structured Cabling System Installer's expense. Upon approval of the faceplate submittals, all materials will be returned to the Installer.

H. Provide a plan for labeling of all structured cabling. Meet with the Owner prior to submittal to coordinate Owner requirements and reflect on the plan.

I. Quality Assurance Submittals:

1. Include certification from the manufacturer that the Structured Cabling System Installer is qualified to install systems as specified in accordance with the specific requirements set forth herein.
2. Include names, qualifications, and certifications of installation personnel including Structured Cabling System Installer's site Supervisor/Foreman who shall be in charge of, and responsible for, all activities at the job site for the duration of the Project. The job Supervisor/Foreman shall not be changed during the Project without notification and approval from the Owner.
3. Complete warranty information including sample Registration Certificate.

J. Close-Out Submittals:

1. Communication System Technical Manual: Submit for approval a draft of the complete Technical Manual at least two weeks prior to the time of final system check out. When the final drafts are approved, provide five (5) copies of detailed technical manuals. The manuals shall include the following:

    a. Table of contents.

    b. Structured Cabling System Installer Name; contact name; address, telephone number, fax number, and email address.

    c. Manufacturer's Registration Certificate of Warranty for Structured Cabling system.

    d. Product Information: Include original copies of manufacturer's installation and operating instructions, and service manuals, arranged alphabetically. All service manuals shall be originals; there shall be no Xerox copies of the service manuals and schematic supplied. Warranty information shall be filled out in the Owner's name.

    e. Detailed Description of the complete system and all subsystems.

    f. Maintenance Documentation: Include the following:

        1) Information necessary to perform routine and corrective maintenance by the Owner's technical staff, or other qualified technicians.

    g. List of all equipment by manufacturer, model or part number, and serial number.

    h. List of spare parts.

2. Test Data: Submit for approval in writing the test results including numerical values for all measurements as specified in the Cable Schedules of this Section. Reports shall be titled and submitted in three ring binders. Once approved, provide one set for the Network Room (MDF) and each Data Room (IDF). Also submit written certifications that the installation conforms to Specification, is complete and operable, and ready for approval by the Architect.

3. Technical Diagrams and Drawings:

    a. Simplified single line block diagrams showing the interconnection of all equipment and functional relationships for all systems specified. Show all equipment, patch panels, cables and jacks, whether connected or not. These drawings shall be on Engineering size E, 30" x 42" sheets. The intent of these diagrams is to provide sufficient clear and complete information that a technician of average skill may efficiently troubleshoot and service the system, even if unfamiliar with the installation.

b. Provide "As Built" architectural quality plan drawings at 1/8-in.= 1-ft scale showing data jack locations and numbers. These drawings shall be on Engineering size E, 30" x 42" sheets. Also provide all plans on CD in AutoCAD 2016.dwg format.

c. All technical diagrams and drawings shall be mounted on the wall behind a clear plastic cover for protection. There shall be one set of the above drawings and diagrams provided for the Network Room.

K. Cable Schedules: Prior to substantial completion, prepare and submit cable schedules for each cable installed under this section describing the as-built condition of the systems. Prepare cabling schedules in tabular form. Include the following information in each schedule:

1. Structured Cabling System Schedule:

a. Network and Data Rooms where all cabling originates.

b. Patch panel port number or block and position where each cable is terminated.

c. Destination room number or locations at which the cables is installed.

d. Outlet jack number in the room where the cable is terminated.

e. In those cases where more than one cable is installed at a specific outlet or locations, clearly identify each cable; e.g. “Data 1”, “Data 2”, “Voice 1”, “Voice 2”.

f. Test results.

L. Sustainability Requirements:

1. The work of this section includes LEEDv4 materials and submittal requirements. LEED v4 requirements for the work of this Section are detailed in Division I of the Project Manual

2. All Sealing, Caulking, and fire proofing materials shall meet or exceed the current LEED v4 VOC requirements.

1.06 QUALITY ASSURANCE

A. Structured Cabling Product Requirements: The products that shall best support the needs of the project, and provide the highest level of system performance over the life of the facility, shall be a cabling system that is made up of system components designed, manufactured and installed as a total system solution. Therefore, it is the intent of the Specification that one manufacturer, not a combination of different manufacturer's components, be selected for the voice and data cabling system as specified to ensure that the final system performance and warranty are the responsibility of a single manufacturer. This requirement also applies to data patch cords specified in this section; (e.g. Belden patch cords shall be used with Belden jacks and patch panels)

B. The onsite Job Supervisor/Foreman shall have at least five (5) years' experience in designing, installing, and testing systems specified as described herein. The onsite Job Supervisor/Foreman shall have a current and valid RCDD certification. The onsite Job Supervisor/Foreman shall carry an active cellular telephone or other two-way device, so that he/she may be reached when circumstances require. Additionally:

1. The Structured Cabling System Installer shall own and maintain tools and equipment necessary for successful installation and testing of all systems specified.
2. The Structured Cabling System Installer shall have personnel who are adequately trained and certified by the Manufacturers providing final system warranties.
3. The Structured Cabling System Installer (Paragraph "E" listed sub-sub bidder) shall be a factory authorized installer of all systems specified and shall hold certifications from the Manufacturer who is providing the final System Warranty and Performance Assurance.

C. Installation Procedures: Adhere to the engineering, installation and testing procedures of the Manufacturer of the components specified, and use only the cabling, components and methods of provisioning the Project authorized by the Manufacturer.

1.07 DELIVERIES, STORAGE AND HANDLING

A. Perform all tasks necessary to properly coordinate with all involved parties/trades for: Shipment, arrivals, loading dock, elevators (as applicable), acceptance, storage, and security of equipment and materials. Do not, during these tasks, interfere with other trades or the progress of this Project.

B. Assure that all deliveries are in correct quantities, within the appropriate times, and in compliance with all manufacturers' shipping instructions.

C. Protect all materials according to manufacturer's Specifications and/or instructions.

1.08 SYSTEM WARRANTY, SERVICE AGREEMENT AND PERFORMANCE ASSURANCE

A. Voice and Data Cabling Warranty: Provide a Manufacturer's Extended Product Warranty that covers product defects for all passive components of the Voice and Data Cabling Systems. Passive components are defined as those exhibiting no gain or contributing no energy to the Cabling System and include but are not limited to cabling, connectors, outlets, patch panels, patch cords, racks as outlined in PART 2 of this Specification.

B. The requirement of this section is that a single warranty shall cover all components of the Voice and Data networks, regardless of which manufacturer actually manufactures the device(s). The Structured Cabling System Installer shall provide clear identification of who is certifying the installation, who is providing the warranty, and what the warranty covers, especially if there are products and items provided by any company not providing the warranty.

1. The following shall be covered by the Manufacturer's Extended Product Warranty:

   a. All passive components that comprise the Voice and Data Cabling Systems shall be free from manufacturing defects in material of workmanship under normal and proper use.

   b. All passive components that comprise the Voice and Data Cabling Systems shall exceed the Specifications set for the herein, and exceed ISO/IEC 11801 standards, including all subsequent changes to these standards that are in effect at the time of installation, and will meet or exceed the performance Specifications as outlined in PART 2 of this Specification.

   c. The installation will exceed the insertion and return loss, attenuation and near end crosstalk (NEXT) requirements set forth herein and the ISO/IEC 11801 standards for cabling links/channel configurations specified in these standards including all subsequent changes to these standards that are in effect at the time of installation.

   d. Each Voice and Data Channel will be capable of delivering data at 10+ Gbps between active network electronics and end user device. A Data Channel is comprised of all passive components including cabling, connectors, patch panel port, and patch cords, with up to a total of four connections.

2. Upon successful completion of the Voice and Data Cabling Systems installation by the Structured Cabling System Installer, and subsequent inspection by an authorized representative of the Manufacturer of the passive components, the Owner shall be provided with Registration Certificate from the Manufacturer, registering the Installation, in its entirety.

3. Duration of Warranty: The warranty shall run for 20 years from the Date of final project completion, unless the Registration Certificate is issued by the Manufacturer at a later date, in which case the warranty shall run for 20 years from the date that the Registration Certificate is issued.

4. The Extended Product Warranty is applicable to the Voice and Data Cabling Systems passive components at the original site of installation. Under the Extended Product Warranty, the Manufacturer of the passive components will either repair or replace the defective product(s) at the Manufacturers cost. This includes the replacement or repair cost of defective materials and the cost of labor to repair or replace any and all defective products.

5. The Structured Cabling Systems Installer shall be able to provide a Manufacturer's warranty that the Voice and Data Cabling Systems will be free from failures which prevent operation of the specific applications for which the original Data System was designed to support.

C. The Warranties required by this section shall not be diminished by other warranties in the Contract Documents, equipment manufacturer's warranties, and all other rights and remedies available to the Owner under this Contract and public law. In addition, this Warranty shall not diminish the terms of individual manufacturer's warranties.

D. The Warranties required by this section shall be for the benefit of the Owner to whom Registration Certificate is issued and any successor in interest to the site.

E. Any repair or replacement of Cabling or Equipment resulting from this warranty will be warranted for either (a) 90 days or (b) the remainder of the original warranty period, whichever is longer.

F. Service Agreement: The Structured Cabling System Installer shall respond to all requests for service during the warranty period. During this period, the Structured Cabling System Installer shall replace defective material and repair items of faulty workmanship at no charge to the Owner. All requests for service shall be responded to by telephone within two business hours, and technicians shall be dispatched within twenty-four hours. Only certified technicians shall be dispatched.

1.09 SEQUENCING AND SCHEDULING

A. The Owner intends to contract separately during the Project for a “State of the Art” telephone system including but not limited to main system equipment, integrated voicemail, and digital station equipment. This system is an integral part of establishing two-way communications between office administration and classrooms. The success of this work by the Owner and Owner’s representatives will depend on the telephone system cabling required and specified herein. Additionally, the majority of the work to furnish and install this equipment by the Owner and Owner’s Representatives will occur approximately 4 weeks prior to the occupancy of building. Therefore, it is imperative that the Structured Cabling System Installer complete the installation of all telephone cabling that shall be used in supporting the Owner’s telephone system at least four weeks prior to substantial completion. It is also essential that a set of Technology Outlet Plans are provided to the Owner by the Structured Cabling System Installer showing the unique label (based on actual final room numbering) for each data outlet used for telephone services installed on the Project, four weeks prior to occupancy.

B. Where cables are to be installed in Wiremold, or other raceway, the Structured Cabling System Installer shall closely coordinate cable, equipment and faceplate installation with the Electrical Contractor.

C. A set of “as-built” Technology Outlet Plans shall be provided to the Owner by the Structured Cabling System Installer showing the unique label (based on actual final room numbering) for each outlet installed. These documents shall be provided four weeks prior to the Owner installing network and telephone equipment.

1.10 TRAINING OF OWNER'S PERSONNEL

A. Conduct a Training Program for the Owner's staff. The Training Program shall include a demonstration of the configuration of all structured cabling systems. Schedule the Training Program at the convenience of the Owner, after the Technical Manual has been submitted and approved. All materials in the Technical Manual shall be reviewed during the training program. All training sessions shall be videotaped with five copies provided to the Owner with closeout submittals.

1.11 E-RATE PROGRAM COMPLIANCE

A. The Structured Cabling System Installer shall adhere to the rules of the E-Rate program and complete all required paperwork in a timely and accurate manner, if applicable.

1. Schedule of values shall be provided by the Structured Cabling System Installer, which details all items that are reimbursable under the Federal E-Rate program. Coordinate with the Owner to determine which items are reimbursable.

1.12 EXTRA INSTALLATION PROVISIONS, MATERIALS AND SPARE PARTS

A. Furnish the following Attic Stock or Spare Parts to the Owner at the conclusion of the project. Spare parts shall be delivered to the Owner with closeout documentation submittals.

1. Provide Spare Single Data Outlet Faceplates. Quantity of twenty of each type.
2. Provide Spare Data and Voice Outlet Jacks. Quantity of twenty of each type.
3. Provide Spare 48 Port Patch Panels. Quantity of two.
4. Provide Spare Horizontal Wire Manager. Quantity four.
5. Provide Spare Cat 6A Cable: 4000’

PART 2 PRODUCTS

2.01 GENERAL

A. It is the intent of the Specification that one manufacturer, not a combination, be selected for each particular class of material. A combination of manufactures for cabling and connectivity is acceptable, as long as the solution provides for a certified, warranted cable plant as described herein.

B. Certain equipment is listed by manufacturer and model number (I.e. Belden, Hubbell). This is to define and establish a level of quality, design and functionality. The words, "or equal", are understood to follow all names of these specified products, trade names, catalog numbers, and detailed descriptions. It shall be interpreted to apply to any material, article, assembly or system, which in the opinion of the Owner is at least equal in quality, durability, appearance, strength and design to the material specified, and shall perform at least equally the functions imposed by the general design. The words, "or equal", shall not be construed to permit departure from the detailed requirements of the Specification. The “or equal” provision of G.L. c.30, §39M(b) is hereby incorporated by reference.

C. All materials and equipment shall be new and unused.

D. All part numbers and manufacturers shall be according to this Specification unless otherwise noted on the construction Drawings.

E. Provide all mounting hardware, shelving, bracketing, bracing, support members, required to support all cabling and equipment specified.

2.02 MANUFACTURERS

A. To establish a level of quality, design, and function, Belden part numbers are specified herein. Acceptable “or equal” manufacturers for the Structured Cabling System include the following:

1. Berk-Tek
2. Chatsworth
3. CommScope
4. Hitachi
5. Legrand
6. Leviton
7. Hubbell
8. Minuteman
9. APC
10. Mohawk/CDT

11. Ortronics

12. Superior Essex

2.03 VOICE AND DATA CABLING SYSTEMS

A. Voice and Data Channel Performance Specifications: Voice and Data Cabling System channels shall exhibit Category 6A performance capabilities. The data channel shall be comprised of the passive components including cabling, connectors, patch panel port, and patch cords, providing up to a total of four connections between network electronics. The Category 6A channel shall be component compliant, capable of supporting 10 Gigabit per Second networking. System shall be Belden 10GX series channel solution or equal. Acceptable manufacturers include:

B. Faceplates:

1. Outlet faceplates shall consist of single or double gang utility outlet faceplates, as specified. All Voice and Data faceplates shall match those of corresponding to electrical receptacle faceplates, which are stainless steel plates per Section 260001. All faceplates shall have labeling windows.

2. Faceplates without clear plastic labeling windows are not acceptable, and shall be replaced at no expense to the Owner.

3. Unused ports at each faceplate shall be provided with blank module inserts.

4. Faceplates shall be Belden single and/or double gang stainless steel faceplates with ID windows or approved equal.

5. Wall mounted telephone locations shall have faceplates appropriate for a wall mounted telephone.

C. Category 6A Jacks

1. All voice and data jacks shall meet or exceed Category 6A transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA Commercial Building Telecommunications Cabling Standard, and be part of the UL LAN Certification and Follow-up Program. Category 6A jacks shall contribute to the overall Channel Performance Specifications. Jacks shall be snap-in, 110 style, 8-pin insulation displacement contact (IDC), modular (RJ-45) jacks as specified herein and indicated on the Technology Outlet Plans.

2. Cat 6A Jacks shall be Belden 10 GX Modules Part #AX104156 (blue) for Data; Part #AX104155 (green) for Voice; Part number AX104154 (yellow) for Security, and Part #AX102282 (white) for WAP.

D. Category 6A Voice/Data Patch Panel:

1. Category 6A RJ45/110 Type modular jack panels shall be 48 ports. One wire management-retaining trough shall be installed above every patch panel. Modular Jack Panels shall accommodate both T568A/T568B configurations.
2. The patch panel shall support the appropriate Category 6A applications and contribute to the overall Channel Performance specification. The patch panel shall facilitate cross connection and inter connection using modular patch cords.
3. Provide rear cable management strain relief brackets, one for each row of patch panel terminations.
4. Category 6A Voice/Data Patch Panels shall be Belden 10 GX Part # AX1032643. Provide rear cable management strain relief brackets, one for each row of patch panel terminations.

E. Category 6A UTP, 4 Pair Station Cable

1. Voice and Data horizontal station cables shall be extended between the station location and the Network and Data Rooms, and consist of 4 pair, 24AWG, UTP, and shall be terminated on the 8-pin modular jacks provided at each Outlet. Cable jacket shall comply with Article 800 NEC for use as a plenum cable. The 4-pair UTP cable shall be UL® and c (UL®) Listed Type CMP (plenum).
2. All voice and data station cables shall conform to ANSI/TIA/EIA Commercial Building Telecommunications Cabling Standard, and be part of the UL® LAN Certification and Follow-up Program. These cables shall be capable of supporting evolving high-end applications, including but not limited to: 10GbE, 1000Base-T; 100 Base-T; 100Mbps TP-PMD; 155 Mb/s ATM; and 622Mbps ATM using parallel transmission schemes.
3. Cabling designated for data shall be blue. Cabling designated for voice shall be green. Cabling designation for Wireless Access Points shall be Yellow. Cabling designated for security cameras shall be white. Confirm colors with Owner prior to installation.
4. Category 6A cabling shall be Belden 10 GX Part # 10GX13. Cable colors shall be blue for data cabling (Part # 10GX13D151000), green for voice cabling (Part # 10GX130051000), Yellow for Security cabling (Part # 10GX130041000), and White for WAP cabling (Part # 10GX130091000).
5. All cabling shall be plenum rated. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

F. Category 6A Data Patch Cords:

1. Patch cords shall be Belden 10 GX Category 6A 24 AWG copper, stranded conductors, or equal. Provide two (2) modular patch cords for each wired port on the patch panels. Patch cord one shall be of sufficient length for neat connection from the data patch panels to the network switch electronics utilizing cable management in the MDF and IDFs. Coordinate these lengths with the Owner prior to and during network switch installation. For bidding purposes, assume all cords will be 15 feet. Provide the second data patch cord to the Owner for connection of owner equipment at the user end. Coordinate these lengths with the Owner prior to and during technology equipment installation. For bidding purposes, assume all cords will be 10 feet. Patch Cords shall be hand delivered to, and signed for, by the Owner or Owner's representative. It is the Systems Installer's responsibility to verify the exact quantity and lengths of patch cords and deliver and obtain signature receipt for the same.
2. Provide all patch cables required to neatly connect systems specified in this and other related sections.
3. Patch cords shall be provided in the same colors as the station cabling furnished and installed between the outlets and the patch panels, Blue for data, Green for Voice, White for WAP, and Yellow for security cabling.
4. Only patch cords from the Structured Cabling System manufacturer that is providing the overall system warranty will be accepted. No third-party patch cords shall be accepted.

G. Multi-Mode Fiber Optic Cabling:

1. Multimode Fiber optic cabling shall be provided between the MDF and IDF/Data Rooms. Cabling shall be furnished with the quantity of fibers as designated on the Technology Drawings.
2. All fiber optic cables shall be from the same manufacturer and shall be the same type. A mix of fibers from different manufacturers may not be used without written permission.
3. All multimode fiber optic cables within the premises shall use multimode, graded-index fibers with 50-micron cores only. Fiber shall be laser-enhanced and guaranteed for transmission distances in 10 Gigabit Ethernet of up to 500 Meters. Fiber shall be Belden FI4D012P9A 12 Strand plenum indoor distribution OM4 10 gig 50-micron fiber or equal.
4. All cabling shall be plenum rated. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

H. Single Mode Intra-Building Fiber Optic Distribution Cabling:

1. Single Mode Fiber optic cabling shall be provided between the MDF and IDF/Data Rooms. Cabling shall be furnished with the quantity of fibers as designated on the Technology Drawings.

2. All fiber optic cables shall be from the same manufacturer and shall be the same type. A mix of fibers from different manufacturers may not be used without written permission.

3. All single mode fiber optic cables within the premises shall use single mode, graded-index fibers. All cables shall be of tight buffered, distribution style construction, or riser type construction, all dielectric. Fibers shall be FISD012P9 strand plenum indoor distribution OS2 Single-mode Fiber or equal.

4. All cabling shall be plenum rated. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

G. Single Mode Inter-Building Fiber Optic Cabling.

1. Indoor/Outdoor Fiber optic cabling shall be provided between the new Amesbury Elementary School and the existing Charles C. Cashman Elementary School.

2. All fiber optic cables shall be from the same manufacturer and shall be the same type. A mix of fibers from different manufacturers may not be used without written permission.

4. Fiber shall be OS2 – Single Mode Fiber Belden FDSD024R9 24 strand indoor/outdoor riser rated distribution cable or approved equal for fiber optic cabling in continuous pipe and FDSD024P9 24 strand indoor/outdoor plenum rated distribution cable or approved equal for fiber optic cabling not in continuous pipe.

5. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

J. Light Pole Camera Fiber Optic Cabling

1. Furnish and Install 6-strand OM4 multimode indoor/outdoor rated cable from each pole mounted camera and the nearest IDF Room.

2. Fiber Optic Cabling shall be Belden FD4006R9 6-strand indoor/outdoor riser rated distribution cable or approved equal for fiber optic cabling in continuous pipe and FD4006P9 6 strand indoor/outdoor plenum rated distribution cable or approved equal for fiber optic cabling not in continuous pipe

3. Terminate all pairs of each fiber optic cable in a rack mount fiber optic enclosure in IDF. Clearly label all fibers supporting pole cameras.

4. Furnish and install fiber to surveillance enclosure by SECTION 281000, Installation shall be done in accordance with the requirements of the light pole manufacturer and requirements of the enclosure furnished and installed by SECTION 281000.

5. Terminate all fiber optic pairs at the light pole end in the pole mount surveillance cabinet as required.

6. Coordinate as required with electrical contractor for pathways, grounding of equipment and for the power receptacle required in the pole mount surveillance cabinet.

7. Provide and install all necessary mounting hardware, and accessories for a neat, professional and permanent installation.

K. Fiber Distribution Patch Panels: The Fiber Patch Panel is the termination and administration point for the fiber optic backbone between the MDF and IDF/Data Rooms. These devices shall protect the connectorized fiber from mechanical stress, macro-bending loss at the connection point, tampering with the circuits, and provide circuit identification. The patch panels shall provide cross-connect and inter-connect capabilities and include support hardware to properly terminate cables, route the fibers and jumpers in a rack mount field. A separate Fiber Distribution Patch Panel shall be furnished and installed in the Surveillance (CCTV) cabinet. The panels shall:

1. Have connector panels to accommodate LC connectors;

2. Be UL approved;

3. Be from a manufacturer that is ISO 9001 certified.

4. Be Hubbell FCR3U12SP or equal for MDF and FCR1U3SPL for IDF's

L. Multimode Fiber Optic Connectors: Provide multimode LC type connectors to terminate fiber optic cables for cable-to-cable, cable-to-equipment, and equipment-to-equipment, and to make jumpers. The connectors shall be Hubbell OM4 compatible LC fiber Connectors or equal

M. Single mode Fiber Optic Connectors: Provide Singlemode LC type connectors to terminate fiber optic cables for cable-to-cable, cable-to-equipment or equipment-to-equipment, and to make jumpers. The connectors shall be Hubbell Single-mode OS2 Fiber Connector or equal

N. Fiber Optic Cabling Raceway: All fiber optic cables withing the buildings shall be enclosed in non-metallic corrugated flexible raceway for protection, ease of identification, and general organization of fiber optic cable installation.

1. Corrugated Flexible Raceway (Inner-duct) shall be plenum rated Carlon p/n CG4X1C or approved equal with pull string. The Inner-duct shall begin no more than 24 inches from the termination point and run continuously end-to-end with the appropriate number and size pull boxes as required according to the referenced TIA-568 Standards. The use of conduit sleeves shall not negate the requirement for use of innerduct for fiber optic cables

O. Multi-pair Voice Backbone Cable:

1. Shall be 24 AWG, Category 5, riser or plenum rated and sized as shown on drawings.

P. Wall phones jacks shall support wall phone mounting without any additional hardware.

Q. Patch Panel and Switch Equipment Racks. Each four post rack shall be equipped with the following:

1. Equipment racks shall be 19" EIA floor mount racks with wide floor mounting flanges, Hubbell HPW84RR19 or equal.
2. Four post racks shall be Hubbell SF841929 or equal.
3. Vertical cable guides shall be Hubbell VS76 with covers or equal. Provide on both sides of all racks.
4. Horizontal cable managers shall be Hubbell HS23C with covers or equal. Provide above and below all patch panels.
5. Uninterruptible Power Supplies: One UPS per rack shall be APC p/n SRT3000RMXLA-NC with power cord for connecting to 30A PDU.
6. 30A PDU's per rack shall be rack mounted APC SBP3000RM0 with L5-30R output connection and L5-30P plug and cord to reach L5-30R receptacle above rack.
7. Rack mounted APC AP9564 with L5-20P plug and cord to reach L5-20R receptacles above rack.

R. Server and Video Surveillance Equipment Cabinets shall be equipped with the following:

1. Server Equipment Cabinet (APC NetShelter P/N AR3107) or approved equal.
2. 19" Rack LCD console (APC P/N: AP5719) or approved equal.
3. Sliding Shelf (APC P/N AR8123BLK) or approved equal.
4. Two Horizontal cable managers AR8600A or approved equal.
5. Vertical Cable manager AR7723 or approved equal.
6. USB2 Keyboard, Mouse.
7. KVM Switch APC KVM0108A with 8 KVM-USB modules or approved equal.
8. Uninterruptible Power Supplies: One UPS per rack shall be APC p/n SRT3000RMXLA-NC with power cord for connecting to 30A PDU.
9. 30A PDU's per rack shall be rack mounted APC SBP3000RM0 with L5-30R output connection and L5-30P plug and cord to reach L5-30R receptacle above rack.
10. Rack mounted APC AP9564 with L5-20P plug and cord to reach L5-20R receptacles above rack.

S. Broadband Distribution Backbone shall meet the following minimum standards:

1. CATV Video Distribution cabling shall be 5-1000 MHz capable.
2. All components shall be 1 GHz rated.
3. Trunk cabling shall be plenum rated .500 hard line cable.

4. Cables shall be routed point to point between MDF-Network/Telecom Room and each of the IDF-Data Rooms/Closets.

5. Cable shall be coiled with 15' of slack at each end and secured to the wall above the cable tray and data racks.

6. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

2.04 IBMS SYSTEM PATCH PANEL

1. A single 48 port patch panel shall be provided in the Main Network Room 125 equipment rack for connecting the IBMS System cabling to the Owner's network.

2. All Category 5 UTP cabling from meters, lighting controls, and other Building Management System (BMS) components requiring network connectivity, shall be furnished and installed by the contractor(s) responsible for meters, lighting controls and the BMS system, and is not work included as part of this section. Installation of Category 5 UTP cabling by the BMS contractors will include all provisioning; placement; terminations; testing; labeling; and documenting on as-built plans.

3. Coordinate the location of the IBMS patch panel in the data rack with the BMS contractors.

2.05 UNSPECIFIED EQUIPMENT AND MATERIAL

A. Any item of equipment or material not specifically addressed on the Drawings or in this document and required to provide a complete and functional installation shall be provided in a level of quality consistent with specified items.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to commencing Work of this Section or ordering equipment, examine site and conditions under which work shall be performed. Determine exact locations of items shown diagrammatically on Drawings. Determine dimensions needed to move in racks and any custom items. Notify the Architect of any conflicts or special requirements needed to provide for free access to doorways, corridors, stairs, and similar areas, required to move in the specified equipment. If the Structured Cabling System Installer fails to provide such notification, any additional cost to remove and reinstall any building members will be back charged to the Installer.

B. Prior to commencing Work of this Section, inspect drawings and verify that voice and/or data horizontal station cabling, when fully installed shall not exceed a maximum length of 295-ft. (90m) end to end. Notify the Architect in writing of any cable runs that may exceed this requirement. If the Systems Structured Cabling System Installer fails to provide such notification, any additional cost to remove and reinstall any cabling to satisfy this requirement shall be the responsibility of the Installer.

C. The Electrical Drawings designate the Network and Data Rooms, and related equipment spaces.

D. Electrical Drawings designate Communication System Outlet locations. Install quantity and type of Technology Outlets according to the Technology Outlet Plans and as specified herein. Provide all required adapters and/or accessories for a complete installation in all raceways, and other locations.

E. Commencement of Work of this Section indicates acceptance of existing site conditions.

3.02 WORKMANSHIP

A. Structured cabling system shall be installed in a neat, workmanlike manner. Workboxes, equipment, and enclosures are to be plumb and square. Install the system elements in cooperation with all trades to achieve coordinated progress and desired results. Watch for conflicts with Work being performed by other trades that have impact on the installation of the system components. Make moderate moves or changes in equipment locations as are necessary to accommodate other equipment as directed by the Architect, without a claim for additional payment.

3.03 GENERAL INSTALLATION

A. Pre-installation: Meet with the General Contractor, Project manager, and any other appropriate parties for coordination meeting prior to beginning work and to coordinate requirements.

B. Coordinate Work with adjacent Work of other trades to facilitate installation and prevent conflicts.

C. Staff job appropriately to keep pace with the Project schedule.

D. Abide by the decision of the Architect to case of conflict or interference of the other trades.

E. Work under this Section shall be performed in accordance with associated local, state, and national building codes.

F. Coordinate requirements of ceiling and floor mounted outlets with the Electrical Contractor.

G. Coordinate the type of floor boxes and associated hardware with Electrical Contractor to ensure compatibility of Technology Outlet requirements with floor mount boxes being supplied by the Electrical Contractor. Supply and install all required floor box Technology hardware including bezels, inserts, connectors, and covers for Technology Outlets.

H. In the event that the Structured Cabling System Installer must re-enter an area of a previously completed phase of Work, the Installer shall be responsible for returning that area back to the condition it was in before the Installer re-entered the area. This includes re-installing ceiling tiles, cover plates, cleaning floors,. Coordinate the cutting and patching of holes with the General Contractor. Patching shall match adjacent undisturbed materials.

I. Every effort shall be made to schedule the Work under this Specification in such a manner so as to complete all above ceiling Work prior to ceiling panel installation. In the event that the Structured Cabling System Installer is required to remove ceiling panels, such Work shall not break or disturb the existing ceiling grid or panels and shall be coordinated with the General Contractor and Ceiling Subcontractor.

J. Cabling used throughout this Project shall comply with the requirements as outlined in the National Electric Code (NEC®) Article 725, 760, 770, 800, and 820, and all appropriate local codes. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

K. All cabling must bear the appropriate CMP or ONFR markings, as applicable, on the cable jacket. Cable not appropriately marked is not acceptable and if installed, shall be removed at the Systems Installer's expense.

L. The Structured Cabling System Installer is responsible for furnishing and installing cross-connections between telephone services trunk lines and the multipair risers and/or station cabling serving analog telephone locations and fax machines locations.

M. Spare pull strings shall be left in all EMT, Conduits, and Innerduct.

N. Structured Cabling System Installer shall furnish and install all mounting hardware, shelving, bracketing, bracing, support members as may be required to ensure that all equipment and cabling is properly installed and supported according to the manufacturer's recommendations.

O. Take precautions as necessary to prevent and guard against electromagnetic and electrostatic interference. Avoid potential sources of EMI in all aspects of installation. If interference is experienced, the Structured Cabling System Installer shall provide all required testing to identify the source of interference and provide a remedy including but not limited to re-routing and/or replacing cables.

3.04 CABLE SUPPORTS AND ROUTING

A. Install all cabling shall be installed in accordance with the manufacturer's guidelines and according to all applicable building codes at the time of installation, including but not limited to the NEC and the ANSI/TIA/EIA Telecommunications Building Wiring Standards.

B. Route all cables in large groupings, through main hallways, until cable can be distributed directly to the communication Outlet. Route individual cables to the appropriate Outlet locations in accordance with all standards described herein.

C. Install cables in cable tray, Snake Tray, J-hooks, pipe and/or sleeves specified in this and other sections.

E. In suspended ceilings, bundle cables in bundles of 50 or less, with Velcro cable tie wraps pulled snug, but not deforming the cable geometry. Support the cable bundles with approved "J" style hooks every 3-ft. when outside the Corridor Cable Support.

E. The Structured Cabling System Installer shall adhere to the manufacturers' requirements for bending radius and pulling tension of all communication cable.

F. Install cables in such a manner as to minimize tension and stress on cables, which can lead to changes in the physical and/or electrical characteristics of the cables over time. This applies to, but is not limited to, horizontal cable support methods, vertical cable support methods, tie wraps, or similar types of cable support methods.

G. Cables exiting floor conduits and sleeves shall be neatly dressed, and securely supported from the floor up to the ceiling so that the cables are not stressed or stretched by the weight of the cables. Cables shall be arranged in bundles of not more than 50 cables or less, and secured with Velcro cable tie wraps pulled snug, but not deforming the cable geometry. Acceptable support structures include, but are not limited to: Cable tray runway radius dropout, vertical ladder tray, J-hooks, unistrut, or similar types of support structures. The intent is that cables shall not be supported by the weight of the cables themselves, but are supported so that the weight of the cables is supported by the support structure(s).

H. Route station cables at right angles to electrical power circuits and supported only from the building structure when not in cable tray or conduit.

I. Do not support cabling from ceiling tiles, grid or hanger wires.

J. Do not install random or diagonal cable runs. Cable turns and bends shall be made at 90 degrees angles whenever possible while maintaining manufacturers' requirements for bending radius at all time.

K. Install cables at Technology Outlets, regardless of how routed to the Outlet, with a 5' service loop of cable secured above the ceiling where the cable enters the pathway to the Outlet. Install service loops so as not to exceed cable bend radius, or 295'

L. A 10' service loop of cable shall be provided in the cable tray above the data patch panels for data cables. Service loops shall be installed in either a figure "8" or "U" pattern and shall be installed so as not to exceed cable bend radius, or 295-ft. Service loops shall not be installed as tight circular coiled loops.

M. Cables which penetrate a steel stud or steel wall cap shall be protected from damage with a "stud liner".

N. Cables entering power poles, surface mounted raceway, or other cable management systems shall be protected from damage.

O. Extend cabling between floors utilizing inter-floor sleeves and conduit as shown.

P. Conduit and sleeves provided as a means of routing cables between various rooms and floors shall be used according to the following requirements: Install cabling through separate conduits and/or sleeves for each system. In each group of conduits and/or sleeves, one 4-in. conduit and/or sleeve shall remain empty as a spare conduit or sleeve for future cabling. It is imperative that the cables for each system remain separate from the other systems. Cables routed in violation of this requirement shall be pulled back and rerouted, even if already terminated, at no additional cost to the Owner.

Q. Conduit and sleeves provided as a means of routing cables between various rooms and floors, and those which remain empty as spare, shall be sealed with an approved fireproof, removable safing material. Sleeves which pass vertically from floor to floor shall be sealed in a similar manner using an approved re-enterable system. Additional penetrations through rated assemblies necessary for passage of wiring shall be made using an approved method, coordinated with the General Contractor, and permanently sealed after installation of cables.

R. Meet all requirements regarding use of cable in return air plenums and in raised floor systems. Provide wiring that complies with all applicable state, local building codes, and the National Electrical Code. All cables run in raised floor systems with forced air-cooling shall meet the requirements of NEC Article 645, "Electronic Computer Data Processing Equipment".

S. Cables installed partially or fully within the Network and Data Rooms shall be routed through and secured in the cable tray wherever possible. Cables placed in the cable tray are to be laced or tie wrapped with Velcro tie wraps frequently to keep them neatly bundled and not permitted to shift from one side of the tray to the other as they are routed in the tray.

T. Color of cable jacket for each system shall be unique and distinguishable from other system cabling

3.05 EQUIPMENT RACKS

A. Mount Equipment Racks an isolation pad and utilize non-conductive washers to secure the rack to the floor. Provide a minimum of four anchors per rack.

B. Insulate conduits and sleeves from the equipment racks, equipment cabinets and overhead cable tray.

C. Ground equipment racks and cabinets to the Telecommunications Grounding Busbars within the Network and Data Rooms using a standard ground lug and #6 jacketed green cable. Grounding shall be accomplished per ANSI-J-STD-607.

D. Mount power strips in each equipment rack as shown on the Technology Drawings. Each power strip shall be provided with a power cord long enough to be neatly run from the power strip, at its furthest mounting location, through the equipment racks to the electrical outlets mounted on the bottom of the cable tray. Each power cord shall be equipped with a twist lock type NEMA L5-20P to connect to the electrical receptacles on the underside of the cable tray.

E. Mount specified UPS equipment in racks with only manufacturer's recommended mounting brackets for type of racks they are to be installed in. UPS equipment shall be equipped with twist lock type power cords long enough to connect to electrical receptacles on the underside of the cable tray. Extension cords shall not be acceptable.

F. Provide blank and vent steel panels on all data equipment racks. Aluminum panels are not acceptable. Fill all unused rack spaces. All panels shall be the same finish, color and manufacturer.

3.06 VOICE AND DATA CABLING

A. Provide, install, terminate and test one (1) Category 6A, 4 pair cable from each voice and each data modular insert in each technology outlet shown.

B. The voice and data system station cables shall be run using a star topology format from the technology outlet to the respective Data Closet as indicated on the Technology Drawings.

C. The length of each individual cable run between data patch panels to each data or voice Technology Outlet shall not exceed 295-ft (90m), including service loops. Cables may be routed through rooms and other spaces in the event that cable routing through main hallways negatively affects the requirement that the length of each individual cable run not exceed 295-ft (90m) (terminated end to terminated end). Cabling which deviates from the main pathways shall be clearly identified on the as-built floor plans, and brought to the attention of the Owner or his representative.

D. Observe the bending radius and pulling strength requirements of all the voice and data cable during handling and installation.

E. Each run of cable between the patch panel to the technology outlet shall be continuous without any splices. All cables shall be terminated at each end.

F. Terminate cables using the TIA/EIA 568B wiring configuration.

G. Wiring color codes shall be strictly observed and terminations shall be uniform throughout the system. Identification markings and systems shall be uniform.

H. All data station cables shall be terminated in MDF, IDF, Network and Data Rooms utilizing only approved Category 6A, patch panels. All voice riser cables shall be terminated in the MDF, IDF's, Network, and Data Rooms utilizing only approved Category 5e, 110 style IDC termination blocks. Data patch panels and 110 voice termination blocks shall be sized to allow for 20% spare future expansion in the racks. Data and voice horizontal cables shall be terminated on patch panels specific for each floor. Data, Voice, WAP and Security stations cables shall be terminated on separate data patch panels.

I. Horizontal cable managers shall be provided above each of the patch panels as shown in the Electrical Drawings. No data patch panel shall exceed 48 ports.

J. All voice and data cables shall be terminated onto data patch panels in increasing numerical order, left to right, and from the upper left to bottom right of the patch panel, or termination block or in the case of voice risers. All patch panels shall be labeled with the corresponding station jack location number.

K. Multi-pair voice riser cable shall be installed between the Network Room riser field and the local exchange carrier telephone demarcation wallboard, also in the Network Room. Terminate all pairs at the local carrier demarcation wallboard onto 66 M125 blocks with 89 style brackets, and onto 110-style terminations blocks at the Network Room side as indicated. Voice riser 110-style termination blocks shall use C5 connecting blocks. Provide a 5-ft. service loop of cabling installed in cable tray at each end.

L. Provide one voice station cable to each elevator equipment room. Route cable to elevator control cable termination point in the elevator equipment room, and leave 20 feet of slack for termination by others. Terminate, label and crosswire elevator phone and connect cable to the line provided by Local Exchange Carrier.

M. Provide one voice station cable to each system requiring direct connection to an outside POTS line. Terminate, label and crosswire and connect cable to the line(s) provided by Local Exchange Carrier.

N. Pull boxes shall be installed in accordance with ANSI/TIA/EIA 568-C series Telecommunications Building Wiring Standards.

O. Spare pull strings shall be left in all conduits and inner duct.

P. Data cabling and outlets supporting security surveillance cameras indicated on the side of the buildings shall be terminated in a single gang box with a single jack faceplate located inside on the wall adjacent to where the camera is to be installed; in the plenum space above the finished ceiling on the first floor. Coordinate exact location for the data outlet with the Integrated Security System Installer and Electrical Subcontractor. The scheme is that a data patch cable shall run from the camera mounted on the outside of the building to the jack just inside the building.

3.07 CONDUITS, SLEEVES, CABLE TRAY AND WALL/FLOOR PENETRATIONS

A. Conduits, sleeves, cable tray and wall/floor penetrations and back boxes required to support and provide a pathway for the Structured Cabling System shall be provided by Division 260001.

B. Conduits, sleeves cable tray and wall/floor penetrations required to support and provide a pathway between Network and Data Rooms and the main corridors on all three floors shall be provided by Division 260001.

C. The Structured Cabling System Installer shall be responsible for coordinating room and/or space for all cabling within all conduits, sleeves, cable tray and wall/floor penetrations provided by Division 260001.

D. Conduit sleeves between all main corridors and hallways into all rooms, offices, and spaces showing communications devices, and through all fire rated walls shall be provided by Division 260001.

3.08 LABELING

A. Meet with the Owner prior to the final labeling of all installed jacks, blocks, patch panels and related equipment to verify and confirm the exact requirements and desired labeling scheme for the project.

B. Labeling of communication jack wall plates and patch panels shall initially consist of five digits, assigned as follows:

1. The first digits shall be the room number of the installed jack.

2. The next two digits is the unique jack/cable identifier in the room where it is installed.

3. Example: Jack number 115-010 shall be data cable number 10 in Room 115.

4. Terminate Data Cables in closets on patch panels in sequential order by room number, then by cable number. If there are 6 cables for a given room they should be located in sequential order, next to each other in numerical order on the patch panel.

5. Terminate telephone cables in closets on frames and punch down panels in sequential order, by cable number. If there are six cables for a given room, they would be located in sequential order, next to each other in numerical order.

C. Clearly label and identify all components. Logically and permanently mark all cable, jacks, connectors, patch panels, racks, electronic equipment, and all wall plates.

D. Use a letter quality printer or other mechanically produced lettering for patch panel and outlet labels. Insert patch panel and outlet labels behind clear plastic designation strips. Labels which are surface mounted directly onto the patch panel or faceplate are not acceptable and shall be replaced by the Structured Cabling Systems Installer at no expense to the Owner.

E. Place permanent cable markers 3 inches from all connectors to allow easy identification. Use Brady Markers with clear plastic ends. Acceptable markers are, Brady B-320, B-292, SL-292, or Brady machine embossed labels with clear vinyl ends. Machine generated markers are required. Place cable markers on cables so that they can be easily seen.

F. Handwritten labels shall not be accepted, even if written with a permanent marker. Temporary handwritten labels may be used only during the “rough-in” stages; they must be replaced with permanent labels prior to Project completion.

G. Labeling of communication jack wall plates and patch panels shall be as directed by the Owner.

H. All labeling of Technology Outlets, patch panels, cross connect blocks, or similar types of items, shall be based on the finished project room numbers and not the architectural room numbers, or as directed by the Owner. The Structured Cabling System Installer shall be responsible to contact the Architect, CM and/or Owner Representative for obtaining the final room numbers.

I. Voice station blocks, riser termination blocks, and data patch panels shall be color coded as per ANSI/TIA/EIA 606A.

3.09 BONDING AND GROUNDING

A. Bonding and grounding shall be in accordance with ANSI-J-STD-607, the NEC® and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunications equipment and test apparatus and equipment.

B. Telecommunications Bonding Backbone utilizing #6-AWG or larger bonding conductor shall be provided by Division 260001. This is part of the grounding and bonding infrastructure (part of the telecommunications pathways and spaces in the building structure) and is independent of equipment or cable.

C. For all systems, provide equipment grounding connections. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

D. For all systems, provide conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

E. For all systems, provide transient protection on the AC power feed and on station lines leaving or entering the building.

F. Note in the system Drawings, the type and location of these protection devices as well as all wiring information.

G. Furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground bus bar.

H. Provide any necessary screws, anchors, clamps, tie wraps, distribution rings, and miscellaneous grounding support hardware to complete the installation of the grounding system.

I. Grounding busbars shall be installed in the Network and Data Rooms and the Service Entrance Room by Division 260001.

J. All non-current carrying telecommunications components (passive) shall be bonded to the grounding busbar utilizing 2-hole lugs for all bonding connections.

K. All grounding conductors shall be affixed with permanent labels in a visible location at each end of the conductor, and as close as practicable to the bonding point at each end of the conductor. The labels shall clearly identify both the source and destination of the bonding conductors. Handwritten labels are not acceptable.

3.10 FIRESTOPPING

A. Structured Cabling System Installer shall seal all horizontal and vertical openings between floors, through fire rated walls, smoke walls, and corridors used or created by the Installer.

B. Sealing material and application shall be accomplished in a manner acceptable to the local fire and building codes having jurisdiction.

C. Structured Cabling System Installer shall seal any openings created by or for the Installer, and left unused.

D. Prior to installing firestopping materials, penetration surfaces shall be thoroughly cleaned of all dust, dirt, grease, oil, loose materials, rust, and any other debris. Firestopping shall be removed and redone if discovered during inspection that penetrations have not been cleaned prior to firestopping being installed.

E. Install firestop materials in accordance with design requirements and manufacturer's installation procedures.

F. Install firestop materials in accordance with Section 260001 and the approved manufacturer's installation procedures.

3.11 TESTING

A. Voice and Data Cabling Testing:

1. All terminated cabling runs shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements found in the TIA/EIA-568-C series of standards. All pairs in each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation, including (but not limited to) cables, connectors, patch panels, and cordage shall be repaired or replaced in order to ensure 100% usability of all installed runs.

2. COPPER CHANNEL TESTING - All balanced twisted-pair cable links shall be tested for basic continuity and length, as indicated below. Additional testing shall be performed to verify compliance with Category 6A performance. The extent of testing shall be in accordance with the end-customer's testing requirements. Provide 100% testing of permanent links for Insertion Loss, Return Loss, NEXT, PSNEXT and PSACRF. These tests shall be performed at the same time as the Continuity test using an automated tester, such as the Fluke DTX1800.

3. Continuity – Each pair in every installed cabling run shall be tested using a test set that detects and identifies opens, shorts, polarity and pair reversals, crossed pairs, and split pairs. The results shall be recorded as Pass/Fail (as indicated by the test set) and referenced to the appropriate cable identification number and circuit/pair number. Any fault shall be corrected and the run re-tested prior to final acceptance.

4. Length – Every installed cabling run shall be tested for installed length using a time domain reflectometer (TDR) device. The cable length shall not exceed 90 m (295-ft.). The cable length shall be recorded, referencing the cable identification number and circuit/pair number.

5. Category 6 performance testing shall be done according to the published standards.

6. Bring cables and/or pairs not meeting the requirements of the standard into full compliance, at no additional cost to the Owner.

7. Document cable testing in accordance with Submittal paragraph. Provide a table of test results in a 3-ring binder submitted with the as-built Drawings.

8. Provide an electronic version of test results and any cable test software required to read and evaluate results.

B. Fiber Optic Cable Testing.

1. Fiber testing shall be performed on all fibers in the completed end-to-end system. Testing shall consist of a bi-directional end to end OTDR trace, or a bi-directional end to end power meter test performed per TIA-455-C. The system loss measurement shall be provided at 850 and 1310 nanometers.

2. Pre-installation cable testing: Test all fiber optic cable prior to the installation of the cable. Assume all liability for the replacement of the cable should it be found defective after the installation.

3. Loss Budget: Fiber links shall have a Maximum Loss of:

   a) Maximum Loss = (allowable loss per km) (km of fiber in link) + (.4dB) (number of connectors) Note: A mated connector-to-connector interface is defined as a Single connector.

   b) Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two. Any link not meeting the requirements of the Maximum Loss shall be brought into compliance at no additional charge to the Owner.

4. Prepare a certification report listing the test results and both the calculated and measure loss for each fiber. Submit this report with the test results as called for in Article 1.5 SUBMITTALS.

5. The Structured Cabling Systems Installer shall bring cables and/or strands not meeting the requirements of the standard into full compliance, at no additional cost to the Owner.

6. Document cable testing in accordance with Submittal paragraph. Provide a table of test results in a 3-ring binder submitted with the as-built Drawings.

7. Provide an electronic version of test results and any cable test software as required to read and evaluate results.

3.12 TRAINING

A. Train systems administrative and/or maintenance personnel in procedures involved in operating, troubleshooting, servicing and preventative maintenance of each system specified.

1. Review of the physical configuration and interrelationship of the system components.
2. Labeling and interconnection techniques used in the installation.
3. Applications of systems including any unique connections or interfaces required in the use of systems on site.
4. A review of warranty documents for the system.
5. A review of the Technical Manual prepared per "Closeout Submittals."
6. A Review of operation manuals and users guides for the system.
7. System operation and maintenance procedures.
8. Review of all user programmable options and how to modify options.

B. Provide owner with complete user instructions used for training purpose as well as training log of all users who attended training classes.

3.13 CLEANING

A. Clean all equipment and work areas under this Section, prior to scheduling Owner training. Include, as necessary, wiping of Work areas and surfaces, and the removal of dust, streaks, stains from all equipment specified. Leave installed systems and components clean and undamaged.

END OF SECTION

SECTION 274000

AUDIO-VIDEO COMMUNICATION SYSTEM

(THIS SECTION TO BE INCLUDED IN SUB-BID FOR SECTION 260001 - ELECTRICAL)

PART 1 GENERAL

1.00 SUB-SUB-BID REQUIREMENTS

A. Filed Sub-Sub Bids:

1. Sub-sub-bid requiring a paragraph “E” listing on the form for sub-bid required per M.G.L. Chapter 149 Section 44A, as amended to date. The Electrical Sub-Contractor shall be responsible for all related building preparation and coordination required. See specification for additional Paragraph “E” listing requirements of the listed contractor, and coordination of responsibilities. Failure to meet or exceed the requirements of the Contractor, as detailed in this specification, shall be grounds to reject the applicable bidder.
2. It is the sole intent of this Paragraph "E" listing to ensure to the end-user, single source responsibility from a single qualified Audio-Video Communication System Installer listed as the Paragraph “E” sub-subbidder for this Class of Work.
3. The Paragraph “E” sub-sub bidder listed shall not sub-contract any portion of this specification.

B. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this Section.

B. Examine all Project Specifications and Drawings for requirements which affect this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with all trades affecting or affected by work of this Section. Cooperate with such trades to assure a steady progress of all work under Contract.

1.02 SUMMARY OF WORK

A. This Section includes, but is not limited to the following:

1. Gymnasium Audio-Video System
2. Cafeteria Audio-Video System
3. Music Room Local Sound System
4. Listening Assistance System
5. Digital Signage Systems

B. Commissioning of Installed Systems

C. Work to be done under this SECTION is shown on the Electrical Drawings.

D. Work to be done under this SECTION shall be performed by the Paragraph E sub-sub bidder meeting the requirements of this SECTION and listed on the Bid Form for this Class of Work, and referred to as the Structured Cabling System Installer herein.

E. The work of this section includes materials and submittal requirements for fulfillment of Project LEED-S Certification.

1.03 RELATED WORK IN OTHER SECTIONS

A. Coordinate work with that of all other trades affecting or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the contract.

B. Blocking for attaching Communication Systems Components: ROUGH CARPENTRY, SECTION 061000

C. SECTION 090003 – ACOUSTICAL TILE

D. SECTION 115213 - PROJECTION SCREENS

E. SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

F. SECTION 260001 – ELECTRICAL – For technology workboxes, back boxes, floor boxes, conduits, sleeves, cable tray, corridor cable support, grounding systems, and fire safing.

G. SECTION 270100 STRUCTURED CABLING SYSTEM

1.04 TECHNICAL REFERENCES

A. The product specifications, design considerations, and installation guidelines provided in this document are in part derived from recommendations found in recognized telecommunications industry standards. In cases where product specifications, design considerations, and installation guidelines provided in this document are in conflict with the references listed below, the more stringent requirements shall apply. The bidder is responsible for determining and referencing the most recent releases of all specifications during bidding and installation. Design, manufacture, test, and install all Audio-Video Communications Systems per manufacturer's requirements and in accordance with NFPA 70 (National Electric Code), state codes, local codes, Underwriters Laboratories (U.L.), requirements of authorities having jurisdiction, ADA requirements, and the following specifications:

1. ANSI/TIA-568-C.0–2009+A1:2010+A2:2012, *Generic Telecommunications Cabling for Customer Premises.*
2. ANSI/TIA-568-C.1–2009+A1:2012, *Commercial Building Telecommunications Cabling Standard.*
3. ANSI/TIA-568-C.2–2009+A1:2010, *Balanced Twisted-Pair Telecommunications Cabling and Components Standard.*
4. ANSI/TIA-568-C.3–2009+A1:2011, *Optical Fiber Cabling Components Standard.*
5. ANSI/TIA-568-C.4–2011, *Broadband Coaxial Cabling and Components Standard.*
6. ANSI/TIA-569-C–2012, *Telecommunications Pathways and Spaces.*
7. Building Industries Consulting Services International (BICSI) *Telecommunications Distribution Methods Manual* (TDMM)
8. BICSI *Information Transport Systems Installation Manual (ITSIM)*
9. ISO/IEC 18010, *Pathways and Spaces for Customer Premises Cabling*
10. TIA-942-A-1, *Telecommunications Infrastructure Standard for Data Centers*
11. ANSI-J-STD-607-A, *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*
12. ISO/IEC 11801, *Information Technology – Generic cabling for Customer Premises*
13. TIA-862, *Building Automation Systems Cabling Standard for Commercial Buildings*
14. ISO/IEC 14763, *Implementation and Operation of Customer Premises Cabling*
15. TIA/EIA-606-A, *Administration Standard for Commercial Telecommunications Infrastructure*

16. EE Standard 802.3an – *10GBASE-T* over copper twisted pair cable
17. National Electric Code (NEC)
18. Massachusetts Electric Code
19. All relevant American National Standards Institute (ANSI) Committee

B. In cases where product specifications, design considerations, and installation guidelines provided in this document are in conflict with the references listed above, the more stringent requirements shall apply. All references listed above were current during development of this publication. The bidder is responsible for referencing to the most recent releases when developing bid proposals.

C. This document does not take precedence over any code, either partially or wholly.

1.05 SUBMITTALS

A. Refer also to Section 013300 SUBMITTALS

B. General: Submit shop drawings, samples, and related submittals all together, at the same time, for coordinated review. Isolated items submitted will not be reviewed until all items have been submitted for review.

C. Equipment List: Provide a detailed Equipment List showing quantities by manufacturer and model number of all major items of equipment and installation material to be used in the system as specified herein.

D. Product Data: Include complete sets of indexed cut sheets, in quantity as dictated by the project, of all major pieces of equipment, cable and connectors being supplied. Arrange these sheets in the order the equipment appears in the Specification. Clearly highlight information showing compliance with this and/or all applicable Specifications. In the event that the manufacturer or representatives' cut sheet contains more than one item, clearly indicate which items of the cut sheet are intended for installation.

E. Firestop: Include cut sheets on all firestopping materials.

F. Shop Drawings: Submit a set of complete Shop Drawings, by system, showing equipment to be installed, including but not limited to:

1. System configuration block diagrams of all equipment, indicating equipment type and model numbers. Show each and every component, system and subsystem, as well as all proposed connections between system components, and cable types connecting components.
2. Proposed layouts and elevations of equipment racks.
3. Provide scaled room layout drawings of all tel/data closets showing rack positions in relation to all other equipment.

G. Provide a plan for labeling of all cabling and system components. Meet with the Owner prior to submittal to coordinate Owner requirements and reflect on the plan.

H. Quality Assurance Submittals:

1. Include certification from the manufacturer that the Audio-Video Communication System Installer is qualified to install systems as specified in accordance with the specific requirements set forth herein.

2. Include names, qualifications, and certifications of installation personnel including Audio-Video Communication System Installer's site Supervisor/Foreman who shall be in charge of, and responsible for, all activities at the job site for the duration of the Project. The job Supervisor/Foreman shall not be changed during the Project without notification and approval from the Owner.

3. Complete warranty information including sample Registration Certificate.

I. Close-Out Submittals:

1. Communication System Technical Manual: Submit for approval a draft of the complete Technical Manual at least two weeks prior to the time of final system check out. When the final drafts are approved, provide five copies of detailed technical manuals. The manuals shall include the following:

a. Table of contents.

b. Audio-Video Communication System Installer’s Name; contact name; address, telephone number, fax number, and email address.

c. Manufacturer's Registration Certificate of Warranty for the Audio-Video Communication System(s).

d. Product Information: Include original copies of manufacturer's installation and operating instructions, and service manuals, arranged alphabetically. All service manuals shall be originals; there shall be no Xerox copies of the service manuals and schematic supplied. Warranty information shall be filled out in the Owner's name.

e. Detailed Description of the complete system and all subsystems.

f. Maintenance Documentation: Include the following:

1) Information necessary to perform routine and corrective maintenance by the Owner's technical staff, or other qualified technicians.

g. List of all equipment by manufacturer, model or part number, and serial number.

h. List of spare parts.

2. Submit written certifications that the installation conforms to Specification and Manufacture's recommended installation practices, and is complete and operable, and ready for approval by the Architect.

3. Technical Diagrams and Drawings:

   a. Simplified single line block diagrams showing the interconnection of all equipment and functional relationships for all systems specified. Show all equipment, patch panels, cables and jacks,. whether connected or not. These drawings shall be on Engineering size E, 30" x 42" sheets. The intent of these diagrams is to provide sufficient clear and complete information that a technician of average skill may efficiently troubleshoot and service the system, even if unfamiliar with the installation.

   b. Provide "As Built" architectural quality plan drawings at 1/8-in.= 1-ft. scale showing data jack locations and numbers. These drawings shall be on Engineering size E, 30" x 42" sheets. Also provide all plans on CD in AutoCAD 2000 .dwg format.

   c. All technical diagrams and drawings shall be mounted on the wall behind a clear plastic cover for protection. There shall be one set of the above drawings and diagrams provided for the Main Distribution Room (MDF).

J. Sustainability Requirements:

1. The work of this section includes LEEDv4 materials and submittal requirements. LEED v4 requirements for the work of this Section are detailed in Division I of the Project Manual

2. All Sealing, Caulking, and fire proofing materials shall meet or exceed the current LEED v4 VOC requirements.

1.06 QUALITY ASSURANCE

A. The onsite Job Supervisor/Foreman shall have at least five years' experience in designing, installing, and testing systems specified as described herein. The onsite Job Supervisor/Foreman shall carry an active cellular telephone or other two-way device, so that he/she may be reached when circumstances require. Additionally:

1. The Audio-Video Communication System Installer shall own and maintain tools and equipment necessary for successful installation and testing of all systems specified.

2. The Audio-Video Communication System Installer shall have personnel who are adequately trained and certified by the Manufacturers providing final system warranties.

3. The Audio-Video Communication System (Paragraph “E” listed sub-subbidder) shall be a factory authorized installer of all systems specified and shall hold certifications from the Manufacturer who is providing the final System Warranty and Performance Assurance.

4. Installation Procedures: Adhere to the engineering, installation and testing procedures of the Manufacturer of the components specified, and use only the cabling, components and methods of provisioning the Project authorized by the Manufacturer.

1.07 DELIVERIES, STORAGE AND HANDLING

A. Perform all tasks necessary to properly coordinate with all involved parties/trades for: Shipment, arrivals, loading dock, elevators (as applicable), acceptance, storage, and security of equipment and materials. Do not, during these tasks, interfere with other trades or the progress of this Project.

B. Assure that all deliveries are in correct quantities, within the appropriate times, and in compliance with all manufacturers’ shipping instructions.

C. Protect all materials according to manufacturer's Specifications and/or instructions.

1.08 SYSTEM WARRANTY, SERVICE AGREEMENT AND PERFORMANCE ASSURANCE

A. Warranty all systems to be free of faulty workmanship and defects, and from damage due to contamination from the site for a period of five years from the date of final project completion.

B. The Warranties required by this section shall not be diminished by other warranties in the Contract Documents, equipment manufacturer's warranties, and all other rights and remedies available to the Owner under this Contract and public law. In addition, this Warranty shall not diminish the terms of individual manufacturer's warranties.

C. The Warranties required by this section shall be for the benefit of the Owner to whom Registration Certificate is issued and any successor in interest to the site.

D. Any repair or replacement of Cabling or Equipment resulting from this warranty will be warranted for either (a) 90 days or (b) the remainder of the original warranty period, whichever is longer.

E. Service Agreement: The Audio-Video Communication System Installer shall respond to all requests for service during the warranty period. During this period, the Audio-Video Communication System Installer shall replace defective material and repair items of faulty workmanship at no charge to the Owner. All requests for service shall be responded to by telephone within two business hours, and technicians shall be dispatched within twenty-four hours. Only certified technicians shall be dispatched.

1.09 TRAINING OF OWNER'S PERSONNEL

A. Conduct a Training Program for the Owner's staff. The Training Program shall include a demonstration of the configuration of all Audio-Video Communication Systems. Schedule the Training Program at the convenience of the Owner, after the Technical Manual has been submitted and approved. All materials in the Technical Manual shall be reviewed during the training program. All training sessions shall be videotaped with five copies provided to the Owner with closeout submittals.

1.10 EXTRA INSTALLATION PROVISIONS, MATERIALS AND SPARE PARTS

A. Furnish the following Attic Stock or Spare Parts to the Owner at the conclusion of the project. Spare parts shall be delivered to the Owner with closeout documentation submittals.

1. Provide ten spare teacher microphones including batteries and lanyards for classroom sound systems.

2. Provide ten spare student microphones for classroom speech reinforcement systems.

PART 2 PRODUCTS

2.01 GENERAL

A. It is the intent of the Specification that one manufacturer, not a combination, be selected for each particular class of material

B. Audio-Video Communication System as specified, must be able to be serviced and supported after the initial installation and warranty period is complete by no less than 3 resellers authorized by the manufacturer in the State of Massachusetts to install, service and support the Audio-Video Communication System specified.

C. Certain equipment is listed by manufacturer and model number. This is to define and establish a level of quality and functionality. The words, "or equal", are understood to follow all names of these specified products, trade names, catalog numbers, and detailed descriptions. It shall be interpreted to apply to any material, article, assembly or system, which in the opinion of the Owner is at least equal in quality, durability, appearance, strength and design to the material specified, and shall perform at least equally the functions imposed by the general design. The words, "or equal", shall not be construed to permit departure from the detailed requirements of the Specification. The “or equal” provision of G.L. c.30, §39M(b) is hereby incorporated by reference.

D. All materials and equipment shall be new and unused.

E. All part numbers and manufacturers shall be according to this Specification unless otherwise noted on the construction Drawings.

F. Provide all mounting hardware, shelving, bracketing, bracing, support members, required to support all cabling and equipment specified.

2.02 MANUFACTURERS

A. Acceptable “or equal” manufacturers for the Audio-Video Communication Systems for Gymnasium, Cafeteria and Music Classrooms include:

1.	Microphones:	Shure, AKG, Audio-Tecnica
2.	Listening Assistance:	Telex, Listen, Williams
3.	DSP’s:	Biamp, Ashly Audio, Bose
4.	AV Processing:	Extron AMX, Crestron,
6.	Sound Amplifiers:	Crown, QSC, Bose
7.	Projectors:	Epson, Christie, Sony
8.	Audio Recorders:	Denon, Tascom, Marantz
9.	Bluetooth Receivers:	Denon, Tascom, Rane
10.	AV Streamers:	Extron, Haivision, Reach

11. DVD Players: LG, Sony, Panasonic

B. Acceptable “or equal” manufacturers for the Digital Signage System include:

1. Displays: NEC, Samsung, Sony
2. Players: Spinetix, Carousel, UCview

2.03 GYMNASIUM AUDIO-VIDEO SYSTEM

A. Main Equipment Rack: Supply one equipment rack to house all audio-visual system equipment intended for rack mounting. The rack shall be supplied with lift off side panels, a top panel and a locking front and rear doors, which can be fitted for either left hand or right hand hinging. The rack, the side panels and all filler and vent panels shall be black. The rack shall have 70-in. min. of equipment mounting space. It shall be at least 26” deep. There shall be in internal space provided for running cables within the frame. The rack shall be supplied with heavy-duty casters. There shall be two locking storage drawers provided in the rack. The drawers shall be Middle Atlantic LBX-3. The Audio-Video Communication Systems Installer shall fill all empty space in the rack with blank rack panels. Provide AC power strips to accommodate all AC powered units with a spare capacity of at least three outlets for the connection of test equipment. The rack shall be Middle Atlantic MRK-3726 with side panels, top, lockable vented front door, rear door and caster kit.

1. Provide Middle Atlantic Drawer Model D5 or approved equal in sound system equipment rack. Shelves for electronic equipment with load carrying capacity to support at least 100 percent of each piece of electronic equipment weight. Shelves shall have adequate openings within them to dissipate heat and flow for adequate ventilation of all equipment.
2. Mounting brackets specifically designed to support the equipment installed within the rack.
3. Hook and loop (Velcro) horizontal and vertical cable management system to properly dress the electronic equipment power cords through the rack. Tie-wraps are specifically prohibited.
4. Bonding and grounding cables required for any and all equipment.
5. Furnish and install locking front hinged door.
6. Furnish and install surge suppression power strip. Surge Suppression Power strip shall be SurgeX model SX1120RT or approved equal.
7. Provide Blank panels to fill all empty spaces in racks.

B. Power Amplifier: The loudspeaker amplifier shall be Crown Audio DCI 2/300 or equal. Supply rack mount brackets and bridging transformers.

C. DSP within rack mounted control for each system: Provide one rack mounted BiAmp TesiraForte with TEC-1 or approved equal. TEC-1 to be rack mounted on custom panel in Local Sound System Equipment Cabinet.

1. Provide paging system interface required to mute inputs of DSP during paging system announcements.

D. Ceiling Mounted Speakers: Speakers in the Gymnasium shall be Atlas Sound SM12CXT-W Coaxial Speakers (White) with SM12CBKT-W U-Bracket (White). Confirm preferred finish color with the architect. Provide all hardware and brackets required for installing speakers flush with bottom of trusses in the gymnasium according to manufacturer approved methods. Tap speakers at 60 Watts per speaker.

E. Provide a permanent projection system. The projector shall be mounted even with the top of the projection screen. Install to avoid conflict with all lighting. Provide all required mounting hardware for a complete, neat and professional installation. Provide a cover plate for the ceiling tile to conceal all mounting hardware and provide a clean finish. Field verify all dimensions prior to ordering equipment. Projector shall be:

1. Epson Pro L1750UNL with correct lens for optimal image given location of projector and specified screen.
2. Lens shall be Epson ELPLM07. Prior to ordering lens, verify correct lens to be used based on the actual location of projector in the ceiling of GYM STORAGE 116 relative to a tensioned projection screen located on the opposite wall in GYMNASIUM 114 by others. Projector with appropriate Lens shall be made to fill the available screen surface with a projected image. Screen is provided by SECTION 115213 – PROJECTION SCREENS.
3. Projector shall be ceiling mounted in location shown on plans using appropriate Chief Manufacturing or equal ceiling mount brackets as required to support the projector.
3. Projector shall be mounted in the location shown on plans. Verify proper lens required to fill, but not exceed the dimensions of the rear projection screen. Provide all wall mount hardware required. Screen is provided by SECTION 115213 – PROJECTION SCREENS.
4. Provide Crestron DMPS3-4K-150-C for interfacing between the FVS Outlet and the Projector. Signal and control should be sent directly to Projector's HDBaseT input.
5. Crestron DM-TX-200-C-2G shall be incorporated into the FVS outlet. FVS Outlets shall also be equipped with a 2-pole Neutrik Speakon connector with cabling to the DSP output to allow for the addition of a powered subwoofer by Owner. FVS Outlet shall incorporate Crestron DM-TX-200-C-2G and Speakon connector into a single three gang metal cover plate. Coordinate finish color of plate with Architect and include in product submittals.

6. Provide Extron SMP 351 Streaming Media Processor or equal.

7. Provide Sony BDPS-3700 Blu Ray player with custom rack shelf and connections to the Crestron DMS via HDMI and IR Control.

8. Provide Crestron TSW-760-NC-B-S Touchscreen in the Sound System Equipment Rack. Provide XPanel Program and IPad Program and set up to mimic touch panel on at least two Owner furnished devices (iPads and/or Computers).

9. A Niveo NR-10 or approved equal so that system can be put on the school network and set up to be controlled by Owner's computer and/or iPad wirelessly.

10. Crestron C2N-IO Relay and Cresnet cabling to connect to the low voltage controller of the specified projection screen.

11. All UTP video cabling and connectors shall be Cat6 Shielded cabling and connectors.

12. Provide all programming for a fully functional system. All uncompiled source code and graphics files are to be turned over to the Owner.

F. Wireless Microphone System: Wireless microphones and combiners shall be by Shure or Telex rack mounted receivers as shown on plans. Provide all antenna equipment including but not limited to dual rack mount kit, passive antenna splitters, active antenna amplifiers, antenna cable and antenna. Remotely locate antenna in the ceiling for optimal performance. Provide two lithium batteries for each transmitter. Provide two complete systems, each including hand held microphone transmitter and lavalier microphone with bodypack transmitter and receiver. System shall be Shure SLXD124/85 system or approved equal.

G. Microphone wall plates shall be Proco WP1004 for a single microphone locations.

H. Microphones and Accessories: The following microphones and accessories shall be provided for use with the systems.

1. Two Shure SM 58A with cables, or approved equal.

2. Two Shure S39A Isolated Microphone Table Stands

3. Two Shure MS-10C Microphone Stands

4. Two Shure C-25E 25' Microphone Cables

I. Hearing Assistance System: System shall consist of a rack-mounted transmitter and a group of wireless receivers and accessories as listed below:

1. One Listen Technologies LT-800-07201 Stationary RF Transmitter.

2. One Listen Technologies LA-326 Rack mount kit.

3. One Listen Technologies LA-122 Universal antenna. Mount as needed, can be mounted on ceiling, wall, and remote base or flexible dipole. If

antenna is remoted, use RG58 for less than 100 ft Or RG8 for more than 100 ft runs (50 0hm).

4. Listen technologies LR-4200-072 Intelligent DSP RF Receiver. Provide quantity of 22 to meet ADA requirements for maximum occupancy of 535 for the Gym.
5. Listen Technologies LA-401 Ear Speakers for each receiver.
6. Listen Technologies LA-430 Intelligent Earphone/Neck Loop Lanyards. Provide quantity of 6 to meet ADA requirements for maximum occupancy of 535 for the Gym.
7. Listen Technologies LA-423 4-Port USB Chargers as required.
8. One Listen Technologies LA-304 ADA Access/Compliance signage kit.
9. Configurable carrying case/cases for storing and transporting all portable equipment.
10. Cables and connections required for a complete and fully installed system.

Note: The Audio-Video Communication Systems Installer shall check factory for their recommendation on suitable frequency for operation in site area. The frequency selected must permit interference free simultaneous operation of a similar systems in the building.

J. CD Player: The unit shall be designed for rack mounting. The CD player shall be Tascam CDRW901MKII.

K. Rack Mount Bluetooth Receiver shall be Denon DN-300D or equal.

L. Audio system shall be by-passed in the event of an emergency page/announcement or a fire alarm.

M. Provide all cabling and connectors required for a complete and fully functional system. Utilize cabling and connector solutions that will work within the constraints of conduits and boxes provided. All cabling shall be professional grade. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

N. Provide all equipment specified and shown on plans and required for a fully functional system.

2.04 CAFETERIA AUDIO-VIDEO SYSTEM

A. Main Equipment Rack: Supply one equipment rack to house all audio-visual system equipment intended for rack mounting. The rack shall be supplied with lift off side panels, a top panel and a locking front and rear doors, which can be fitted for either left hand or right hand hinging. The rack, the side panels and all filler and vent panels shall be black. The rack shall have 70-in. min. of equipment mounting space. It shall be at least 26" deep. There shall be in internal space provided for running cables within the frame. The rack shall be supplied with heavy-duty casters. There shall be two locking storage drawers provided in the rack. The drawers shall be Middle Atlantic LBX-3. The Audio-Video Communication Systems Installer shall fill all empty space in the rack with blank rack panels. Provide AC power strips to accommodate all AC powered units with a spare capacity of at least three outlets for the connection of test equipment. The rack shall be Middle Atlantic MRK-3726 with side panels, top, lockable vented front door, rear door and caster kit.

1. Provide Middle Atlantic Drawer Model D5 or approved equal in sound system equipment rack. Shelves for electronic equipment with load carrying capacity to support at least 100 percent of each piece of electronic equipment weight. Shelves shall have adequate openings within them to dissipate heat and flow for adequate ventilation of all equipment.
2. Mounting brackets specifically designed to support the equipment installed within the rack.
3. Hook and loop (Velcro) horizontal and vertical cable management system to properly dress the electronic equipment power cords through the rack. Tie-wraps are specifically prohibited.
4. Bonding and grounding cables required for any and all equipment.
5. Furnish and install locking front hinged door.
6. Furnish and install surge suppression power strip. Surge Suppression Power strip shall be SurgeX model SX1120RT or approved equal.
7. Provide Blank panels to fill all empty spaces in racks.

B. Power Amplifier: The loudspeaker amplifier shall be Crown Audio DCI 4/600 or equal. Supply rack mount brackets and bridging transformers.

C. Digital Signal Processors shall be BiAmp TesiraForte AI. Provide in quantities to meet all functional requirements of system and to connect all components.

1. Provide paging system interface required to mute inputs of DSP during paging system announcements.

D. Ceiling Mounted Speakers shall be Community D6, or approved equal. Speakers shall be tapped at 60W.

E. Program Playback Speakers shall be Bose DesignMax DMS DM8S with wall mounts for aiming speakers horizontally. Speakers shall be initially aimed for maximum sound coverage of the Cafeteria.

F. Provide a permanent projection system. The projector shall be mounted even with the top of the projection screen. Install to avoid conflict with all lighting. Provide all required mounting hardware for a complete, neat and professional installation. Provide a cover plate for the ceiling tile to conceal all mounting hardware and provide a clean finish. Field verify all dimensions prior to ordering equipment. Projector shall be:

1. Epson Pro L1750UNL with correct lens for optimal image given location of projector and specified screen.
2. Lens shall be Epson ELPW06. Prior to ordering lens, verify correct lens to be used with the projector based on the actual location of projector in the ceiling relative to the location of the tensioned dual vision screen mounted in the ceiling by others. Projector and Lens shall be made to fill the available screen surface with a projected image.
3. Projector shall be ceiling mounted in location shown on plans using appropriate Chief Manufacturing or equal ceiling mount brackets as required to support the projector.
4. Projector shall be mounted in the location shown on plans. Verify proper lens required to fill, but not exceed the dimensions of the rear projection screen. Provide all wall mount hardware required. Screen is provided by SECTION 115213 – PROJECTION SCREENS.
5. Provide Crestron DMPS3-4K-150-C for interfacing between the FVS Outlet and the Projector. Signal and control should be sent directly to Projector's HDBaseT input.
6. Crestron DM-TX-200-C-2G shall be incorporated into the FVS outlet. FVS Outlets shall also be equipped with a 2-pole Neutrik Speakon connector with cabling to the DSP output to allow for the addition of a powered subwoofer by Owner. FVS Outlet shall incorporate Crestron DM-TX-200-C-2G and Speakon connector into a single three gang metal cover plate. Coordinate finish color of plate with Architect and include in product submittals.
7. Provide Extron SMP 351 Streaming Media Processor or equal.
8. Provide Sony BDPS-3700 Blu Ray player with custom rack shelf and connections to the Crestron DMS via HDMI and IR Control.
9. Provide Crestron TSW-760-NC-B-S Touchscreen in the Sound System Equipment Rack. Provide XPanel Program and IPad Program and set up to mimic touch panel on at least two Owner furnished devices (iPads and/or Computers).
10. A Niveo NR-10 or approved equal so that system can be put on the school network and set up to be controlled by Owner's computer and/or iPad wirelessly.

11. Crestron C2N-IO Relay and Cresnet cabling to connect to the low voltage controller of the specified projection screen.

12. All UTP video cabling and connectors shall be Cat6 Shielded cabling and connectors.

13. Provide all programming for a fully functional system. All uncompiled source code and graphics files are to be turned over to the Owner.

G. Wireless Microphones: Wireless microphones and combiners shall be by Shure rack mounted receivers as shown on plans. Provide all antenna equipment including but not limited to dual rack mount kit, passive antenna splitters, active antenna amplifiers, antenna cable and antenna. Remotely locate antenna in the ceiling of the space they are serving for optimal performance. Provide two lithium batteries for each transmitter. Provide two complete systems, each including hand held microphone transmitter and lavalier microphone with bodypack transmitter and receiver. System shall be Shure SLXD124/85 system or approved equal.

H. Microphone wall plates shall be Proco WP1004 for dual microphone locations.

I. Microphones and Accessories: The following microphones and accessories shall be provided for use with the systems.

1. Four Shure SM 58A with cables

2. Four On-Stage DS7200QRB Desktop Microphone Stands

3. Four Shure MS-10C Microphone Stands

4. Four Shure C-25E 25' Microphone Cables

J. Hearing Assistance System: System shall consist of a rack-mounted transmitter and a group of wireless receivers and accessories as listed below:

1. One Listen Technologies LT-800-07201 Stationary RF Transmitter.

2. One Listen Technologies LA-326 Rack mount kit.

3. One Listen Technologies LA-122 Universal antenna. Mount as needed, can be mounted on ceiling, wall, and remote base or flexible dipole. If antenna is remoted, use RG58 for less than 100-ft. or RG8 for more than 100-ft. runs (50 0hm).

4. Listen technologies LR-4200-072 Intelligent DSP RF Receiver. Provide quantity of 10 to meet ADA requirements for maximum occupancy of 250 for the Cafeteria.

5. Listen Technologies LA-401 Ear Speakers for each receiver.

6. Listen Technologies LA-430 Intelligent Earphone/Neck Loop Lanyards. Provide quantity of 3 to meet ADA requirements for maximum occupancy of 250 for the Cafeteria.

7. Listen Technologies LA-423 4-Port USB Chargers as required.

8. One Listen Technologies LA-304 ADA Access/Compliance signage kit.

9. Configurable carrying case/cases for storing and transporting all portable equipment.

10. Cables and connections required for a complete and fully installed system.

Note: The Audio-Video Communication Systems Installer shall check factory for their recommendation on suitable frequency for operation in site area. The frequency selected must permit interference free simultaneous operation of a similar systems in the building.

K. Rack Mount Bluetooth Receiver shall be Denon DN-300D or equal. Initialization of paring should be controlled from the touch panel interface.

L. Audio/Video Streaming Recorder shall be Extron SMP351 or equal. Device shall record audio and video sources of choice onto a USB drive or stream onto the building network. Unit must also interface with Camera Input Plate designated as the “C” outlet, which shall be a stainless-steel custom plate with one XLR-F connector and one recessed BNC labeled camera. Microphone and SDI cabling shall run from the “C” outlet to the DSP microphone input and Audio/Video Streaming Recorder respectively. Provide Cat 6 patch cord with sufficient length to reach nearest data jack to the rack. Leave coiled in cabinet clearly labeled “For streaming AV to School’s Local Area Network”.

M. Audio system shall be by-passed in the event of an emergency page/announcement or a fire alarm.

N. Provide all cabling and connectors required for a complete and fully functional system. Utilize cabling and connector solutions that will work within the constraints of conduits and boxes provided. All cabling shall be professional grade. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

O. Provide all equipment specified and shown on plans and required for a fully functional system.

2.05 MUSIC CLASSROOMS LOCAL SOUND SYSTEM

A. Equipment Racks on Casters:

The EIA/TIA compliant, UL 2416 Listed, 19" portable equipment rack shall be Lowell Model No. LPR-2122FV, which shall be constructed of 16-gauge U.S. steel with 14-gauge steel bottom, reinforced at all loadbearing junctures. It shall measure 42.875"H (without casters) x 22"D x 23.06"W and provide 21 rack units of panel space. It shall include one-pair swivel and one-pair swivel/locking casters which shall be field installed and increase rack height 5.13-in. Total load rating shall be 900 lbs. The rack frame shall have vents above and below the fully vented steel surface-mount front door, which shall have an integral handle

and key lock. The rack shall feature vented side panels with recessed handles, vented recessed rear door with key lock and one-pair of adjustable mounting rails tapped 10-32. The rear shall feature removable knockout panels above and below the door with knockouts for BNC wireless antenna (0.5"), compound knockouts for conduit (.75–.50" and 1.5–1.0"), and a blank project panel. Finish shall be black wrinkle powder epoxy.

1. Provide Middle Atlantic Drawer Model D5 or approved equal in sound system equipment rack. Shelves for electronic equipment with load carrying capacity to support at least 100 percent of each piece of electronic equipment weight. Shelves shall have adequate openings within them to dissipate heat and flow for adequate ventilation of all equipment.
2. Mounting brackets specifically designed to support the equipment installed within the rack.
3. Hook and loop (Velcro) horizontal and vertical cable management system to properly dress the electronic equipment power cords through the rack. Tie-wraps are specifically prohibited.
4. Bonding and grounding cables required for any and all equipment.
5. Furnish and install locking front hinged door.
6. Furnish and install surge suppression power strip. Surge Suppression Power strip shall be SurgeX model SX1120RT or approved equal.
7. Provide Blank panels to fill all empty spaces in racks.

B. System Components:

1. Each product category listed below is typical for each system. Provide required equipment.
2. DSP within rack mounted control for each system: Provide one rack mounted BiAmp TesiraForte with TEC-1 or approved equal. TEC-1 to be rack mounted on custom panel in Local Sound System Equipment Cabinet.
    a. Provide paging system interface required to mute inputs of DSP during paging system announcements.
3. Power Amplifier: The loudspeaker amplifier shall be Crown Audio DCI 2/300 or equal. Supply rack mount brackets and bridging transformers.
4. CD Players/Recorders: Provide one rack-mounted Tascam CDRW901MKII or approved equal.
5. Rack Mount Bluetooth Receiver shall be Denon DN-300D or equal.

6. Blu-Ray player: Provide one Sony BDPS3700 or approved equal with Lowell US214 rack shelf with Audio inputs to the DSP and Video HDMI cabling from the Blu-Ray to the teaching wall Owner provided projector. Provide audio cable from audio output of Owner provided projector to input of the DSP. Make all connections for a fully functional system.

7. Music Room program loudspeakers shall be surface mount Bose Professional part number DN6SE or approved equal. Coordinate final locations with architect and engineer prior to locating back boxes for cabling. Provide all mounting hardware required for a complete installation. Provide speaker/grill in the color white.

8. Microphones and Accessories: The following microphones and accessories shall be provided for use with the systems.

   a. Two Shure SM 58A with cables

   b. Two On-Stage DS7200QRB Desktop Microphone Stands

   c. Two Shure MS-10C Microphone Stands

   d. Two Shure C-25E 25' Microphone Cables

C. Microphone wall plates shall be Proco WP1004 or equal.

2.06 CLASSROOM SPEECH REINFORCEMENT SYSTEM

A. Main system shall be Lightspeed Topcat or equal by Extron or Crestron. Install in ceiling grid with proper safety supports, as close to the center of the classrooms as possible. The Electrical Contractor shall provide hardwired power to all systems. The following shall be provided for each installed system:

1. One Flexmike Pendant Microphone, with USB Charging Cable.

2. One Sharemike Handheld Microphone, with USB Charging Cable

3. One wireless access media connector per system, with one 3.5 mm to 3.5 mm stereo audio cable

4. One Charging Stations and cables per system that will accommodate all accessories.

B. Connect the audio out feed from owner provided projector to the audio input to the main system. This work will occur after substantial completion. Classroom projectors are by others. Coordinate with Owner's classroom projector vendor.

C. Coordinate with the Intercom system and provide PageFirst emergency page priority, automatically muting the Topcat during an announcement from the Intercom System.

D. Upon completion, all systems shall be clean, adjusted and left in perfect operating condition. Transmitters shall be plugged in and charging and user manual should be left in a conspicuous place. There shall be no audible components of hum, noise, or distortion.

2.07 DIGITAL SIGNAGE SYSTEMS

A. IP Digital Signage and Message Board

1. Shall be a digital information bulletin board that can be viewed from any computer or Media set top/decoder on the LAN, WAN or Internet. Shall allow multiple play lists to be setup so different information can be pushed out and displayed at different locations across a site or district. The play list shall allow automatic full screen playback of different resources to be shown in sequential order for a defined period of time. Shall automatically sequence through the prescribed resources and loop or end playback based on preference settings. The type of information that can be played include; video, audio, text messages, custom input HTML pages, Microsoft PowerPoint, Word, Excel, Producer presentations, Adobe PDF files, Flash documents, Captivate files, Web sites and all other digital media types within the digital repository. Emergency message system shall be included. Emergency mode shall be started by users with appropriate permissions and shall allow special messaging to automatically override the normal bulletin board message. Shall work with the Media decoder/set top to automatically turn on/off the displays and select the proper input during an All-Call and Emergency broadcast. System shall be Spinetix Diva Player System or equal.

2. Provide three Digital Signage Display and Message Board systems as indicated on plans, each consisting of wall mount bracket; HDMI, Ethernet and RS-232 cables as required; handheld remote, with Spinetix Diva Player System for each. Systems shall include:

a. Cafeteria: Planar PS6574K 4K LCD or equal from Samsung or NEC. Display shall be designed for 24x7 operation with a 5-year advance placement warranty. Display shall be mounted on a low profile wall mount that extends the panel out from the wall for service and gaining access to connections behind the display. See plans for exact mounting locations.

b. Main Lobby Display: Planar PS5024K or equal from Samsung or NEC. Display shall be designed for 24x7 operation with a 5-year advance placement warranty. Display shall be mounted on a low profile wall mount that extends the panel out from the wall for service and gaining access to connections behind the display. See plans for exact mounting locations.

c. Feature Wall Display: Planar QE8650 or equal from Samsung or NEC. Display shall be designed for 24x7 operation with a 5-year advance placement warranty. with adjustable low profile wall mount bracket that will allow for the display to be adjusted out from the wall and locked into place so that the display can be calibrated to be flush with the other aspects of the Feature Wall. Carefully coordinate installation with the construction of the Feature Wall including work of SECTION 101400 IDENTIFYING DEVICES. Furnish and install high speed HDMI 2.0 cabling from

display to a custom single gang stainless steel faceplate with a single HDMI connection located at outlet height on the adjacent wall. Furnish 8' custom HDMI patch cord to go between Owner's provided computer or Chromebook device and HDMI connection plate. Furnish and install Owner provided wireless receiver device (AppleTV, Chromecast or equal) to the display prior to installation of display. Furnish and install Crestron MPC3-102-B 3-Series media presentation control panel in workbox at the side of the millwork as indicated, with RS232 cabling between control panel and display. Program and configure control panel to switch between the hard-wired HDMI input, wireless receiver input, and input from the Spinetix Divia Player System at the display. Using an Owner provided laptop device, demonstrate that all three inputs can be selected by the button panel.

2. Work with the Owner to assist in the creation of initial signage content templates at all three displays, as well as loading content into templates to create the initial digital signage message boards. Afterwards, provide three (3) separate 1-hour training sessions to review signage; modify templates and content, and; train on using and managing the digital signage and message board system. Training shall be performed by a certified Spinetix reseller/dealer. Training shall be provided at the Owner's discretion during the school year after the initial installation is complete.

2.08 ACCESSORIES

A. Provide all professional grade cabling and accessories required to furnish complete and functional systems.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to commencing Work of this Section or ordering equipment, examine site and conditions under which work shall be performed. Determine exact locations of items shown diagrammatically on Drawings. Determine dimensions needed to install components, move in racks and any custom items. Notify the Architect of any conflicts or special requirements needed to provide for free access to doorways, corridors, stairs, and similar areas, required to move in the specified equipment. If the Audio-Video Communication System Installer fails to provide such notification, any additional cost to remove and reinstall any building members will be back charged to the Systems Installer.

B. Technology Drawings designate component locations. Install quantity and type according to the Technology Outlet Plans and as specified herein. Provide all required adapters and/or accessories for a complete installation in all raceways, and other locations.

C. Commencement of Work of this Section indicates acceptance of existing site conditions.

3.02 WORKMANSHIP

A. Audio-Video Communication System shall be installed in a neat, workmanlike manner. Workboxes, equipment, and enclosures are to be plumb and square. Install the system elements in cooperation with all trades to achieve coordinated progress and desired results. Watch for conflicts with Work being performed by other trades that have impact on the installation of the system components. Make moderate moves or changes in equipment locations as are necessary to accommodate other equipment as directed by the Architect, without a claim for additional payment.

3.03 GENERAL INSTALLATION

A. Pre-installation: Meet with the Construction Manager, Project manager, and any other appropriate parties for coordination meeting prior to beginning work and to coordinate requirements.

B. Coordinate Work with adjacent Work of other trades to facilitate installation and prevent conflicts.

C. Staff job appropriately to keep pace with the Project schedule.

D. Abide by the decision of the Architect to case of conflict or interference of the other trades.

E. Work under this Section shall be performed in accordance with associated local, state, and national building codes.

F. Coordinate requirements of ceiling and floor mounted outlets with the Electrical Contractor.

G. Coordinate the type of back boxes and conduit requirements and associated hardware with Electrical Contractor to ensure compatibility with devices to be installed as part of this Section.

H. In the event that the Audio-Video Communication System Installer must re-enter an area of a previously completed phase of Work, the Installer shall be responsible for returning that area back to the condition it was in before the Installer re-entered the area. This includes re-installing ceiling tiles, cover plates, cleaning floors. Coordinate the cutting and patching of holes with the Construction Manager, and comply with the Cutting and Patching Section.

I. Every effort shall be made to schedule the Work under this Specification in such a manner so as to complete all above ceiling Work prior to ceiling panel installation. In the event that the Audio-Video Communication Systems Installer is required to remove ceiling panels, such Work shall not break or disturb the existing ceiling grid or panels and shall be coordinated with the Construction Manager and Ceiling Contractor.

J. Audio-Video Communication System Installer is responsible for furnishing and installing cross-connections between the riser and station cabling required for a fully functional system.

K. Spare pull strings shall be left in all EMT, Conduits, and Innerduct.

L. Audio-Video Communication System Installer shall furnish and install all mounting hardware, shelving, bracketing, bracing, support members as may be required to ensure that all equipment and cabling and equipment is properly installed and supported according to the manufacturer's recommendations.

M. Take precautions as necessary to prevent and guard against electromagnetic and electrostatic interference. Avoid potential sources of EMI in all aspects of installation. If interference is experienced, the Audio-Video Communication System Installer shall provide all required testing to identify the source of interference and provide a remedy including but not limited to re-routing and/or replacing cables.

N. Cafeteria Creston Control System shall be made to interface with and control the electric projection screen, electric lighting and electric shades provided by others for the Cafeteria. Audio-Video Communication Systems Installer shall coordinate all work including interfacing and programing AV control system with Electrical Contractor and Subcontractors responsible for the installation of the electric screen, lighting, and shade controls. Audio-Video Communication System Installer shall run all necessary control cabling and provide and perform all necessary programing to Interface and control electric screen, lighting and shade systems directly from the Crestron TSW-752 as well as an external Apple iPad device. Audio-Video Communication System Installer shall review options for the

touch panel layout with Owner representatives and obtain approval from the Owner for the touch panel layout prior to programing Cafeteria Control System.

O. Provide all mounting hardware and accessory items required for mounting and installing the projector to the finished wall or ceiling in the cafeteria for optimal rear projection utilizing a tensioned projection screen provided by others. This shall include but not be limited to coordinating the final location of the projector at the ceiling or wall with the architect; installing all mounting hardware; running and concealing AV cables from the sound system rack to the projector through conduit and pathways provided by others; coordinating with installer of the finished ceiling for mounting the projector and passage of cables through the ceiling; coordinating with the installer of the projection screen, and; making all calibrations and adjustments required for optimal projection of video images sourced at connection outlets on both sides of the stage

3.04 CABLE SUPPORTS AND ROUTING

A. Install all cabling shall be installed in accordance with the manufacturer's guidelines and according to all applicable building codes at the time of installation, including but not limited to the NEC and the ANSI/TIA/EIA Telecommunications Building Wiring Standards.

B. Route all cables in large groupings, through main hallways, until cable can be distributed directly to the communication Outlet. Route individual cables to the appropriate Outlet locations in accordance with all standards described herein.

C. Install cables in cable tray, Snake Tray, J-hooks, pipe and/or sleeves specified in this and other sections.

D. In suspended ceilings where cable trays or conduit are not available, and it is not possible to install corridor cable support, bundle cables in bundles of 50 or less, with Velcro cable tie wraps pulled snug, but not deforming the cable geometry. Support the cable bundles with approved "J" style hooks attached to the building structure at a maximum of three foot intervals. J-Hooks shall not be used in lieu of the corridor cable support Snake Tray. Prior to installing J-Hooks, The Audio-Video Communication System Installer shall submit a Request For Information stating the location at which he/she requests to use J-Hooks, and justification why Snake Tray cannot be installed.

E. The Audio-Video Communication System Installer shall adhere to the manufacturers' requirements for bending radius and pulling tension of all communication cable.

F. Install cables in such a manner required to minimize tension and stress on cables, which can lead to changes in the physical and/or electrical characteristics of the cables over time. This applies to, but is not limited to, horizontal cable support methods, vertical cable support methods, tie wraps, or similar types of cable support methods.

G. Cables exiting floor conduits and sleeves shall be neatly dressed, and securely supported from the floor up to the ceiling so that the cables are not stressed or stretched by the weight of the cables. Cables shall be arranged in bundles of not more than 50 cables or less, and secured with Velcro cable tie wraps pulled snug, but not deforming the cable geometry. Acceptable support structures include, but are not limited to: Cable tray runway radius dropout, vertical ladder tray, J-hooks, unistrut, or similar types of support structures. The intent is that cables shall not be supported by the weight of the cables themselves, but are supported so that the weight of the cables is supported by the support structure(s).

H. Route cables at right angles to electrical power circuits and supported only from the building structure when not in cable tray or conduit.

I. Do not support cabling from ceiling tiles, grid or hanger wires.

J. Do not install random or diagonal cable runs. Cable turns and bends shall be made at 90 degrees angles whenever possible, but maintaining manufacturers' requirements for bending radius at all time.

K. Above finished ceiling at all Audio-Video equipment racks, provide 10’ service loop for all cabling.

L. Cables which penetrate a steel stud or steel wall cap shall be protected from damage with a "stud liner".

M. Cables entering power poles, surface mounted raceway, or other cable management systems shall be protected from damage.

N. Meet all requirements regarding use of cable in return air plenums and in raised floor systems. Provide wiring that complies with all applicable state, local building codes, and the National Electrical Code. All cables run in raised floor systems with forced air-cooling shall meet the requirements of NEC Article 645, "Electronic Computer Data Processing Equipment”.

3.05 CONDUITS, SLEEVES, CABLE TRAY AND WALL/FLOOR PENETRATIONS

A. Conduits, Sleeves, and cabling pathways between all equipment shall be provided by Division 260001.

3.06 FIRESTOPPING

A. Seal all horizontal and vertical openings between floors, through fire rated fire and smoke walls, used or created by the Audio-Video Communication System Installer.

B. Refer to Section for Firestopping, for all product requirements for maintaining integrity of fire-rated construction at penetrations.

3.07 LABELING

A. Clearly label and identify all components. Logically and permanently mark all cable, connectors and electronic equipment.

B. Use a letter quality printer or other mechanically produced lettering for labels.

C. Place permanent cable markers three inches from all connectors to allow easy identification. Use Brady Markers with clear plastic ends. Acceptable markers are, Brady B-320, B-292, SL-292, or Brady machine embossed labels with clear vinyl ends. Machine generated markers are required. Place cable markers on cables so that they can be easily seen.

D. Handwritten labels shall not be accepted, even if written with a permanent marker. Temporary handwritten labels may be used only during the “rough-in” stages; they must be replaced with permanent labels prior to Project completion.

3.08 BONDING AND GROUNDING

A. Telecommunications Bonding Backbone utilizing #6-AWG or larger bonding conductor shall be provided by Division 260001. This is part of the grounding and bonding infrastructure (part of the telecommunications pathways and spaces in the building structure), and is independent of equipment or cable.

B. For all systems, provide equipment grounding connections. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

C. For all systems, provide conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

D. For all systems, provide transient protection on the AC power feed and on station lines leaving or entering the building.

E. Provide any necessary screws, anchors, clamps, tie wraps, distribution rings, and miscellaneous grounding support hardware to complete the installation of the grounding system.

F. Grounding busbars shall be installed at all rack locations by Division 260001.

G. All non-current carrying telecommunications components (passive) shall be bonded to the grounding busbar utilizing 2 hole lugs for all bonding connections.

H. All grounding conductors shall be affixed with permanent labels in a visible location at each end of the conductor, and as close as practicable to the bonding point at each end of the conductor. The labels shall clearly identify both the source and destination of the bonding conductors. Hand written labels are not acceptable.

3.09 TESTING

A. Audio/Visual Systems

1. Test the proper functioning of all equipment items to ensure components meet manufacturer's published specifications and the intent of this specification. All adjustments shall be made to optimize the system prior to Owner training.

2. Provide full commissioning of all Audio/Visual Systems. All system performance certification and programming must be performed by a factory certified technician. All performance design criteria must be met and documented utilizing “EASE” or equal industry standard for acoustic measurement. System must be capable of delivering 100db SPL A weighted to all seats in the auditorium. Auditorium System must provide performance of +/- 4 db from 500hz-10,000hz to all seats.

3.10 TRAINING

A. Train systems administrative and/or maintenance personnel in procedures involved in operating, troubleshooting, servicing and preventative maintenance of each system specified and installed. Provide four separate 60 minute training sessions for a total four hours, one for each major system installed (Gym, Cafeteria, Music Rooms, and Digital Signage), scheduled at the Owner’s discretion, to include:

1. Review of the physical configuration and interrelationship of the system components.

2. Labeling and interconnection techniques used in the installation.

3. Applications of systems including any unique connections or interfaces required in the use of systems on site.

4. A review of warranty documents for the system.

5. A review of the Technical Manual prepared per "Closeout Submittals."

6. A Review of operation manuals and users guides for the system.

7. Full system operation and maintenance procedures.

8. Review of all user programmable options and how to modify options.

3.11 CLEANING

A. Clean all equipment and work areas under this Section, prior to scheduling Owner training. Include, as necessary, wiping of Work areas and surfaces, and the removal of dust, streaks, stains from all equipment specified. Leave installed systems and components clean and undamaged.

END OF SECTION

SECTION 275000

DISTRIBUTED COMMUNICATION SYSTEM

(THIS SECTION TO BE INCLUDED IN SUB-BID FOR SECTION 260001 - ELECTRICAL)

PART 1 GENERAL

1.00 SUB-SUB-BID REQUIREMENTS

A. Filed Sub-Sub Bids:

1. Sub-sub-bid requiring a paragraph “E” listing on the form for sub-bid required per M.G.L. Chapter 149 Section 44A, as amended to date. The Electrical Sub-Contractor shall be responsible for all related building preparation and coordination required. See specification for additional Paragraph “E” listing requirements of the listed contractor, and coordination of responsibilities. Failure to meet or exceed the requirements of the Contractor, as detailed in this specification, shall be grounds to reject the applicable bidder.
2. It is the sole intent of this Paragraph "E" listing to ensure to the end-user, single source responsibility from a single qualified Distributed Communication System Installer listed as the Paragraph “E” sub-subbidder for this Class of Work.
3. The Paragraph ”E” sub-subbidder listed shall not sub-contract any portion of this specification.
4. The Distributed Communication System Installer shall be DCAM Certified by the State of Massachusetts Division of Capital Asset Management in the Category of TELECOMMUNICATION SYSTEMS.

B. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this Section.

B. Examine all Project Specifications and Drawings for requirements which affect this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with all trades affecting or affected by work of this Section. Cooperate with such trades to assure a steady progress of all work under Contract.

1.02. SUMMARY OF WORK

A. This Section includes, but is not limited to the following:

1. Public Address and Clock system per School for a total of two systems that function independently but have the ability to function as a single system as required. Equipment shall include but not limited to:

a. Central Control Unit and Server

b. Admin Console

c. PC Based GUI

d. Amplifiers and other components

e. Speakers

f. Integration with VoIP telephone system

g. Master and Secondary Clocks

h. System Cabling

B. Commissioning of Installed Systems

C. Work to be done under this SECTION is shown on the Electrical Drawings.

D. Work to be done under this SECTION shall be performed by the Paragraph E sub-subbidder meeting the requirements of this SECTION and listed on the Bid Form for this Class of Work, and referred to as the Distributed Communication System Installer herein.

E. The work of this section includes materials and submittal requirements for fulfillment of Project LEED-S Certification.

1.03 RELATED WORK IN OTHER SECTIONS

A. Coordinate work with that of all other trades affecting or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the contract.

B. Workboxes required to support technology devices, back boxes, floor boxes, conduits, sleeves, cable tray, corridor cable support, grounding systems, and fire safing are per SECTION 260001 – ELECTRICAL.

C. Blocking for attaching Communication Systems Components: SECTION 061000 -ROUGH CARPENTRY

D. SECTION 090003 – ACOUSTICAL TILE

E. SECTION 270100 - STRUCTURED CABLING SYSTEM

F. SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

1.04 TECHNICAL REFERENCES

A. The product specifications, design considerations, and installation guidelines provided in this document are in part derived from recommendations found in recognized telecommunications industry standards. In cases where product specifications, design considerations, and installation guidelines provided in this document are in conflict with the references listed below, the more stringent requirements shall apply. The bidder is responsible for determining and referencing the most recent releases of all specifications during bidding and installation. Design, manufacture, test, and install Distributed Communication System per manufacturer's requirements and in accordance with NFPA 70 (National Electric Code), state codes, local codes, Underwriters Laboratories (U.L.), requirements of authorities having jurisdiction, ADA requirements, and the following specifications:

1. TIA-526-7 (OFSTP-7)-2002+A1:2008, *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*.
2. TIA-526-14-B-2010 (OFSTP-14), *Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 Edition 2, Fibre-Optic Communications Subsystem Test Procedure- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement*.
3. ANSI/TIA-568-C.0–2009+A1:2010+A2:2012, *Generic Telecommunications Cabling for Customer Premises.*
4. ANSI/TIA-568-C.1–2009+A1:2012, *Commercial Building Telecommunications Cabling Standard.*
5. ANSI/TIA-568-C.2–2009+A1:2010, *Balanced Twisted-Pair Telecommunications Cabling and Components Standard.*
6. ANSI/TIA-568-C.3–2009+A1:2011, *Optical Fiber Cabling Components Standard.*
7. ANSI/TIA-568-C.4–2011, *Broadband Coaxial Cabling and Components Standard.*
8. ANSI/TIA-569-C–2012, *Telecommunications Pathways and Spaces.*
9. Building Industries Consulting Services International (BICSI) *Telecommunications Distribution Methods Manual* (TDMM)
10. BICSI *Information Transport Systems Installation Manual (ITSIM)*
11. ISO/IEC 18010, *Pathways and Spaces for Customer Premises Cabling*
12. TIA-942-A-1, *Telecommunications Infrastructure Standard for Data Centers*
13. ANSI-J-STD-607-A, *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*
14. ISO/IEC 11801, *Information Technology – Generic cabling for Customer Premises*

15. TIA-862, *Building Automation Systems Cabling Standard for Commercial Buildings*

16. ISO/IEC 14763, *Implementation and Operation of Customer Premises Cabling*

17. TIA/EIA-606-A, *Administration Standard for Commercial Telecommunications Infrastructure*

18. EE Standard 802.3an – *10GBASE-T* over copper twisted pair cable

19. National Electric Code (NEC)

20. Massachusetts Electric Code

21. All relevant American National Standards Institute (ANSI) Committee

B. In cases where product specifications, design considerations, and installation guidelines provided in this document are in conflict with the references listed above, the more stringent requirements shall apply. All references listed above were current during development of this publication. The bidder is responsible for referencing to the most recent releases when developing bid proposals.

C. This document does not take precedence over any code, either partially or wholly.

1.05 SUBMITTALS

A. Refer also to Section 013300 SUBMITTALS

B. General: Submit shop drawings, samples, and related submittals all together, at the same time, for coordinated review. Isolated items submitted will not be reviewed until all items have been submitted for review.

C. Equipment List: Provide a detailed Equipment List showing quantities by manufacturer and model number of all major items of equipment and installation material to be used in the system as specified herein.

D. Product Data: Include complete sets of indexed cut sheets, in quantity as dictated by the project, of all major pieces of equipment, cable and connectors being supplied. Arrange these sheets in the order the equipment appears in the Specification. Clearly highlight information showing compliance with this and/or all applicable Specifications. In the event that the manufacturer or representatives' cut sheet contains more than one item, clearly indicate which items of the cut sheet are intended for installation.

E. Firestop: Include cut sheets on all firestopping materials.

F. Shop Drawings: Submit a set of complete Shop Drawings, by system, showing equipment to be installed, including but not limited to:

1. System configuration block diagrams of all equipment, indicating equipment type and model numbers. Show each and every component, system and subsystem, as well as all proposed connections between system components, and cable types connecting components.
2. Proposed layouts and elevations of equipment racks.
3. Provide scaled room layout drawings of all tel/data closets showing rack positions in relation to all other equipment.

G. Provide a plan for labeling of all cabling. Meet with the Owner prior to submittal to coordinate Owner requirements and reflect on the plan.

H. Quality Assurance Submittals:

1. Include certification from the manufacturer that the Distributed Communication System Installer is qualified to install systems as specified in accordance with the specific requirements set forth herein.
2. Include names, qualifications, and certifications of installation personnel including Distributed Communication System Installer's site Supervisor/Foreman who shall be in charge of, and responsible for, all activities at the job site for the duration of the Project. The job Supervisor/Foreman shall not be changed during the Project without notification and approval from the Owner.
3. Complete warranty information including sample Registration Certificate.

I. Close-Out Submittals:

1. Communication System Technical Manual: Submit for approval a draft of the complete Technical Manual at least two weeks prior to the time of final system check out. When the final drafts are approved, provide five (5) copies of detailed technical manuals. The manuals shall include the following:
    a. Table of contents.
    b. Distributed Communication System Installer’s Name; contact name; address, telephone number, fax number, and email address.
    c. Manufacturer's Registration Certificate of Warranty for Distributed Communication System.

d. Product Information: Include original copies of manufacturer's installation and operating instructions, and service manuals, arranged alphabetically. All service manuals shall be originals; there shall be no Xerox copies of the service manuals and schematic supplied. Warranty information shall be filled out in the Owner's name.

e. Detailed Description of the complete system and all subsystems.

f. Maintenance Documentation: Include the following:

1) Information necessary to perform routine and corrective maintenance by the Owner's technical staff, or other qualified technicians.

g. List of all equipment by manufacturer, model or part number, and serial number.

h. List of spare parts.

2. Submit written certifications that the installation conforms to Specification and Manufacture's recommended installation practices, and is complete and operable, and ready for approval by the Architect.

3. Technical Diagrams and Drawings:

a. Simplified single line block diagrams showing the interconnection of all equipment and functional relationships for all systems specified. Show all equipment, patch panels, cables and jacks, and other components. whether connected or not. These drawings shall be on Engineering size E, 30" x 42" sheets. The intent of these diagrams is to provide sufficient clear and complete information that a technician of average skill may efficiently troubleshoot and service the system, even if unfamiliar with the installation.

b. Provide "As Built" architectural quality plan drawings at 1/8-in = 1-ft scale showing data jack locations and numbers. These drawings shall be on Engineering size E, 30" x 42" sheets. Also provide all plans on CD in AutoCAD 2016 .dwg format or later.

c. All technical diagrams and drawings shall be mounted on the wall behind a clear plastic cover for protection. There shall be one set of the above drawings and diagrams provided for the Main Distribution Room (MDF).

J. Sustainability Requirements:

1. The work of this section includes LEEDv4 materials and submittal requirements. LEED v4 requirements for the work of this Section are detailed in Division I of the Project Manual

2. All Sealing, Caulking, and fire proofing materials shall meet or exceed the current LEED v4 VOC requirements.

1.06 QUALITY ASSURANCE

A. Distributed Communication System Product Requirements: The products that shall best support the needs of the project, and provide the highest level of system performance over the life of the facility, shall be a system that is made up of system components designed, manufactured and installed as a total system solution. Therefore, it is the intent of the Specification that one manufacturer, not a combination of different manufacturer's components, be selected for the Distributed Communication System specified to ensure that the final system performance and warranty are the responsibility of a single manufacturer.

B. The onsite Job Supervisor/Foreman shall have at least five (5) years' experience in designing, installing, and testing systems specified as described herein. The onsite Job Supervisor/Foreman shall carry an active cellular telephone or other two-way device, so that he/she may be reached when circumstances require. Additionally:

1. The Distributed Communication System Installer shall own and maintain tools and equipment necessary for successful installation and testing of all systems specified.
2. The Distributed Communication System Installer shall have personnel who are adequately trained and certified by the Manufacturers providing final system warranties.
3. The Distributed Communication System Installer (Paragraph "E" listed sub-subbidder) shall be a factory authorized installer of all systems specified and shall hold certifications from the Manufacturer who is providing the final System Warranty and Performance Assurance.

C. Installation Procedures: Adhere to the engineering, installation and testing procedures of the Manufacturer of the components specified, and use only the cabling, components and methods of provisioning the Project authorized by the Manufacturer.

1.07 DELIVERIES, STORAGE AND HANDLING

A. Perform all tasks necessary to properly coordinate with all involved parties/trades for: Shipment, arrivals, loading dock, elevators (as applicable), acceptance, storage, and security of equipment and materials. Do not, during these tasks, interfere with other trades or the progress of this Project.

B. Assure that all deliveries are in correct quantities, within the appropriate times, and in compliance with all manufacturers' shipping instructions.

C. Protect all materials according to manufacturer's Specifications and/or instructions.

1.08 SYSTEM WARRANTY, SERVICE AGREEMENT AND PERFORMANCE ASSURANCE

A. Warranty all systems to be free of faulty workmanship and defects, and from damage due to contamination from the site for a period of five years from the date of final project completion.

B. The Warranties required by this section shall not be diminished by other warranties in the Contract Documents, equipment manufacturer's warranties, and all other rights and remedies available to the Owner under this Contract and public law. In addition, this Warranty shall not diminish the terms of individual manufacturer's warranties.

C. The Warranties required by this section shall be for the benefit of the Owner to whom Registration Certificate is issued and any successor in interest to the site.

D. Any repair or replacement of Cabling or Equipment resulting from this warranty will be warranted for either (a) 90 days or (b) the remainder of the original warranty period, whichever is longer.

E. Service Agreement: The Distributed Communication System Installer shall respond to all requests for service during the warranty period. During this period, the Distributed Communication System Installer shall replace defective material and repair items of faulty workmanship at no charge to the Owner. All requests for service shall be responded to by telephone within two business hours, and technicians shall be dispatched within twenty-four hours. Only certified technicians shall be dispatched.

1.09 TRAINING OF OWNER'S PERSONNEL

A. Conduct a Training Program for the Owner's staff. The Training Program shall include a demonstration of the configuration of all components of the Distributed Communication System. Training Program shall include two one hour sessions. Schedule the Training Program at the convenience of the Owner, after the Technical Manual has been submitted and approved. All materials in the Technical Manual shall be reviewed during the training program. All training sessions shall be videotaped with five copies provided to the Owner with closeout submittals.

1.10 EXTRA INSTALLATION PROVISIONS, MATERIALS AND SPARE PARTS

A. Furnish the following Attic Stock or Spare Parts to the Owner at the conclusion of the project. Spare parts shall be delivered to the Owner with closeout documentation submittals.

1. Provide three spare Call Buttons; three Clocks, and; 3 Speakers of each type specified.

PART 2 PRODUCTS

2.01 GENERAL

A. It is the intent of the Specification that one manufacturer, not a combination, be selected for each particular class of material.

B. Distributed Communication System as specified, must be able to be serviced and supported after the initial installation and warranty period is complete by no less than 3 resellers authorized by the manufacturer in the State of Massachusetts to install, service and support the Distributed Communication System specified.

C. Certain equipment is listed by manufacturer and model number. This is to define and establish a level of quality and functionality. The words, "or equal", are understood to follow all names of these specified products, trade names, catalog numbers, and detailed descriptions. It shall be interpreted to apply to any material, article, assembly or system, which in the opinion of the Owner is at least equal in quality, durability, appearance, strength and design to the material specified, and shall perform at least equally the functions imposed by the general design. The words, "or equal", shall not be construed to permit departure from the detailed requirements of the Specification. The “or equal” provision of G.L. c.30, §39M(b) is hereby incorporated by reference.

D. All materials and equipment shall be new and unused.

E. All part numbers and manufacturers shall be according to this Specification unless otherwise noted on the construction Drawings.

F. Provide all mounting hardware, shelving, bracketing, bracing, support members, required to support all cabling and equipment specified.

G. Distributed Communication System as specified shall fully integrate with the Owner’s Voice over IP telephone system (to be specified and procured at a later date), so that paging can be initiated from any Voice Communication System handset anywhere in the building.

2.02 DISTRIBUTED COMMUNICATION SYSTEM

A. The system specified is based on the Telecor eSeries Supervised Network based Communications System or approved equal from Valcom or Bogen, providing at least the features and functions outlined below.

B. The system shall utilize a decentralized network structure not requiring any head-end equipment, central server, or any other control hardware to maintain system operation. Systems utilizing centralized electronics and subject to a single-point-of-failure (power supply, CPU, server, or other components) shall not be accepted unless the system has 100% duplication of all centralized operating equipment running concurrently and can automatically take over, including up to the minute programming configuration in the event of a failure of the main system head-end electronics or any required, centralized electronics required to make the system fully operational. Systems that are not based on decentralized structure or systems that do not provide 100% duplication of head-end or

systems that operate in a “down-graded” operational mode as the result of a centralized failure are not acceptable.

C. Speech shall be transmitted in the frequency range from 50 Hz to 7 kHz and shall use a maximum of 128 kbps of bandwidth during a call. In order to assure maximum intelligibility, all system audio shall be HD Audio.

D. Intercom communications between consoles and system devices shall be non-blocking with no channel restrictions or limitations (other than network capacity) to the number of simultaneous conversations at any time between pairs of intercom stations, intercom station to console, console to console, console to speaker or zone of speakers, program source to a speaker or zone of speakers, or bell tones to a speaker or zone of speakers regardless of number of stations or consoles.

E. Audio communications between all devices shall be accomplished with latency values of a maximum of 0.1 seconds and connection times of 0.01s for 1 to 500 speakers.

F. The system shall support a minimum of 50 channels of simultaneous duplex communication paths on the intercom system LAN, plus a minimum of 10 simultaneous duplex channels for PBX integration.

G. The system shall be capable of interconnecting with the building LAN (Local Area Network). This connection shall be minimal and utilize only one Ethernet 100 Mbps (or optionally 1 Gb) connection per station to accomplish all intercom operations. Ethernet ports and associated network equipment is required to be included as part of the complete system. Rack Mounted UPS equipment shall be provided by the Owner.

H. The System shall be a hybrid IP based system utilizing analog end devices for speakers, clocks, and call switches.

I. Supervised Network Administrative Control Console:

1. The Supervised Network Administrative Control Console (subsequently referred to as Console) shall be a Telecor model e300 or approved equal. The Console shall be supervised and allow the operator to establish two-way communications with an intercom station, talkback speaker, or another Console using the handset or speakerphone. VOX functioning shall be automatically enabled when the handset is used. The Push-to-Talk button shall toggle the Console between talk and listen mode when the speakerphone is used. The Console shall provide a two line by 20-character LCD display. The display shall be able to be tilted at different angles for optimum viewing. When there are no active calls, the display shall show the Console name and dial number. If a time server is connected to the network, the display shall also show the time and date.

2. Incoming calls to a Console shall show the originating station dial number and name on the Console display. Calls shall be displayed in the order they are received. The operator shall be able to scroll through the list of calls and answer them out of sequence. Emergency call-ins shall be distinctly annunciated both visually and audibly.

3. The Console shall allow call-ins to be forwarded to another Console, or for calls to be put on hold or transferred to another Console location. Additionally, call-ins or calls shall be forward/transfer-able to PBX telephone extensions via a SIP trunk interface.

4. The Console shall be able to select remote audio sources connected at any location on the local area network, and distribute the audio broadcast from the source to all speakers in a facility or to selected areas such as a speaker zone or a selection of speakers. The Console shall be capable of audio source verification by attendant prior to page zone activation. In this manner attendants shall be able to listen to the audio source locally, including listening to pre-recorded announcements, prior to system broadcast.

5. The Console shall be able select a tone or a pre-recorded announcement and broadcast the tone or announcement to all facility speakers or to select areas, such as a speaker zone or a selection of speakers.

6. The Console shall be equipped with digital volume control that shall allow for the separate adjustment of the speaker listen and handset listen volumes. The levels for intercom listen, tones, and program distributions shall be independently adjusted and stored in memory.

7. The system shall allow user programming of alphanumeric architectural room names and numbers. The Console shall be capable of using 1 to 7 digit sequences for dial out and call-in identification, and shall display station numbering, station name, and call-in priority.

8. The end-user shall be allowed to choose and determine the number and location of Consoles. The end-user shall not be limited by pre-set manufacturer limitations of the number of Consoles required by this project; allowing for unrestricted future expansion. Consoles may be added at any time. Consoles added by the end-user that exceed the engineered design for this project shall be at owner's expense. Communication between consoles or consoles and intercom stations or rooms shall not be inhibited by channel number restrictions.

9. The Console shall be capable of displaying room statuses such as Privacy and Do Not Disturb and shall have the ability to override any status limiting communication between the Console and a station with Privacy or Do Not Disturb status activated. Temporary override shall not interfere with continued activation of Privacy and Do Not Disturb after communication has been established and electively terminated.

I. Supervised Network Amplifiers:

1. The Supervised Network Amplifier (subsequently referred to as Network Amplifier) shall provide a minimum of 25 watts for paging and public address and shall be capable of utilizing analog amplifiers to increase the amount of amplified signal from the network amplifier. The Network Amplifier shall be connected directly to the network switch by an RJ45 connector and shall receive signals directly from the network.
2. The Network Amplifier shall be supervised and in the event that network communications is lost, an audible alert shall sound on the Amplifier. The Network Amplifier shall provide a silence feature to mute the audible alert for 24 hours.
3. The Network Amplifier shall also be capable of receiving local input from local devices such as tape decks, iPod docks, CD players, or other audio source equipment. The network amplifier shall be capable of transmitting signals received from the local input to other network locations or locally to directly connected 25/70 volt or 8-ohm analog speakers.
4. Each Network Amplifier shall be capable of providing two audio inputs for local devices and shall be programmable as either a microphone or line-level input.
5. The Network Amplifier shall be controlled remotely such that audio programs, input, tones, textual messages, or announcements may be initiated by other devices connected at different locations on the local area network.
6. The Network Amplifier shall have a minimum of 4 local tone/pre-recorded announcement audio message control lines which when activated will distribute tones/pre-recorded audio messages to intended network amplifiers for re-distribution, network talk-back speakers (or a zone), and/or local 25/70 volt or 8-ohm analog speakers directly connected to amplifier. Each network amplifier shall be capable of storing four (4) pre-recorded announcements in addition to a minimum of 16 tones. Tones and announcements shall be activated locally or from other network devices.
7. The Network Amplifier shall store and transmit companion textual messages for each stored audio announcements. Textual messages shall be automatically broadcasted to the same zones along with the audio messages such that any device programmed for that zone automatically receives both the audio and textual announcement/message and automatically reproduced each or both messages to the extent of the devices' capabilities.
8. The Network Amplifier shall be capable of transmitting HD level audio as defined by Intel(TM) High Definition Audio specification dated June 17th, 2010 at a minimum.

9. The Network Amplifier shall shut down to protect itself should an output short circuit fault or overload occur that jeopardizes the integrity of the Network Amplifier.

J. Supervised SIP Trunk IP/PBX Interface:

1. The system Session Internet Protocol (SIP) Interface shall be a VoIP PBX phone interface of the same manufacturer as the supervised network intercom and paging system. Third party gateway devices shall not be accepted.

2. The SIP Interface shall be supervised and shall connected directly to the facilities network and the PBX's network and shall provide the following:

   a. Establish a barrier gateway between the intercom and paging network and the PBX and/or common computer network.

   b. Transparent audio operation between VoIP PBX phones and any device on the supervised network intercom and paging system. Paging access from any telephone on the facility system VoIP PBX to any intercom speaker, speaker zone, intercom station, console, all speakers, or paging horns and zones throughout the facility.

   c. Any call-in from the supervised network intercom and paging system shall be capable of being routed directly to a VoIP PBX phone. Call-in stations can be configured and programmed to automatically dial any number on the publicly switched telephone network, landline, or cellular number through the SIP interface and via the PBX.

   d. Ability to escalate a call-in directed to a console to be redirected to a VoIP PBX connected phone via the SIP Interface. Escalation can also include the ability to dial any number on the publicly switched telephone network, landline, or cellular number through the SIP interface via the PBX.

   e. Ability to initiate alarm and crisis response protocols from any VoIP PBX connected phone.

   f. Ability to require security access code to utilize the intercom or paging system emergency communication features.

   g. Minimum of 10 simultaneous telephone channels of access to/from VoIP PBX phone system.

   h. Full caller ID support from any supervised network intercom call-in device to a VoIP PBX connected phone identifying the calling station ID/Location.

   i. Emergency level call-in to be uniquely identified as emergency on the VoIP PBX phones.

j. Activation of all supervised networked intercom and paging system emergency tones and pre-recorded announcements from any phone connected to the building VoIP PBX phone system.

k. The SIP Interface shall additionally allow for calls to be placed from a console to any phone number on the publicly switched telephone network (landline or cellular). Additionally, intercom calls at a console may be transferred to any number on the publicly switched telephone network to any landline or cellular number through the SIP interface via the PBX. Systems that connect to a building or district phone system and are limited to a SLT or CO connection will not be accepted as a substitute for a fully operational SIP Interface.

K. Ethernet Termination Unit:

1. The eTBU-MI Ethernet Termination Unit allows industry standard 25/70V intercom speakers and call switches to be added to an eSeries network. Since room station locations use a radially cabled design, the eTBU-MI allows these locations to be added to the eSeries network by providing termination for up to 25 locations equipped with call stations, clocks, and speakers. Each location is represented consistently with eSeries end-point devices, allowing them to initiate or be targeted by eSeries operations such as calls, call-ins, pages, and audio distributions

2. The eTBU-MI is equipped with an integrated 25-watt, dual-purpose intercom/paging amplifier. It provides amplification for two-way intercom communications to call devices and amplification for paging and audio programs to speaker devices. If the paging audio load is greater than 25 watts, a line level output provides for the connection of an external power amplifier.

3. The eTBU-MI supports multiple CS5 call-in devices with LED call assurance and privacy or do-not-disturb indication for each room. All of this is supported on a single CAT6 twisted pair (in addition to the speaker pair). Each room location can be configured to place call-ins to different destinations and with Normal or Emergency priority levels. If the call-in destination of these devices is an e300 eConsole or an IP-PBX phone extension, the device display indicates the calling room location dial number, a textual room name, and the priority level of the call-in. Room locations can be configured with a primary, secondary, and back-up call-in destinations. Emergency priority call-ins placed from a room location can be configured with a different call-in destination. Consistent with the ANSI/NEMA SB 40-2008 Communications Systems for Life Safety in Schools standard, the eTBU-MI allows the establishment of multiple call-in locations per room (via a separate emergency station) without the investment in additional wiring infrastructure.

L. Cat 6 Patch Panel:

1. The panel provides termination facilities for 25 classrooms, utilizing a single CAT-6 cable per classroom location.

2. The panel simplifies cable management by providing both cable termination and signal distribution facilities for classroom wiring. The panel contains circuitry to minimize noise, capacitive coupling, and crosstalk from clock data and 24-volt clock power. This enables a single CAT-6 cable to be used to distribute intercom audio to classroom speakers as well as support call in signaling from call switches and provide signaling for synchronization and correction of digital and analog secondary classroom clocks. The panel can also supply 24 volts to power classroom clocks on the same CAT-6 cable.

M. Ethernet 25 Watt Amplifier:

1. The eAMP is a 25-watt amplifier that adds paging and public address capabilities to the eSeries Intercom System. It is designed to receive audio signals from either the eSeries network or a local input and broadcast them over conventional speakers and/or back into the eSeries network for broadcast to other eSeries devices. It also has the ability to store and play pre-recorded announcements or tones to its speakers or over other eSeries devices connected to the network. Each eAMP is intended to provide one zone of paging. For larger applications, multiple eAMPs can work co-operatively on the network to support a comprehensive zone paging system.

N. Speaker Breakout Module:

1. The eSeries eSBM-TB Speaker Breakout Module provides the means of integrating speakers and call initiating devices to the eSeries System. The module is also a Single Zone Paging Adapter that can drive an amplifier to provide paging coverage in a facility. The eSBM-TB features three relay outputs that can activate automatically during a call processing operation.
2. The eSBM-TB uses Power-over-Ethernet technology, Just Plug It In!™ design, and a decentralized network structure to ensure easy wiring and simplified network planning. The use of Power-over-Ethernet technology allows the eSBM-TB to be plugged into a PoE network switch to supply both power and data.
3. The eSBM-TB is suitable for a variety of audio applications. It can connected to conventional 8Ω/25V/70V speakers to provide paging and talkback operation from eSeries e300 eConsoles or phones via an eSIP and an IP-PBX.

O. Horn Speakers:

1. Reentrant type: flush mount installation.
2. Frequency Response: 600 to 14,000 Hz.
3. Power Handling: 15 Watts RMS, 30 Watts Peak.
4. Variable screw taps, 25 V transformer.
5. Sound Pressure Level: 110 dB at 1 meter with 1-watt input.

6. Color: Coordinate with Architect.

7. Atlas/Sound APF-15T Horn Speaker with 193-8 backbox and VP161-APF Speaker Baffle or approved equal.

P. Ceiling/Wall Mounted Loudspeakers

1. Type: Speakers in corridors and general spaces shall be flush mounted cone speakers.

2. Frequency Response: 50 to 18,000 Cycles.

3. Magnet: 10 Ounce.

4. Axial Sensitivity: 97 dB at 1 meter with 1-watt input.

5. For Corridors and General Spaces: Atlas/Sound SD72W 8" Loudspeaker with LT-72 25/70.7 volt transformer, 62-8 steel speaker baffle and EZ95-8 backboxes and T-bars or approved equal. For locations requiring speakers with volume control, substitute speaker SD72WV for SD72W. Wall mounted speakers shall be flush mounted.

6. For Classrooms: Atlas/Sound SD72W (or Telecor STB-10) configured as talkback speaker. NOTE: All rooms and/or spaces indicated on the plans to be equipped with a Distributed Communication System Call Button shall also be equipped with a talk back speaker.

7. In exposed ceiling areas (No acoustical ceiling tiles) provide surface mounted baffle and enclosure. Surface mounted raceway to accessible ceiling by Division 26.

Q. Call Button shall be single gang faceplate with button or toggle switch that utilize a momentary contract touchpoint to initiate a “normal” priority level call from a remote location. A call assurance LED on the plate should provide confirmation that the call has been made and the light shall go off after it is answered by the main office console operator. Telecor CS5-6-MA or approved equal.

R. Microphone for general announcements shall be Shure 588SDX hand held microphone with an S39A table stand and A25C stand adapter or approved equal. Contractor shall use XLR Switchcraft A3F type connectors and West Penn 2529 cable or approved equal between the front office location and the Public Address microphone interfaces.

S. Provide all cabling as recommended by the manufacturer. All cabling shall be plenum rated. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

T. Unspecified Equipment and Material. Any item of equipment or material not specifically addressed on the Drawings or in this Document and necessary to provide a complete and functional installations shall be provided in a level of quality consistent with other specified items.

U. Provided network switches, patch panels, patch cords, and other equipment for a complete Distributed Communication System. Network Switches shall be Aruba 2930F switches consistent with switches being provided by the Owner to support their Local Area Network.

V. System shall incorporate a Telecor Media Source (TMS) unit that has the capability of playing audio content over the Distributed Communication System from one of three different sources. System shall be a single 19" rack mount unit that includes a CD player, Media Player with USB and SD/MMC memory card input, and an AM/FM Tuner. MP3 files shall be able to be played from the CD player, USB memory stick, or SD/MMC memory card.

W. System shall incorporate an integrated Master Clock and messaging system (eMH), which shall provide the capability to schedule and manage events. It shall incorporate a browser-based GUI interface that allow users to connect and manage school schedules from anywhere using a PC, smart phone or tablet device. Customizable tones and pre-recorded audio files shall be activated automatically by schedules and or emergency conditions and be broadcast over the Distributed Communication System automatically. Multiple schedules for the Middle School and High School shall be simultaneously active.

2.03 INTEGRATED MASTER AND SECONDARY CLOCK SYSTEM

A. The System shall provide "State of the Art" in Technology for Master Clock and Secondary Clocks, so that they form as an integrated system together and with the Public Address System. Time programming shall be accomplished by way of a microprocessor-based and user-programmable master control system. The system shall be easy to learn and operate. All standard system programming shall be user friendly to allow the system administrator the ability to easily reprogram system features. Features offered by this system shall be implemented and controlled by software programs that can be changed and expanded as customer needs evolve. The Master Clock shall use an integrated master controller capable of operating and correcting both digital and analog secondary clocks as well as controlling class change signals to all speakers. The Master Clock systems shall provide the necessary signals to assure synchronization of all Secondary Clocks. The Public Address System and Master Clock System shall be fully integrated.

B. The Master Clock shall be a Telecor model 2400-IP or approved equal from Sapling, Bogen or Valcom. The Master Clock is designed to function as a central timekeeping, event scheduling, and relay control device. When used with the eSeries system, the Master Clock can be programmed to activate bells, sound tones, or activate other devices according to the Master Clock schedules. It can also be used to synchronize and correct synchronous movement analog clocks. Features of the Master Clock include:

1. LED display of current time in HH:MM
2. Any call-in.
3. Two-line, 20 character, backlit LCD display
4. Programmable from the front panel pushbutton keyboard

5. (S)NTP input capability
6. Up to 10 pre-programmed server addresses for continuous synchronization
7. DHCP capable
8. 12 or 24 hour format
9. Automatic bi-annual day lights saving time adjustment
10. Web interface
11. SMA settings IGUI configurable via web browser
12. Minimum 4 aux relays for activation of timed events
13. Control of all IP settings
14. View complete list of events and schedules over web browser
15. Minimum 800 event capability
16. Compatible with synchronous wired secondary clocks

B. Battery back-up for non-volatile memory and timekeeping. The Master Clock comes standard with (S)NTP capability for synchronization to any (S)NTP web site or Network Time Protocol (NTP) time server. Up to 10 server addresses can be pre-programmed into the Master Clock for this purpose. It also encompasses a fully functional web interface for controlling the Master Clock from any computer on a network or via a crossover cable. The Master Clock can also distribute time via (S)NTP protocol over the facilities network

C. The Master Clock is fully equipped with an LED readout displaying the current time. Event programming is easy with the 2X8 rubber tactile keypad and the backlit two line LCD display. A minimum of 800 events and 250 schedules can be programmed into the master clock. Events can be assigned to any of four relay zones (expandable to 8) for activation of time tones, bells, and other signals.

D. Master Clock shall be able to receive time from both an NP server and GPS receiver on a continuous basis, and continuously synchronize with the Analog secondary clocks. The master clock shall have a GPS receiver and antenna hardware and software to allow the master clock to receive UTC data from GPS satellites.

E. The master clock shall also be configured to receive time from the an NTP server over the internet and have the capability to distribute time via SNTP protocol over the network so that IP devices on the network will be able to acquire SNTP time data from the master clock if required.

F. The Master Clock shall have the ability to control two or three wire analog and digital secondary clocks.

G. Secondary Clocks:

1. The secondary clock shall be 12” Sapling SAM Series round clock with automatic protocol detection. 16” Sapling SAM Series Round for Gymnasium clocks. The clock shall have plug and play features with no settings required.
2. The clock shall have self–diagnostic capabilities for protocol detection, last received communication time and a comprehensive analysis of the entire clock. The clock shall be capable of having remote diagnostic capabilities from the master clock location.
3. The clock shall have automatic polarity detection, as well as a maximum correction time of five minutes.
4. The clock shall be designed to be used in a two-wire system Master Clock System, which can regulate it by digital communication protocol. Upon receipt of the digital signal, the clock shall immediately self–correct.
5. The secondary clock shall have the ability to accept sync–wire communication protocols with hourly and daily correction.
6. The secondary clock is to have a microprocessor based movement.
7. The clock shall have a low–profile, semi–flush smooth surface metal case. The crystal shall be shatterproof polycarbonate material. Glass and visible molding marks are unacceptable.
8. The clocks shall be able to be mounted to a standard single gang box.
9. The clock is to have black hour and minute hands, as well as a red second hand, standard dial,
10. The clocks shall have UL, cUL and FCC compliance.
11. Provide wireguard for Clocks in Gymnasium.
12. Provide all cabling as recommended by the manufacturer. All cabling shall be plenum rated.
13. Type and Quantity of Secondary Clocks and backboxes are per the Technology Drawings.

H. Provide all equipment, wiring, accessories required for the installation of a complete and operating system in accordance with applicable local, state and national codes, the manufacturers' recommendations, drawings and specifications.

I. Cabling as specified by manufacturer.

2.04 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. A UPS shall be provided for all Public Address/Master Clock System main equipment, ensuring complete system capabilities during power failures, outages, and surges. Once power is restored, the Master Clock shall instantaneously update all clocks with the correct time.

B. UPS shall be rack-mountable and provide a minimum of 1 hour of battery back-up in the event of a power failure to all main equipment.

C. UPS shall be manufactured by American Power Conversion of approved equal and contain all necessary hardware for a complete installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to commencing Work of this Section or ordering equipment, examine site and conditions under which work shall be performed. Determine exact locations of items shown diagrammatically on Drawings. Determine dimensions needed to install components, move in racks and any custom items. Notify the Architect of any conflicts or special requirements needed to provide for free access to doorways, corridors, stairs, and similar areas, required to move in the specified equipment. If the Distributed Communication System Installer fails to provide such notification, any additional cost to remove and reinstall any building members will be back charged to the Systems Installer.

B. Electrical Drawings designate component locations. Install quantity and type according to the Technology Outlet Plans and as specified herein. Provide all required adapters and/or accessories for a complete installation in all raceways, and other locations.

C. Commencement of Work of this Section indicates acceptance of existing site conditions.

3.02 WORKMANSHIP

A. System shall be installed in a neat, workmanlike manner. Workboxes, equipment, and enclosures are to be plumb and square. Install the system elements in cooperation with all trades to achieve coordinated progress and desired results. Watch for conflicts with Work being performed by other trades that have impact on the installation of the system components. Make moderate moves or changes in equipment locations as are necessary to accommodate other equipment as directed by the Architect, without a claim for additional payment.

3.03 GENERAL INSTALLATION

A. Pre-installation: Meet with the General Contractor, Project manager, and any other appropriate parties for coordination meeting prior to beginning work and to coordinate requirements.

B. Coordinate Work with adjacent Work of other trades to facilitate installation and prevent conflicts.

C. Staff job appropriately to keep pace with the Project schedule.

D. Abide by the decision of the Architect to case of conflict or interference of the other trades.

E. Work under this Section shall be performed in accordance with associated local, state, and national building codes.

F. Coordinate requirements of ceiling and floor mounted outlets with the Electrical Contractor.

G. Coordinate the type of back boxes and conduit requirements and associated hardware with Electrical Contractor to ensure compatibility with devices to be installed as part of this Section.

H. In the event that the Distributed Communication System must re-enter an area of a previously completed phase of Work, the Installer shall be responsible for returning that area back to the condition it was in before the Installer re-entered the area. This includes re-installing ceiling tiles, cover plates, and cleaning walls and floors as required. Coordinate the cutting and patching of holes with the General Contractor, and comply with the Cutting and Patching Section.

I. Every effort shall be made to schedule the Work under this Specification in such a manner so as to complete all above ceiling Work prior to ceiling panel installation. In the event that the Distributed Communication Systems Installer is required to remove ceiling panels, such Work shall not break or disturb the existing ceiling grid or panels and shall be coordinated with the General Contractor and Ceiling Contractor.

J. The Distributed Communication System Installer is responsible for furnishing and installing cross-connections between the riser and station cabling required for a fully functional system.

K. Spare pull strings shall be left in all EMT, Conduits, and Innerduct.

L. Distributed Communication System Installer shall furnish and install all mounting hardware, shelving, bracketing, bracing, and support members, as may be required to ensure that all equipment and cabling is properly installed and supported according to the manufacturer's recommendations.

M. Take precautions as necessary to prevent and guard against electromagnetic and electrostatic interference. Avoid potential sources of EMI in all aspects of installation. If interference is experienced, the Distributed Communication System Installer shall provide all required testing to identify the source of interference and provide a remedy including but not limited to re-routing and/or replacing cables.

N. Coordinate with provider of Owner's Voice over IP (VoIP) System, by others, and assist in providing connections required between the VoIP system and the Distributed Communication system so that pages can be seamlessly initiated and accomplished from any VoIP handset location in the school.

3.04 CABLE SUPPORTS AND ROUTING

A. Install all cabling shall be installed in accordance with the manufacturer's guidelines and according to all applicable building codes at the time of installation, including but not limited to the NEC and the ANSI/TIA/EIA Telecommunications Building Wiring Standards.

B. Route all cables in large groupings, through main hallways, until cable can be distributed directly to the communication Outlet. Route individual cables to the appropriate Outlet locations in accordance with all standards described herein.

C. Install cables in cable tray, Snake Tray, J-hooks, pipe and/or sleeves specified in this and other sections.

D. In suspended ceilings where cable trays or conduit are not available, and it is not possible to install corridor cable support, bundle cables in bundles of 50 or less, with Velcro cable tie wraps pulled snug, but not deforming the cable geometry. Support the cable bundles with approved "J" style hooks attached to the building structure at a maximum of three (3) foot intervals. J-Hooks shall not be used in lieu of the corridor cable support Snake Tray. Prior to installing J-Hooks, The Distributed Communication System Installer shall submit a Request For Information stating the location at which he/she requests to use J-Hooks, and justification why Snake Tray cannot be installed.

E. The Distributed Communication System Installer shall adhere to the manufacturers' requirements for bending radius and pulling tension of all communication cable.

F. Install cables in such a manner required to minimize tension and stress on cables, which can lead to changes in the physical and/or electrical characteristics of the cables over time. This applies to, but is not limited to, horizontal cable support methods, vertical cable support methods, tie wraps, or similar types of cable support methods.

G. Cables exiting floor conduits and sleeves shall be neatly dressed, and securely supported from the floor up to the ceiling so that the cables are not stressed or stretched by the weight of the cables. Cables shall be arranged in bundles of not more than 50 cables or less, and secured with Velcro cable tie wraps pulled snug, but not deforming the cable geometry. Acceptable support structures include, but are not limited to: Cable tray runway radius dropout, vertical ladder tray, J-hooks, unistrut, or similar types of support structures. The intent is that cables shall not be supported by the weight of the cables themselves, but are supported so that the weight of the cables is assumed by the support structure(s).

H. Route station cables at right angles to electrical power circuits and supported only from the building structure when not in cable tray or conduit.

I. Do not support cabling from ceiling tiles, grid or hanger wires.

J. Do not install random or diagonal cable runs. Cable turns and bends shall be made at 90 degrees angles whenever possible, but maintaining manufacturers' requirements for bending radius at all time.

K. In the MDF Room, a 10’ service loop for all cables shall be provided in the cable tray above racks. Service loops shall be installed in either a figure “8” or “U” Pattern. Service loops shall not be installed as tight circular coiled loops.

L. Cables which penetrate a steel stud or steel wall cap shall be protected from damage with a "stud liner".

M. Cables entering power poles, surface mounted raceway, or other cable management systems shall be protected from damage.

N. Extend cabling between floors utilizing inter-floor sleeves and conduit as shown.

O. Conduit and sleeves provided as a means of routing cables between various rooms and floors shall be used according to the following requirements: Install cabling through separate conduits and/or sleeves for each system. In each group of conduits and/or sleeves, one 4" conduit and/or sleeve shall remain empty as a spare conduit or sleeve for future cabling. It is imperative that the cables for each system remain separate from the other systems. Cables routed in violation of this requirement shall be pulled back and rerouted, even if already terminated, at no additional cost to the Owner.

P. Conduit and sleeves provided as a means of routing cables between various rooms and floors, and those which remain empty as spare, shall be sealed with an approved fireproof, removable safing material. Sleeves which pass vertically from floor to floor shall be sealed in a similar manner using an approved re-enterable system. Additional penetrations through rated assemblies necessary for passage of wiring shall be made using an approved method, coordinated with the General Contractor, and permanently sealed after installation of cables.

Q. Meet all requirements regarding use of cable in return air plenums and in raised floor systems. Provide wiring that complies with all applicable state, local building codes, and the National Electrical Code. All cables run in raised floor systems with forced air-cooling shall meet the requirements of NEC Article 645, "Electronic Computer Data Processing Equipment".

R. Cables installed partially or fully within the MDF Room shall be routed through and secured in the cable tray wherever possible. Cables placed in the cable tray are to be laced or tie wrapped with Velcro tie wraps frequently to keep them neatly bundled and not permitted to shift from one side of the tray to the other as they are routed in the tray.

S. Color of cable jacket for each system shall be unique and distinguishable from other system cabling

T. Cables routed in main corridors shall be installed in corridor cable support as specified in this Section. The Distributed Communication System Installer shall size and select the correct product so that no more than 75% of the manufacturer's loading capacity is achieved in any given corridor area. The installer shall use the manufacturers' recommended attachment hardware for hanging the corridor cable support. Corridor cable support shall be suspended from integrated mounting hardware every four (4) feet along the center spine.

3.05 CONDUITS, SLEEVES, CABLE TRAY AND WALL/FLOOR PENETRATIONS

A. Conduits, Sleeves, Cable Tray and Wall/Floor Penetrations between MDF and main corridors, and between main corridors and rooms shall be provided by Division 260001 for cabling under this section.

B. The Distributed Communication System Installer shall be responsible for coordinating room and/or space for cabling within all conduits, sleeves, cable tray and wall/floor penetrations provided by Division 260001.

C. Conduit sleeves between all main corridors and hallways into all rooms, offices, and spaces showing communications devices, and through all fire rated walls shall be provided by Division 260001.

3.06 FIRESTOPPING

A. Seal all horizontal and vertical openings between floors, through fire rated fire and smoke walls, used or created by the Distributed Communication System Installer.

B. Refer to Electrical Section, for all product requirements for maintaining integrity of fire-rated construction at penetrations.

3.07 LABELING

A. Clearly label and identify all components. Logically and permanently mark all cable, connectors and electronic equipment.

B. Use a letter quality printer or other mechanically produced lettering for labels.

C. Place permanent cable markers 3 inches from all connectors to allow easy identification. Use Brady Markers with clear plastic ends. Acceptable markers are, Brady B-320, B-292, SL-292, or Brady machine embossed labels with clear vinyl ends. Machine generated markers are required. Place cable markers on cables so that they can be easily seen.

D. Handwritten labels shall not be accepted, even if written with a permanent marker. Temporary handwritten labels may be used only during the “rough-in” stages; they must be replaced with permanent labels prior to Project completion.

3.08 BONDING AND GROUNDING

A. Bonding and grounding shall be in accordance with ANSI-J-STD-607, the NEC® and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunications equipment and test apparatus and equipment.

B. Telecommunications Bonding Backbone utilizing #6-AWG or larger bonding conductor shall be provided by Division 260001. This is part of the grounding and bonding infrastructure (part of the telecommunications pathways and spaces in the building structure), and is independent of equipment or cable.

C. For all systems, provide equipment grounding connections. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

D. For all systems, provide conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

E. For all systems, provide transient protection on the AC power feed and on station lines leaving or entering the building.

F. Note in the system Drawings, the type and location of these protection devices as well as all wiring information.

G. Furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground bus bar.

H. Provide any necessary screws, anchors, clamps, tie wraps, distribution rings, and miscellaneous grounding support hardware to complete the installation of the grounding system.

I. Grounding busbars shall be installed in the MDF Room and the Service Entrance Room by Division 260001.

J. All non-current carrying telecommunications components (passive) shall be bonded to the grounding busbar utilizing two-hole lugs for all bonding connections.

K. All grounding conductors shall be affixed with permanent labels in a visible location at each end of the conductor, and as close as practicable to the bonding point at each end of the conductor. The labels shall clearly identify both the source and destination of the bonding conductors. Handwritten labels are not acceptable.

3.11 TESTING

A. Test the proper functioning of all equipment items to ensure components meet manufacturer's published specifications and the intent of this specification. All adjustments shall be made to optimize the system prior to Owner training.

B. Provide full commissioning of the System. All system performance certification and programming must be performed by a factory certified technician.

3.12 TRAINING

A. Train systems administrative and/or maintenance personnel in procedures involved in operating, troubleshooting, servicing and preventative maintenance of the Distributed Communication and Clock System.

1. Review of the physical configuration and interrelationship of the system components.
2. Labeling and interconnection techniques used in the installation.
3. Applications of systems including any unique connections or interfaces required in the use of systems on site.
4. A review of warranty documents for the system.
5. A review of the Technical Manual prepared per "Closeout Submittals."
6. A Review of operation manuals and users guides for the system.

7. System operation and maintenance procedures.

8. Review of all user programmable options and how to modify options.

9. Record training session and provide video file of the training session to system administrators.

10. Provide system administrators with complete user instructions in a condensed form at the conclusion of training.

B. Provide owner with complete user instructions used for training purpose as well as training log of all users who attended training classes.

3.13 CLEANING

A. Clean all equipment and work areas under this Section, prior to scheduling Owner training. Include, as necessary, wiping of Work areas and surfaces, and the removal of dust, streaks, stains, from all equipment specified. Leave installed systems and components clean and undamaged.

END OF SECTION

Division 28
Electrical Security

SECTION 281000

INTEGRATED SECURITY SYSTEM

(THIS SECTION TO BE INCLUDED IN SUB-BID FOR SECTION 260001 - ELECTRICAL)

PART 1 GENERAL

1.00 SUB-SUB-BID REQUIREMENTS

A. Filed Sub-Sub Bids:

1. Sub-sub-bid requiring a paragraph “E” listing on the form for sub-bid required per M.G.L. Chapter 149 Section 44A, as amended to date. The Electrical Sub-Contractor shall be responsible for all related building preparation and coordination. See specification for additional Paragraph “E” listing requirements of the listed contractor, and coordination of responsibilities. Failure to meet or exceed the requirements of the Contractor, as detailed in this specification, shall be grounds to reject the applicable bidder.

2. It is the sole intent of this Paragraph "E" listing to ensure to the end-user, single source responsibility from a single qualified Integrated Security System Installer listed as the Paragraph “E” sub-sub bidder for this Class of Work.

3. The Paragraph ”E” sub-sub bidder listed shall not sub-contract any portion of this specification.

4. The Integrated Security System Installer shall be DCAM Certified by the State of Massachusetts Division of Capital Asset Management in the Category of **ELECTRONIC SECURITY SYSTEMS** and/or **ALARM SYSTEMS.**

B. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this Section.

B. Examine all Project Specifications and Drawings for requirements which affect this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with all trades affecting or affected by work of this Section. Cooperate with such trades to assure a steady progress of all work under Contract.

1.02 SUMMARY OF WORK

A. This Section includes:

1. Integrated Security System, including but not limited to:
   a. Access Control System
   b. IP-Based Video Surveillance System
   c. Intrusion Detection System
2. Aiphone Video Intercom and Door Control System
3. All required system(s) cabling not included under SECTION 270100 STRUCTURED CABLING SYSTEM.

B. Commissioning of Installed Systems

C. Work to be done under this SECTION is shown on the Electrical Drawings.

D. Work to be done under this SECTION shall be performed by the Paragraph E sub-sub bidder meeting the requirements of this SECTION and listed on the Bid Form for this Class of Work, and referred to as the Integrated Security System Installer herein.

1.03 RELATED WORK IN OTHER SECTIONS

A. Coordinate work with that of all other trades affecting or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the contract.

B. Technology workboxes, back boxes, floor boxes, conduits, sleeves, cable tray, corridor cable support, grounding systems, and fire safing are per SECTION 260001 -ELECTRICAL.

C. Blocking for attaching Communication Systems Components: ROUGH CARPENTRY, SECTION 061000

D. SECTION 270100 – STRUCTURED CABLING SYSTEM

E. SECTION 274000 – AUDIO-VIDEO COMMUNICATION SYSTEMS

F. SECTION 275000 – DISTRIBUTED COMMUNICATION SYSTEM

G. SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

1.04 TECHNICAL REFERENCES

A. The product specifications, design considerations, and installation guidelines provided in this document are in part derived from recommendations found in recognized telecommunications industry standards. In cases where product specifications, design considerations, and installation guidelines provided in this document are in conflict with the references listed below, the more stringent requirements shall apply. The bidder is responsible for determining and referencing the most recent releases of all specifications during bidding and installation. Design, manufacture, test, and install Integrated Security System per manufacturer's requirements and in accordance with NFPA 70 (National Electric Code), state codes, local codes, Underwriters Laboratories (U.L.), requirements of authorities having jurisdiction, ADA requirements, and the following specifications:

1. TIA-526-7 (OFSTP-7)-2002+A1:2008, *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*.
2. TIA-526-14-B-2010 (OFSTP-14), *Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 Edition 2, Fibre-Optic Communications Subsystem Test Procedure- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement*.
3. ANSI/TIA-568-C.0–2009+A1:2010+A2:2012, *Generic Telecommunications Cabling for Customer Premises.*
4. ANSI/TIA-568-C.1–2009+A1:2012, *Commercial Building Telecommunications Cabling Standard.*
5. ANSI/TIA-568-C.2–2009+A1:2010, *Balanced Twisted-Pair Telecommunications Cabling and Components Standard.*
6. ANSI/TIA-568-C.3–2009+A1:2011, *Optical Fiber Cabling Components Standard.*
7. ANSI/TIA-568-C.4–2011, *Broadband Coaxial Cabling and Components Standard.*
8. ANSI/TIA-569-C–2012, *Telecommunications Pathways and Spaces.*
9. Building Industries Consulting Services International (BICSI) *Telecommunications Distribution Methods Manual* (TDMM)
10. BICSI *Information Transport Systems Installation Manual (ITSIM)*
11. ISO/IEC 18010, *Pathways and Spaces for Customer Premises Cabling*
12. TIA-942-A-1, *Telecommunications Infrastructure Standard for Data Centers*
13. ANSI-J-STD-607-A, *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*
14. ISO/IEC 11801, *Information Technology – Generic cabling for Customer Premises*
15. TIA-862, *Building Automation Systems Cabling Standard for Commercial Buildings*
16. ISO/IEC 14763, *Implementation and Operation of Customer Premises Cabling*

17. TIA/EIA-606-A, *Administration Standard for Commercial Telecommunications Infrastructure*

18. EE Standard 802.3an – *10GBASE-T* over copper twisted pair cable

19. National Electric Code (NEC)

20. Massachusetts Electric Code

21. All relevant American National Standards Institute (ANSI) Committee

B. In cases where product specifications, design considerations, and installation guidelines provided in this document are in conflict with the references listed above, the more stringent requirements shall apply. All references listed above were current during development of this publication. The bidder is responsible for referencing to the most recent releases when developing bid proposals.

C. This document does not take precedence over any state or local building codes, either partially or wholly.

1.05 SUBMITTALS

A. Refer also to SECTION 013300-SUBMITTALS

B. General: Submit shop drawings, samples, and related submittals all together, at the same time, for coordinated review. Isolated items submitted will not be reviewed until all items have been submitted for review.

C. Equipment List: Provide a detailed Equipment List showing quantities by manufacturer and model number of all major items of equipment and installation material to be used in the system as specified herein.

D. Product Data: Include complete sets of indexed cut sheets, in quantity as dictated by the project, of all major pieces of equipment, cable and connectors being supplied. Arrange these sheets in the order the equipment appears in the Specification. Clearly highlight information showing compliance with this and/or all applicable Specifications. In the event that the manufacturer or representatives' cut sheet contains more than one item, clearly indicate which items of the cut sheet are intended for installation.

E. Firestop: Include cut sheets on all firestopping materials.

F. Shop Drawings: Submit a set of complete Shop Drawings, by system, showing equipment to be installed, including but not limited to:

1. System configuration block diagrams of all equipment, indicating equipment type and model numbers. Show each and every component, system and subsystem, as well as all proposed connections between system components, and cable types connecting components.

2. Proposed layouts and elevations of equipment racks.

3. Provide scaled room layout drawings of all tel/data closets showing rack positions in relation to all other equipment.

G. Provide a plan for labeling of all cabling. Meet with the Owner prior to submittal to coordinate Owner requirements and reflect on the plan.

H. Quality Assurance Submittals:

1. Include certification from the manufacturer that the Integrated Security System Installer is qualified to install systems as specified in accordance with the specific requirements set forth herein.

2. Include names, qualifications, and certifications of installation personnel including Integrated Security System Installer's site Supervisor/Foreman who shall be in charge of, and responsible for, all activities at the job site for the duration of the Project. The job Supervisor/Foreman shall not be changed during the Project without notification and approval from the Owner.

3. Complete warranty information including sample Registration Certificate.

I. Close-Out Submittals:

1. Communication System Technical Manual: Submit for approval a draft of the complete Technical Manual at least two weeks prior to the time of final system check out. When the final drafts are approved, provide five (5) copies of detailed technical manuals. The manuals shall include the following:

   a. Table of contents.

   b. Integrated Security System Installer’s Name; contact name; address, telephone number, fax number, and email address.

   c. Manufacturer's Registration Certificate of Warranty for Integrated Security System.

   d. Product Information: Include original copies of manufacturer's installation and operating instructions, and service manuals, arranged alphabetically. All service manuals shall be originals; there shall be no Xerox copies of the service manuals and schematic supplied. Warranty information shall be filled out in the Owner's name.

   e. Detailed Description of the complete system and all subsystems.

   f. Maintenance Documentation: Include the following:

      1) Information necessary to perform routine and corrective maintenance by the Owner's technical staff, or other qualified technicians.

   g. List of all equipment by manufacturer, model or part number, and serial number.

   h. List of spare parts.

2. Submit written certifications that the installation conforms to Specification and Manufacture’s recommended installation practices, and is complete and operable, and ready for approval by the Architect.

3. Technical Diagrams and Drawings:

   a. Simplified single line block diagrams showing the interconnection of all equipment and functional relationships for all systems specified. Show all equipment, patch panels, cables and jacks, and other components whether connected or not. These drawings shall be on Engineering size E, 30" x 42" sheets. The intent of these diagrams is to provide sufficient clear and complete information that a technician of average skill may efficiently troubleshoot and service the system, even if unfamiliar with the installation.

   b. Provide "As Built" architectural quality plan drawings at 1/8-in. = 1-ft. scale showing data jack locations and numbers. These drawings shall be on Engineering size E, 30" x 42" sheets. Also provide all plans on CD in AutoCAD 2016 .dwg format.

   c. All technical diagrams and drawings shall be mounted on the wall behind a clear plastic cover for protection. There shall be one set of the above drawings and diagrams provided for the Main Distribution Room (MDF).

J. Sustainability Requirements:

1. The work of this section includes LEEDv4 materials and submittal requirements. LEED v4 requirements for the work of this Section are detailed in Division I of the Project Manual

2. All Sealing, Caulking, and fire proofing materials shall meet or exceed the current LEED v4 VOC requirements.

1.06 QUALITY ASSURANCE

A. Integrated Security System Product Requirements: The products that shall best support the needs of the project and provide the highest level of system performance over the life of the facility, shall be a system that is made up of system components designed, manufactured and installed as a total system solution. Therefore, it is the intent of the Specification that one manufacturer, not a combination of different manufacturer's components, be selected for the Integrated Security System specified to ensure that the final system performance and warranty are the responsibility of a single manufacturer.

B. The onsite Job Supervisor/Foreman shall have at least five years' experience in designing, installing, and testing systems specified as described herein. The onsite Job Supervisor/Foreman shall carry an active cellular telephone or other two-way device, so that he/she may be reached when circumstances require. Additionally:

1. The Integrated Security System Installer shall own and maintain tools and equipment necessary for successful installation and testing of all systems specified.

2. The Integrated Security System Installer shall have personnel who are adequately trained and certified by the Manufacturers providing final system warranties.

3. The Integrated Security System Installer (Paragraph “E” listed sub-subbidder) shall be a factory authorized installer of all systems specified and shall hold certifications from the Manufacturer who is providing the final System Warranty and Performance Assurance.

C. Installation Procedures: Adhere to the engineering, installation and testing procedures of the Manufacturer of the components specified, and use only the cabling, components and methods of provisioning the Project authorized by the Manufacturer.

1.07 DELIVERIES, STORAGE AND HANDLING

A. Perform all tasks necessary to properly coordinate with all involved parties/trades for: Shipment, arrivals, loading dock, elevators (as applicable), acceptance, storage, and security of equipment and materials. Do not, during these tasks, interfere with other trades or the progress of this Project.

B. Assure that all deliveries are in correct quantities, within the appropriate times, and in compliance with all manufacturers’ shipping instructions.

C. Protect all materials according to manufacturer's Specifications and/or instructions.

1.08 SYSTEM WARRANTY, SERVICE AGREEMENT AND PERFORMANCE ASSURANCE

A. Warranty all systems to be free of faulty workmanship and defects, and from damage due to contamination from the site for a period of five years from the date of final project completion.

B. The Warranties required by this section shall not be diminished by other warranties in the Contract Documents, equipment manufacturer's warranties, and all other rights and remedies available to the Owner under this Contract and public law. In addition, this Warranty shall not diminish the terms of individual manufacturer's warranties.

C. The Warranties required by this section shall be for the benefit of the Owner to whom Registration Certificate is issued and any successor in interest to the site.

D. Any repair or replacement of Cabling or Equipment resulting from this warranty will be warranted for either (a) 90 days or (b) the remainder of the original warranty period, whichever is longer.

E. Service Agreement: The Integrated Security System Installer shall respond to all requests for service during the warranty period. During this period, the Integrated Security System Installer shall replace defective material and repair items of faulty workmanship at no charge to the Owner. All requests for service shall be responded to by telephone within two business hours, and technicians shall be dispatched within twenty-four hours. Only certified technicians shall be dispatched.

1.09 TRAINING OF OWNER'S PERSONNEL

A. Conduct a Training Program for the Owner's staff. The Training Program shall include a demonstration of the configuration of all components of the Integrated Security System. Schedule the Training Program at the convenience of the Owner, after the Technical Manual has been submitted and approved. All materials in the Technical Manual shall be reviewed during the training program. All training sessions shall be videotaped with five copies provided to the Owner with closeout submittals.

1.10 EXTRA INSTALLATION PROVISIONS, MATERIALS AND SPARE PARTS

A. Furnish the following Attic Stock or Spare Parts to the Owner at the conclusion of the project. Spare parts shall be delivered to the Owner with closeout documentation submittals.

1. Provide one spare camera and mount of each type specified.
2. Provide five spare Motion Sensors of each type specified.
3. Provide six spare door contacts
4. Provide one spare Keypad
5. Provide one spare lockdown button
6. Provide two spare card readers

PART 2 PRODUCTS

2.01 GENERAL

A. It is the intent of the Specification that one manufacturer, not a combination, be selected for each particular class of material.

B. Integrated Security System as specified, must be able to be serviced and supported after the initial installation and warranty period is complete by no less than 3 resellers authorized by the manufacturer in the State of Massachusetts to install, service and support the Integrated Security System specified.

C. Equipment is specified as the basis of design because it is installed throughout the Owner's other public school facilities. It is the desire of the Owner for the same equipment to be installed on this project to assist the Owner with the daily maintenance, ongoing management, and support of their district wide security systems. The words, "or equal", are understood to follow all names of these specified products, trade names, catalog numbers, and detailed descriptions. "or equal" shall be interpreted to apply to any material, article, assembly or system, which in the opinion of the Owner is at least equal in quality, durability, appearance, strength and design to the materials specified, and shall perform at least equally in all aspects with the functions of the equipment specified, and installed in other schools. The words, "or equal", shall not be construed to permit departure from the detailed requirements of the Specification. The "or equal" provision of G.L. c.30, §39M(b) is hereby incorporated by reference.

D. All materials and equipment shall be new and unused.

E. All part numbers and manufacturers shall be according to this Specification unless otherwise noted on the construction Drawings.

F. Category 6A network cabling, patch panels, and network patch cables required to connect the Video Surveillance System IP Cameras will be provided under Section 270100 STRUCTURED CABLING SYSTEM. A four post equipment cabinet will be provide in the Main Network Room for main video surveillance head end equipment. Fiber optic cabling to support surveillance cameras at light poles will be provided under Section 270100 STRUCTURED CABLING SYSTEM. All other wiring and cabling required for the installation of the Integrated Security System shall be provided as part of the work of this section, and the installation of the same shall meet or exceed all applicable electrical and building codes for the areas and space it is to be installed in.

G. "J" style hooks and/or other approved devices for supporting wire and cable required to be furnished and installed as part of this Section SYSTEMS.

H. Provide all mounting hardware, shelving, bracketing, bracing, support members, required to support all cabling and equipment specified.

2.02 MANUFACTURERS

A. Acceptable manufacturers for Video Surveillance, Intrusion Detection and Access Control Systems include the following:

1. Surveillance: Avigilon, S2, Axis,
2. Access Control: Avigilon, S2, DSX
3. Intrusion Detection: Bosch, DSC, Honeywell.

2.03 CARD ACCESS SYSTEM

A. The Card Access System shall be Avigilon Access Control Manager (ACM). The ACM system shall be an IT-friendly Physical Access Control System (PACS) suitable for enterprise-class installations. It should combine video management, wireless locking, and intrusion control and visitor management into a powerful access management solution

B. The ACM system shall be a. Linux based server pre-loaded with Avigilon Access Manager Software and optimized to manage an IP-based access control system. The ACM will integrate, within a browser interface, access control, alarm monitoring, and video monitoring. These applications shall be browser based and have no software to install including badging.

C. All equipment and materials used shall be standard components, regularly manufactured and regularly utilized in the manufacturer's system.

D. All ACM systems and components shall have been thoroughly tested and proven in actual use.

E. The Main system server shall be the ACM Appliance and shall will be Located in the MDF Room. Connect server to network switch electronics as required.

F. Enterprise Level Access Control Manager (ACM) shall be Avigilon Model: AC-APP-64R-ENT2, /64 AC-APP-64R-ENTZ-6

G. Provide ACM, Full NVR Integration for selected cameras, ID Management Software, and ACM Photo Badging Software.

H. Door Controllers shall be Mercury Security: Products bearing the "Authentic Mercury" mark. Refer to door hardware section of the project manual for complete description of functionality of every door and provide all associated equipment and cabling. Provide quantity of controllers to accommodate the number of total controlled doors plus 20%. Provide minimum of one controller in the MDF and one controller in each IDF/Technology Closet. Door controllers shall be wall mounted on available wallboard area. Connect all network nodes to network switch electronics as required.

1. Controller board: AC-MER-CONT-LP-1502
2. Subpanel: AC-MER-CON-MR52
3. Input Board: AC-MER-CON-MR16IN
4. Output Board: AC-MER-CON-MR16OUT

I. Reader Hardware:

1. HID Global multiCLASS SE RP40 with Proximity reader.

K. Door Contacts/Switches shall be flush mount double pole/double throw, connecting to the access control and intrusion detection systems. Request to Exit devices shall be integrated with door hardware and connected to the Security Access Control System.

L. Duress Buttons shall be connected to the access control system and intrusion detection system. Pressing of the Panic Button shall put the entire facility in lockdown, engage all door hardware, notify authorities of a lockdown situation through the intrusion detection system, and annunciate a lockdown notification through the Public Address system.

M. Access Control System shall independently of the Fire Alarm System, release all doors on magnetic hold opens, utilizing separate relays and cabling running in parallel with the Fire Alarm System to the magnetic hold open power supplies.

N. Locate Duress Buttons as indicated on Security Drawings. Coordinate exact location with Owner prior to installation.

M. Connect system to the fire alarm system so that a fire alarm shall bypass and disengage a lockdown situation, unlocking all doors and meet all applicable fire codes.

O. Coordinate with door hardware specified in Division 08 for specific functionality requirements at each door.

P. Provide all cabling and equipment as recommended by the manufacturer for a fully functional system. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

Q. Provide full integration between the video surveillance system, access control system, and the intrusion detection system. Integration shall be software based requiring no external hardware or modules of any sort. Upon generation of an alarm that has associated video, the Operator will be able to recall the video segment associated with the alarm. Once launched, the Operator will be able to adjust the start and end time of the video segment. Where multiple cameras are associated to a single access control hardware event or alarm, associated cameras will appear in video player in the appropriate matrix view. The ACM will provide the ability to launch more than one camera on a generated alarm.

R. Provide a 10-Minute UPS on all system components to bridge system loads to emergency backup.

2.04 VIDEO SURVEILLANCE SYSTEM

A. Video Management System (VMS) shall be Avigilon Control Center Version 7.10 or later ENTERPRISE level or equal, meeting the following requirements:

1. The VMS shall be available as a pre-loaded application in the following Avigilon

a. ACC ES HD Recorder

b. Avigilon HD Video Appliance

c. Avigilon HD Network Video Recorder

d. Avigilon HD Network Video Recorder Workstation

2. The VMS shall be available as a standalone software application with the following system requirements:

   a. Windows 10

   d. Windows Server 2008

   e. Windows Server 2012 / 2012 R2/ Windows Server 2016

3. The VMS software application can be installed on any open platform hardware, and does not require hardware multiplexer or time-division technology for video or audio.

4. The VMS shall support increasing recording storage capacity without additional licenses.

5. The VMS shall decompress H.264 video through the client graphics card / graphical processing unit.

6. The VMS shall be an enterprise level software solution that shall be scalable from one client, server and camera up to:

   a. 100 servers per site with 300 cameras per server.

   b. Indefinite number of concurrent client to Site connections, limited only by the bandwidth capability of the network and server.

7. The VMS server and client software applications can be installed and run on the same computer or on separate computers.

8. The VMS shall secure video and audio data by securely transmitting all command and control data via TCP/IP using cryptographic keys based on SSL to prevent eavesdropping or tampering.

9. The VMS shall support storage and processing of video and audio.

   a. Audio and video must be recorded natively from the camera with no transcoding.

   b. Audio and video must be synchronized regardless of frame-rate, resolution or bitrate.

10. The VMS shall support industry standard video compression formats, including but not limited to:

    a. JPEG2000

    b. MJPEG

    c. MPEG-4

    d. H.264

11. The VMS shall perform dynamic video stream management.
    a. Also known as Avigilon High Definition Stream Management (HDSM)™
    b. Dynamic video stream management shall reduce the system bandwidth and storage usage by only transmitting video to the client as required.
    c. The client shall communicate the maximum monitor resolution to the server and the server shall act as a video proxy and stream the required video resolution.
    d. The VMS shall tile multi-megapixel videos streams and only transmit the requested portion of the video stream to the client.
    e. Recorded video storage is extended by dynamically reducing the quality of the recorded video over time so that video is still viable but uses less storage. JPEG and JPEG2000 video image rate is reduced to one half or one quarter of the original image rate, while H.264 video records a high quality stream and a low quality stream. The high quality stream is discarded after a set amount of time.
    f. Video shall be available for local users, remote users and mobile devices.
12. The VMS shall find devices and systems on the network by the following methods:
    a. Automatic — servers, video and audio sources that are connected to the same network as the client are automatically discovered.
    b. Search — servers, video and audio sources running on a different network segment than the client can be discovered by searching for the device's IP address or hostname.
    c. Parent to child — logging into a parent site automatically discovers the configured children sites.
13. The VMS shall allow manually discovered server instances, video and audio sources to be visible to all users of a single client workstation.
    a. Network settings for all server instances will be identical for all users of a single client
14. The VMS shall support recording and management of video and audio sources through the use of industry standard drivers. These drivers shall include:
    a. ONVIF Profile S
    b. Publically Published API

15. The VMS shall provide the ability to configure and manage alarms and events.
    a. Individual alarms from a third-party system access control system can be pre-selected and configured to be monitored.
    b. Can define alarm and event triggers.
    c. Can configure resulting video operations.
    d. Detect if the video or audio signal is lost and alert the system administrator.
    e. Support receiving Simple Network Management Protocol (SNMP) messages from servers and alert users.
    f. Alarm and event notifications can be customized and forwarded to users logged into the client application; users logged into the mobile application, configured email addresses, external entities and third party software, such as central monitoring stations and call centers
    g. Can escalate alarms from one user or group to another if the alarm is unacknowledged for a preset duration.
    h. Email notifications can be configured to notify users and system administrators when an event or system health error occurs, schedule when email notifications are sent, and include camera images in email notifications.
    i. Support receiving digital input triggers and triggering digital outputs from and input/output board, supported IP camera or encoder, and other integrated systems.
16. The VMS shall provide the ability to send central monitoring stations heartbeat messages, or regular notification to confirm the system connection and that there are no events of note.
17. The VMS shall run as a service configured to automatically start when the server or workstation is powered on.
18. The VMS shall allow users to monitor and administer the system from:
    a. A single client application for monitoring live and recorded video and audio.
    b. A single window for administrating all system connections.
    c. A single tab for monitoring overall system health and connected sites in parent-child relationships.
    d. Any client with access to a local or distributed network.
19. The VMS shall provide multiple levels of system redundancy:
    a. Cluster and synchronize up to 100 servers into a unified site in the event of a server failure, the system is able to continue running and allow other servers to take over the failed server's tasks.

b. Centralized system administration allowing site and server configuration details to be replicated to all servers in the site, which can also be organized in a hierarchical parent-child relationship where the parent can always control child site settings.

c. Connect a video or audio source to multiple servers to achieve redundant recording.

d. Create a failover connection for a video or audio source between servers in a site.

20. The VMS shall provide the capability to rename all sites, servers, and video and audio sources.

21. The VMS shall provide configurable classified object detection for each device with self-learning video analytics capabilities.

    a. Allow users to connect individual video sources to analytics appliance channels.

    b. Allow users to configure events based on classified object motion detection.

    c. Allow configured video analytics events to be used as alarm and rule triggers.

    d. Allow users to mark classified objects as a true or false detection with ability to transmit data to the video source to improve accuracy of the video analytics device.

22. The VMS shall support the following video analytic event types when captured by supported cameras:

    a. Objects in area

    b. Object loitering

    c. Objects crossing defined line

    d. Object appears or enters area

    e. Object not present in area

    f. Objects enter area

    g. Objects leave area

    h. Object stops in area

    i. Anticipated direction of travel is violated

    j. Scene dramatically changes in an unexpected fashion

    k. Appearance Search

23. The VMS shall authenticate users before granting access to the system.

B. Surveillance System Network Video Recorder (NVR)

1. Network Video Recorders shall be Avigilon HD Network Video Recorder Premium P/N HD-NVR4XPRM-96TB-NA with Avigilon Control Center Camera licenses as required or equal. Provide two NVR's, each with two 10GbE SFP+ connections, transceivers and cables as required.
2. Provide one spare 10GbE SFP+ transceiver, spare hot swappable Power supply and Analytics kit for Avigilon Appearance Search software.
3. Provide 20 Fail Over Licenses P/N ACC7-ENT-FO for configuring 20 cameras assigned by the Owner that will be required to remain operational in the event that one of the two servers fails.
4. An empty and dedicated full height cabinet is being provided under SECTION 270100 STRUCTURED CABLING SYSTEM for the Integrated Security System main surveillance system equipment, which shall be furnished and installed as part of this Section and include but not be limited to the following equipment.
    a. NVR Servers
    b. Network Switches
    c. Rack mount LCD console, APC P/N: AP5719 or equal for use in configuring the Server and accessing video management software at the server location.
    d. Rack mounted KVM switch and sliding shelf P/N AR8123BLK or approved equal for use in configuring the Server and accessing video management software at the server location.
    e. Rack mounted UPS for supporting NVR's, console and KVM for 10 minutes. UPS shall be by APC, Emerson/Liebert or Eaton with manufacturer approved mounting rail kit for the cabinet. UPS shall support all main surveillance system components in order to bridge system loads to emergency backup power. UPS shall be connected to emergency backup power receptacles above security system cabinet in MDF.
    f. fiber optic patch cords between NVR servers and network switches.

C. Surveillance System Cameras

1. Interior in-ceiling Video Surveillance IP Cameras shall be Avigilon H4A-DC P/N 4.0C-H5A-D1 or equal, equipped with a 3.0mm to 9mm varifocal lens and shall include manufacturer recommended recessed ceiling mount hardware and installation methods.
2. Interior surface mount video surveillance IP cameras shall be Avigilon H4A-D P/N 4.0C-H5A-D1 or equal equipped with a 3.0mm to 9mm varifocal lens and be surface mounted to the wall using manufacturer's recommended surface mount hardware and installation methods.
3. Interior 180-degree ceiling and wall mount cameras denoted as 180 shall be Avigilon P/N 9C-H4A-180 Avigilon P/N 9C-H4A-3MH-180 or equal and be recess mounted to the suspended ceiling using manufacturer recommended ceiling mounts and methods.

4. Interior 270-degree ceiling mounted cameras denoted as 270 shall be Avigilon P/N 15C-H4A-3MH-270 or equal, and be recess mounted to the suspended ceiling using manufacturer recommended ceiling mounts and methods.

5. Interior 360-degree ceiling mount cameras denoted as 360 shall be Avigilon P/N 20C-H4A-4MH-360 or equal, and recess mounted to the suspended ceiling using manufacturer recommended ceiling mounts and methods in the Cafeteria. In the Gym, cameras shall be surface mounted securely to the bottom side of the roof truss using manufacturer recommended surface mount hardware and methods. Cameras in the Gym shall also be secured to permanent structure using safety cable.

6. Exterior Door cameras shall be Avigilon 12.0-H4F-DO1-IR 360-degree fish eye camera or equal, surface mountned at door locations as indicated.

7. Exterior surface mount dome cameras shall be Avigilon 6.0-H5A-DO1-IR camera or equal, surface mounted to the wall locations as indicated

8. Exterior surface mount 180 degree camera denoted as 180 shall be Avigilon P/N 15C-H4A-3MH-180 or equal, and pendant mounted to the side of the building and configured for 180 degree panoramic viewing, using manufacturer recommended pendent mounting hardware and methods.

9. Exterior surface mount 270 degree camera denoted as 270 shall be Avigilon P/N 15-C-H4A-3MH-270 or equal, and mounted directly to the corner of the building and configured for 270 degree panoramic viewing, using manufacturer's recommended pendant mounting hardware and methods for corner mounting cameras.

10. Exterior surface mount 270 degree camera noted as 270-24 shall be Avigilon P/N 24C-H4A-3MH-270 or equal, and mounted directly to the corner of the building and configured for 270 degree panoramic viewing using manufacturer's recommended pendant mounting hardware and methods for corner mounting to the building.

11. Elevator Camera shall be Elevator surveillance camera shall be furnished and installed in each elevator cab and shall be Avigilon Mini Dome P/N 2.0-C-H5M-MT-DO1-IR with H5M-MT-DCIL1 when mounted in suspended ceiling. Coordinate installation with installer of elevator system.

12. Pole Mount 180-degree camera denoted as 180 at light pole locations shall be Avigilon P/N 15-C-H4A-3MH-270 or equal, and mounted directly to the light pole and configured for 270 degree panoramic viewing, using manufacturer's recommended pendant mounting hardware and methods for mounting directly to the light poles.

13. Pole Mount 270 degree camera denoted as 270 shall be Avigilon P/N 15-C-H4A-3MH-360 or equal, and mounted directly to the light pole and configured for 270 degree panoramic viewing, using manufacturer's recommended pendant mounting hardware and methods for mounting directly to the light poles.

14. Pole Mount 360 degree camera denoted as 360 shall be Avigilon P/N 20C-H4A-3MH-270 or equal, and mounted directly to the light pole and configured for 270 degree panoramic viewing, using manufacturer's recommended pendant mounting hardware and methods for mounting directly to the light poles.

15. Pole Mount cameras with no designation shall be Avigilon P/N 8.0C-H5A-DP1-IR or equal, and mounted directly to the light pole and configured for optinal viewing of vehicles entering and exiting the school property, using manufacturer's recommended pole mounting hardware and methods for mounting the camera directly to light poles.

16. All cameras shall be supplied with manufacturer's recommended mounting hardware and clear covers. Utilize recessed ceiling mount camera brackets for all ceiling mounted cameras where applicable.

17. The exterior cameras shall feature a rugged weatherproof exterior housing with an advanced dehumidification device, base and body as independent structures, with an outdoor temperature rating of -40 degrees F to 122 degrees F, and IP66 rated water and dust resistant.

18. All cameras shall feature a local connection capability, wired or wireless, for individual camera focus and position adjustments.

19. All Cameras must fully integrate with the Avigilon Video Management Server hardware and software.

20. Exterior light pole cameras shall include but not be limited to the following equipment for a fully functional camera at the light pole.

    a. Manufacture approved mounting hardware for camera.

    b. Pole mounted NEMA surveillance cabinet at camera for electronics and fiber terminations with waterproof flex conduit between surveillance cabinet and camera. Note: fiber optic cabling including terminations in the cabinet shall be provided by Section 270100 STRUTURED CABLING SYSTEM.

    c. Provide all necessary power supplies, fiber optic 10/100/1000 Mbps Ethernet Media Converters, SFP miniGBIC transceivers, patch cables, and all accessory hardware required at the light pole and in the IDF where pole fiber originates, for interfacing cameras to network switches provided by Section 272000.

    d. Fiber Optic Media Converters shall be ComNet CNGE2MCM/C with ComNet SFP modules or approved equal for the multimode fiber pulled to light poles per Section 270100 STRUCTURED CABLING SYSTEM. Note: units to be provided with Conformally Coated Circuit Boards to extend to condensation conditions.

    e. Fiber Optic Media Converters in NETWORK and IDF rooms where pole camera fiber originates shall be installed in data equipment rack below the fiber optic terminations using ComNet Product to Din Rail to Standard 19" rack adapter kit, or approved equal

    f. Furnish and install camera and media converter power supplies and electrical safety kit between 120V power receptacles provided by Electrical and the camera and media converters.

D. Integrated Security System Network Switches

1. Provide Aruba 2930M series network switches for all networked security system devices as part of the video surveillance, card access, and intrusion detection systems. Include fiber optic connection modules for connecting to fiber backbone provided by SECTION 270100 STRUCTURED CABLING SYSTEM.
2. Provide all necessary hardware including but not limited to Stacking Modules, stacking cables, 10 Gb GBIC Transceiver modules to connect network switches between Network and Data Rooms, fiber optic patch cords, rack mounting hardware, etc., and anything else required for a complete system.
3. Install switches in Network and Data Rooms that are closest to cameras.
4. Size switch network to provide 50% spare PoE network ports and so that no more than 50% of the available PoE power is utilized in each Network and Data Room to support Integrated Security System PoE devices including surveillance cameras.
5. Provide a 10-Minute UPS on all security network switches to carry load to emergency backup power. Provide all cabling, cords and adapters required to connect UPS to power outlets provided by the electrical contractor.

E. Surveillance System Cabling

1. All Category 6A cabling and fiber optic cabling required to support the video surveillance system cameras shall be furnished and installed under Section 270100STRUCTURED CABLING SYSTEMS. This includes all Category 6A cabling, terminations, patch panels in the closets, outlet jacks at the camera locations, labeling, testing and documentation of the structured cabling system. Category 6A patch cables for use at camera outlets and at patch panels shall also be furnished as part of SECTION 270100 STRUCTURED, but, patch cords shall be installed by the SECTION 281000 INTEGRATED SECURITY SYSTEM installer.
2. Furnish and install all system cabling (except where specified and provided under Section 270100), media converters, power injectors, miniGBIC transceivers, fiber optic patch cords at cameras, power supplies and other miscellaneous equipment necessary for a fully functional system.

F. Provide and install all equipment necessary for a fully functioning system including mounting hardware, and accessories for a neat, professional and permanent installation.

2.05 SECURITY SYSTEM INTRUSION DETECTION

A. Main Control Panel shall be Bosch B9512G Control Panel with Universal Enclosure. Locate Panel in the MDF on wallboard

B. All alarm points on the system shall be individually addressable.

C. Door contacts shall be flush mount, double pole/double throw, connecting to the access control and intrusion detection systems. Include door contacts on all doors including roof hatches and access ways whether indicated or not.

D. Recessed Steel door contacts shall be Interlogix 1076D-N.

E. Ethernet Communication Module shall be B426.

F. Addressable Expansion Module shall be Bosch D8125, with Bosch D9127 Series POPIT Modules when expanding beyond the standard number of onboard zones or points.

G. Wall mounted Motion Sensors shall be Bosch or approved equal for optimal coverage and protection against false alarms. Motion sensors shall be acceptable shall work seamlessly with Main Control Panel. Sensors for Classrooms shall be Bosch Blue Line Gen2 TriTech Motion Detectors ISC-BDL2-W12G. Long range motion sensors shall be Bosch Professional Series TriTech Curtain Detectors, part number ISC-PDL1-WC30G. Use Manufacturers recommended mounting heights and hardware to provide maximum coverage of applicable areas

H. Keypads shall be the Bosch D1260 with STI Keypad Protectors.

I. Sirens shall integrate with the Control panel and be flush wall mounted with optional and programmable tones. Surface mounted sirens are not acceptable.

J. Duress Button shall be Potter HUM-M or equal, with cabling extending from a custom satin stainless steel wall plate. Duress Button shall be a Double Pole, Double Throw Latching switch. Connect the panic button to both the access control system and the intrusion detection system so that when the Panic Button is pressed it shall initiate an entire facility lockdown, which shall include the releasing of fire alarm hold-open doors, the locking of all access controlled doors, the notification of law enforcement authorities, and annunciation of a lockdown through the Distributed Communication System. Coordinate the exact location and mounting methods of the Duress Button with the architect and furniture consultant so that the button is concealed and protected from accidentally being pushed, while being fully accessible by administrators and office personnel.

K. The intrusion detection system shall notify police dispatch directly upon activation of any lockdown situation.

L. Any fire alarm shall disarm the intrusion detection system.

M. System shall interface with Owner's Central Monitoring Service provider. Coordinate requirements with the Owner.

N. Provide all cabling and intrusion detection system accessories for a complete and functional system. All cabling shall be plenum rated. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation.

O. Connect all systems and sub systems to 10-minute UPS and emergency backup power.

P. Sirens shall be 15W flush mounted with optional and programmable tones.

2.06. VIDEO INTERCOM AND DOOR CONTROL SYSTEM

A. Video/Audio Entrance Station (VES) device shall be Aiphone model IX Series 2-IX-DVF. Video/Audio Entrance Station (VES) devices shall be flush mounted. Coordinate location of device with architect and install according to manufacturer recommendations. Coordinate installation of device with other trades including door hardware and equipment schedule. Custom workbox shall be supplied to EC for installation by Division 26.

C. Video/Audio Master Station (VMS) shall be Aiphone IX Series 2 model IX-MV7-HW, configured for desktop or wall mount use. Unit shall be integrated with door hardware for controlling electric strikes, to allow access using Video Master Station device.

D. Verify locations and mounting requirements of all Video/Audio Master Stations (VMS) devices with Owner prior to installation. Be prepared to provide either desk top option or wall mount option for all VMS devices. Wall mounting option shall utilize work box and mounting bracket as recommended by manufacturer. Custom back boxes shall be supplied to electrical contractor for installation by Division 26. Video/Audio Master Station devices shall control door locks at the outside entrance door leading to their respective main entry vestibule, as well as the doors leading from Vestibule B100 and C100. Coordinate and verify with the architect before installation for which specific doors will be controlled by the VMS.

E. Video/Audio Master Station devices (VMS) shall control door lock at the outside entrance door leading to the main Vestibule, as well as the door leading from main Vestibule into the main lobby.

F. The VMS locations shall not be able to automatically unlock the receiving door. The Video/audio Entrance Station (VES) at the receiving door shall only be for communication purposes between the VES and VMS locations.

G. Temporarily unlocking one door using the VMS shall not unlock other doors controlled by the Video/Audio Mater Station (VMS). However, it shall be possible to program the system to unlock more than a single door at the same time. For example, the exterior door leading into the main Vestibule and the door from main Vestibule into the Main Lobby shall be capable of being unlocked at the same time.

H. The VMS door control system shall be integrated with any Automatic Door Operator Pushbutton System that is at the same door as a Video/Audio Entrance Station (VES), so that unlocking the door by the VMS is required before the Automatic Door Operator receives power to automatically operate and open the door.

I. Provide all Category 6 cabling as required and recommended by manufacturer for a fully operational system. Cables routed through underground or under slab conduits shall be rated for underground/direct burial installation. Install cable so as to not exceed the manufacturer's maximum length of cable between power supply and Video Monitor.

J. 24V DC Power Supply shall be Aiphone PS-1208UL as required.

K. Provide Cisco rack mount layer 2 PoE Switch or approved equal.

L. Review programming options with Owner prior to final configuration and set-up.

M. Coordinate with door hardware specified in Division 08 for specific functionality requirements at each door. Connect to door hardware as required. Coordinate with card access system and any other hardware related to door operation.

N. Provide all installation, configuration and integration for a fully functional system. Provide all system and cabling components as recommended by the manufacturer and adhere to manufacturer's installation requirements.

O. Provide a five minute rack mount UPS on all equipment required to maintain full functionality between loss of power and emergency power cutover.

2.07 ACCESSORIES

A. Provide all accessories required to furnish complete and functional systems.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to commencing Work of this Section or ordering equipment, examine site and conditions under which work shall be performed. Determine exact locations of items shown diagrammatically on Drawings. Determine dimensions needed to install components, move in racks and any custom items. Notify the Architect of any conflicts or special requirements needed to provide for free access to doorways, corridors, stairs, and similar areas, required to move in the specified equipment. If the Integrated Security System Installer fails to provide such notification, any additional cost to remove and reinstall any building members will be back charged to the Systems Installer.

B. Technology Drawings designate component locations. Install quantity and type according to the Technology Outlet Plans and as specified herein. Provide all required adapters and/or accessories for a complete installation in all raceways, and other locations.

C. Commencement of Work of this Section indicates acceptance of existing site conditions.

3.02 WORKMANSHIP

A. System shall be installed in a neat, workmanlike manner. Workboxes, equipment, and enclosures are to be plumb and square. Install the system elements in cooperation with all trades to achieve coordinated progress and desired results. Watch for conflicts with Work being performed by other trades that have impact on the installation of the system components. Make moderate moves or changes in equipment locations as are necessary to accommodate other equipment as directed by the Architect, without a claim for additional payment.

3.03 GENERAL INSTALLATION

A. Pre-installation: Meet with the General Contractor, Project manager, and any other appropriate parties for coordination meeting prior to beginning work and to coordinate requirements.

B. Coordinate Work with adjacent Work of other trades to facilitate installation and prevent conflicts.

C. Staff job appropriately to keep pace with the Project schedule.

D. Abide by the decision of the Architect to case of conflict or interference of the other trades.

E. Work under this Section shall be performed in accordance with associated local, state, and national building codes.

F. Coordinate requirements of ceiling and floor mounted outlets with the Electrical Contractor.

G. Coordinate the type of back boxes and conduit requirements and associated hardware with Electrical Contractor to ensure compatibility with devices to be installed as part of this Section.

H. In the event that the Integrated Security System Installer must re-enter an area of a previously completed phase of Work, the Installer shall be responsible for returning that area back to the condition it was in before the Installer re-entered the area. This includes re-installing ceiling tiles, cover plates, and cleaning walls and floors. Coordinate the cutting and patching of holes with the General Contractor, and comply with the Cutting and Patching Section.

I. Every effort shall be made to schedule the Work under this Specification in such a manner so as to complete all above ceiling Work prior to ceiling panel installation. In the event that the Integrated Security System Installer is required to remove ceiling panels, such Work shall not break or disturb the existing ceiling grid or panels and shall be coordinated with the General Contractor and Ceiling Contractor.

J. The Integrated Security System Installer is responsible for furnishing and installing cross-connections between the riser and station cabling required for a fully functional system.

K. Spare pull strings shall be left in all EMT, Conduits, and Innerduct.

L. Integrated Security System Installer shall furnish and install all mounting hardware, shelving, bracketing, bracing, and support members as may be required to ensure that all equipment and cabling is properly installed and supported according to the manufacturer's recommendations.

M. Take precautions as necessary to prevent and guard against electromagnetic and electrostatic interference. Avoid potential sources of EMI in all aspects of installation. If interference is experienced, the Integrated Security System Installer shall provide all required testing to identify the source of interference and provide a remedy including but not limited to re-routing and/or replacing cables.

3.04 EQUIPMENT

A. Provide coordination and integration with Section 275000 DISTRIBUTED COMMUNICATION SYSTEM so that when a security lockdown is initiated, the public address system will be notified to generate a unique security lockdown alarm tone and/or prerecorded message.

B. Coordinate the requirements of the Access Control system with door hardware provider.

C. Coordinate as required with electrical contractor for pathways, grounding of equipment and for all power requirements including those at designated light poles.

D. Coordinate with SECTIOIN 270100 STRUCTURED CABLING SYSTEM installer for fiber optic cable and terminations.

E. Cameras shown on plans are for designating location of cameras only. Coordinate with the Architect and Owner regarding the exact camera location on buildings, in ceilings, and on structures.

F. Generally, exterior cameras shall be mounted so that cameras are located between 10'-12' above the finished grade. Carefully coordinate locations of cameras with the Architect and Landscape design as well as Section 26 00 10 ELECTRICAL. Cameras shall be surface mounted allowing access of conduit for cabling to run directly through exterior wall into the back of the camera's mounting hardware. Patch cables shall provide the direct connection between the camera and a single data outlet supporting video cameras to be located at the interior wall of the ceiling plenum space of the first floor. Coordinate all requirements of all exterior video surveillance cameras with Section 26 00 10 ELECTRICAL.

G. Meet with the Owner prior to installation to coordinate and document specific camera information including but not limited to the desired direction and field of view, varifocal lens selection, and any other Owner specific requirements of the surveillance cameras and system specified before final installation of cameras.

H. After cameras shall be initially installed according to Owner's prescribed directives, review all camera images with Owner representatives and make final adjustments at each camera according to Owner's requirements. Coordinate all cabling requirements, interior and exterior mounting requirements, conduit and exterior wall pass through requirements of all cameras with Section 26 00 10 ELECTRICAL.

F. Configure the surveillance system so that live and recorded images will be available to authorized clients/users of the system and software.

G. Provide all necessary coordination with IT staff to provide complete remote administration over local area network and wide area network.

H. Provide remote viewing/web interface client software to Owner and Police. Install and configure the remote software as required by the Owner and Police.

I. Install and configure the remote software required on at least two Owner-provided PC's.

J. Provide full integration between the surveillance system, access control system, and the intrusion detection system. Surveillance system provided shall be fully compatible with the Access Control and Intrusion Detection Systems. Integration shall be software based requiring no external hardware or modules of any sort

K. Provide all required system programming and adjustments to meet Owner requirements, and all equipment necessary for a fully functional system.

L. Schedule all work requiring the input from the Owner representative(s) at least 60 days in advance to when the cameras will be installed, and adjustments need to be made.

M. Coordinate the requirements for all work boxes and conduit as well as miscellaneous installation requirements with Section 260001 ELECTRICAL.

N. The Video Surveillance system provided shall be fully compatible with the Access Control and Intrusion Detection Systems specified. Provide integration modules, software, and other equipment required to provide full integration including but not limited to:

1. Triggering operations in one system from events generated in another
2. Camera call up during alarm, authorized passage or card swipe/card read
3. Motion-based recording/archive
4. Incident-based recording/archive

O. Security Lockdown:

1. Prior to the installation of cabling and Security System components, work with Owner representatives, including but not limited to local law enforcement representatives, in confirming the various options that are available to the Owner through the Security System specified, including but not limited to the Intrusion Detection, Access Control, and Video Surveillance Systems, in the event of a school wide incident requiring “facility wide lockdown”.
2. Confirm with the Owner for confirm the location of lockdown card readers.
3. Lockdown sequence shall be initiated using Duress Buttons. When Duress Buttons are pushed, the Intrusion Detection System shall initiate through the Access Control System, the locking of all electronically controlled doors with electronic door hardware that have been identified by the Owner to become locked.
4. At the same time, the Access Control System shall independently of the Fire Alarm System, release all doors on magnetic hold opens, utilizing separate integrated security system relays and cabling running in parallel with the Fire Alarm System to the magnetic hold open power supplies.
5. All access cards normally used with the Access Control System, except those special cards issued to Police, Fire and emergency response personnel, shall be locked out of the system so that they cannot be used with the system in Lockdown mode.
6. Intrusion Detection System shall call out on a dedicated phone line to the Owner’s alarm monitoring company.
7. Work with the installer of the Public Address System and take another output contact from the Access Control or Intrusion Control panel and connect it to the Public Address System to initiate the playing of an Owner approved prerecorded lockdown message and/or dedicated tone sequence over the Public Address speakers in order to notify of a lockdown condition.
8. Work with Owner representatives to identify the specific prerecorded message to be played and/or tones to be generated.
9. Alarm from the Access Control or Intrusion system shall also initiate the video surveillance system to start recording and provide date/stamp of all event recordings.

P. Elevators

1. Install card readers at corridor call button at each floor. Integrate with elevator control system so that a positive card read at the corridor call button allows the elevator call button associated with a specific floor to be activated and respond normally. The call button shall not respond without first initiating a positive card read.
2. Install card reader inside elevator cab. Integrate with elevator control system so that positive read shall allow the elevator cab floor buttons to respond normally. The cab floor buttons shall not respond without first initiating a positive card read.
3. Installation and integration shall be performed with the Section 140001 and Elevator subcontractor.

Q. Work with Owner's technology personnel and integrators of school's wide area and local area networks, including the wireless network, in securing remote access and monitoring of facility wide surveillance system cameras through client access software and access privileges, to allow Police and other security personnel to gain remote monitoring capability from outside of the building.

R. Load and configure client access software not only on Owner provided workstation computers, but also on systems at the Police Station and other predetermined locations, to allow authorized Law Enforcement and security personnel remote access of school cameras outside of the school. Configure remote viewing/web interface for full access over the Web for the police.Provide and install all necessary mounting hardware, and accessories for a neat, professional and permanent installation. Provide ceiling brackets for all ceiling mounted surveillance cameras for a secure and permanent installation.

S. Provide all system cabling (other than the cabling provided), amplifiers, and other equipment necessary for a fully functional system. All Category 6A cabling required to support surveillance cameras shall be installed by Division 270100.

T. Provide integration of the Access Control System with the Automatic Door Operator Pushbuttons at doors with a card reader. The Automatic Door Operator shall be prevented from receiving power to operate until an access card has been presented and positively read by the card reader.

U. Provide all required system programming and adjustments to meet owner specific requirements.

V. Provide a 10-Minute UPS on all systems and connect all systems and sub systems to emergency backup power.

W. Provide all equipment necessary for a fully functional system including all required system programming and adjustments to meet owner requirements.

3.05 CABLE SUPPORTS AND ROUTING

A. All Category 6A cabling to support video surveillance cameras specified in this section is provided under SECTION 270100 STRUCTURED CABLING SYSTEM.

B. All other cabling required for a complete Integrated Security System shall be installed under the work of this Section.

C. Install all cabling shall be installed in accordance with the manufacturer's guidelines and according to all applicable building codes at the time of installation, including but not limited to the NEC and the ANSI/TIA/EIA Telecommunications Building Wiring Standards.

D. Route all cables in large groupings, through main hallways, until cable can be distributed directly to security system devices. Route individual cables to the appropriate Outlet locations in accordance with all standards described herein.

E. Install cables in cable tray, Snake Tray, J-hooks, pipe and/or sleeves specified in this and other sections.

F. In suspended ceilings where cable trays or conduit are not available, and it is not possible to install corridor cable support, bundle cables in bundles of 50 or less, with Velcro cable tie wraps pulled snug, but not deforming the cable geometry. Support the cable bundles with approved "J" style hooks attached to the building structure at a maximum of three-foot intervals. J-Hooks shall not be used in lieu of the corridor cable support Snake Tray. Prior to installing J-Hooks, The Integrated Security System Installer shall submit a Request for Information stating the location at which he/she requests to use J-Hooks, and justification why Snake Tray cannot be installed.

G. The Integrated Security System Installer shall adhere to the manufacturers' requirements for bending radius and pulling tension of all system cable.

H. Install cables in such a manner required to minimize tension and stress on cables, which can lead to changes in the physical and/or electrical characteristics of the cables over time. This applies to, but is not limited to, horizontal cable support methods, vertical cable support methods, tie wraps, or similar types of cable support methods.

I. Cables exiting floor conduits and sleeves shall be neatly dressed, and securely supported from the floor up to the ceiling so that the cables are not stressed or stretched by the weight of the cables. Cables shall be arranged in bundles of not more than 50 cables or less, and secured with Velcro cable tie wraps pulled snug, but not deforming the cable geometry. Acceptable support structures include, but are not limited to: Cable tray runway radius dropout, vertical ladder tray, J-hooks, unistrut, or similar types of support structures. The intent is that cables shall not be supported by the weight of the cables themselves, but are supported so that the weight of the cables is assumed by the support structure(s).

J. Route cables at right angles to electrical power circuits and supported only from the building structure when not in cable tray or conduit.

K. Do not support cabling from ceiling tiles, grid or hanger wires.

L. Do not install random or diagonal cable runs. Cable turns and bends shall be made at 90 degrees angles whenever possible, but maintaining manufacturers' requirements for bending radius at all time.

M. In the Network and Data Rooms, a 10-ft. service loop for all cables shall be provided in the cable tray above equipment. Service loops shall be installed in either a figure “8” or “U” Pattern. Service loops shall not be installed as tight circular coiled loops.

N. Cables which penetrate a steel stud or steel wall cap shall be protected from damage with a "stud liner".

O. Cables entering power poles, surface mounted raceway, or other cable management systems shall be protected from damage.

P. Extend cabling between floors utilizing inter-floor sleeves and conduit as shown.

Q. Conduit and sleeves provided as a means of routing cables between various rooms and floors shall be used according to the following requirements: Install cabling through separate conduits and/or sleeves for each system. In each group of conduits and/or sleeves, one 4-in. conduit and/or sleeve shall remain empty as a spare conduit or sleeve for future cabling. It is imperative that the cables for each system remain separate from the other systems. Cables routed in violation of this requirement shall be pulled back and rerouted, even if already terminated, at no additional cost to the Owner.

R. Conduit and sleeves provided as a means of routing cables between various rooms and floors, and those which remain empty as spare, shall be sealed with an approved fireproof, removable safing material. Sleeves which pass vertically from floor to floor shall be sealed in a similar manner using an approved re-enterable system. Additional penetrations through rated assemblies necessary for passage of wiring shall be made using an approved method, coordinated with the General Contractor, and permanently sealed after installation of cables.

S. Meet all requirements regarding use of cable in return air plenums and in raised floor systems. Provide wiring that complies with all applicable state, local building codes, and the National Electrical Code. All cables run in raised floor systems with forced air-cooling shall meet the requirements of NEC Article 645, "Electronic Computer Data Processing Equipment”.

T. Cables installed partially or fully within the MDF Room shall be routed through and secured in the cable tray wherever possible. Cables placed in the cable tray are to be laced or tie wrapped with Velcro tie wraps frequently to keep them neatly bundled and not permitted to shift from one side of the tray to the other as they are routed in the tray.

U. Color of cable jacket for each system shall be unique and distinguishable from other system cabling

V. Cables routed in main corridors shall be installed in corridor cable support as specified in this Section. The Integrated Security System Installer shall size and select the correct product so that no more than 75% of the manufacturer’s loading capacity is achieved in any given corridor area. The installer shall use the manufacturers’ recommended attachment hardware for hanging the corridor cable support. Corridor cable support shall be suspended from integrated mounting hardware every four feet along the center spine.

3.06 CONDUITS, SLEEVES, CABLE TRAY AND WALL/FLOOR PENETRATIONS

A. Conduits, Sleeves, Cable Tray and Wall/Floor Penetrations between MDF and main corridors, and between main corridors and rooms shall be provided by Division 260001 for cabling under this section.

B. The Integrated Security System Installer shall be responsible for coordinating room and/or space for cabling within all conduits, sleeves, cable tray and wall/floor penetrations provided by Division 260001.

C. Conduit sleeves between all main corridors and hallways into all rooms, offices, and spaces showing communications devices, and through all fire rated walls shall be provided by Division 260001.

3.07 FIRESTOPPING

A. Seal all horizontal and vertical openings between floors, through fire rated fire and smoke walls, used or created by the Integrated Security System Installer.

B. Refer to Section for Firestopping, for all product requirements for maintaining integrity of fire-rated construction at penetrations.

3.08 LABELING

A. Provide Owner with preliminary set of plans showing all security related devices including, but not limited to door contacts, motion sensors, key-pads, card readers, and cameras with preliminary numbering of devices assigned by the installer. Owner will review preliminary labeling of devices by installer, revise as may be required for consistency with other systems, and provide to the installer a set of plans and/or correlation tables with final device numbering to be used with labeling all devices, system programing, and as-built documentation.

B. Clearly label and identify all components. Logically and permanently mark all cable, connectors and electronic equipment.

C. Use a letter quality printer or other mechanically produced lettering for labels.

D. Place permanent cable markers 3 inches from all connectors to allow easy identification. Use Brady Markers with clear plastic ends. Acceptable markers are, Brady B-320, B-292, SL-292, or Brady machine embossed labels with clear vinyl ends. Machine generated markers are required. Place cable markers on cables so that they can be easily seen.

E. Handwritten labels shall not be accepted, even if written with a permanent marker. Temporary handwritten labels may be used only during the “rough-in” stages; they must be replaced with permanent labels prior to Project completion.

3.09 BONDING AND GROUNDING

A. Bonding and grounding shall be in accordance with ANSI-J-STD-607, the NEC® and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunications equipment and test apparatus and equipment.

B. Telecommunications Bonding Backbone utilizing #6-AWG or larger bonding conductor shall be provided by Division 260001. This is part of the grounding and bonding infrastructure (part of the telecommunications pathways and spaces in the building structure), and is independent of equipment or cable.

C. For all systems, provide equipment grounding connections. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

D. For all systems, provide conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

E. For all systems, provide transient protection on the AC power feed and on station lines leaving or entering the building.

F. Note in the system Drawings, the type and location of these protection devices as well as all wiring information.

G. Furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground bus bar.

H. Provide any necessary screws, anchors, clamps, tie wraps, distribution rings, and miscellaneous grounding support hardware to complete the installation of the grounding system.

I. Grounding busbars shall be installed in the MDF Room and the Service Entrance Room by Division 260001.

J. All non-current carrying telecommunications components (passive) shall be bonded to the grounding busbar utilizing 2-hole lugs for all bonding connections.

K. All grounding conductors shall be affixed with permanent labels in a visible location at each end of the conductor, and as close as practicable to the bonding point at each end of the conductor. The labels shall clearly identify both the source and destination of the bonding conductors. Handwritten labels are not acceptable.

3.10 TESTING

A. Engage factory-authorized service representatives to inspect components, assemblies, and equipment installations of all systems specified, including connections, and to assist in testing.

B. Tests, Inspections and Adjustments:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements, best practice, and manufacturer recommendations.
3. Conduct video surveillance camera tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
    a. Prepare equipment list described in "Submittals" Article.
    b. Verify operation of auto-iris lenses.
    c. Set focus of fixed focal length lenses according to Owner requirements.
    d. Set focus of zoom lenses. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
    e. Set and name all preset positions; consult Owner's personnel for preferences.
    f. Set sensitivity of motion detection.
    g. Connect and verify responses to alarms.
    h. Verify operation of all control-station equipment.
4. Perform operational system tests to verify that system complies with specifications. Test equipment for proper operation in all functional modes, including lockdown.
5. Schedule and perform a sample security lockdown sequence and demonstrate that all systems function.
6. Walk the system with the Owner before or after normal building hours, holidays or Saturdays at Owner’s option. A “Walk Test” shall be performed to verify correct programming and functionality of the Access Control and Intrusion Detection Systems. Confirm that initiating a lockdown closes and lock doors on fire alarm held doors, notifies the Central Monitoring Stations that a lockdown has been initiated, and annunciates a lockdown notification over the Distributed Communication System. Any improperly placed or malfunctioning equipment shall be noted and repaired. Upon repair of discrepancies, system shall be walk-tested again, until no further problems exist. Keep a record of problems noted, and the date they were repaired. A copy of this log shall be supplied to the Owner upon successful resolution of discrepancies.
7. Upon completion of a successful walk test, provide programming sheets and AutoCAD files, showing all areas of coverage and the corresponding hardware zones to the Owner and with closeout submittals.
8. When requested by the Owner, provide adjustments to the system to suit actual occupied conditions. Tasks will include, but are not limited to, the following:

a. Adjust operation of cameras and lenses.

b. Adjust all preset positions; consult with appointed Owner's personnel.

c. Make changes to cameras, lenses, and associated equipment to improve performance of the system.

d. Provide a written report of all adjustments made.

3.11 TRAINING

A. Train systems administrative and/or maintenance personnel in procedures involved in operating, troubleshooting, servicing and preventative maintenance of each system specified. Provide two (2) separate two hour training sessions to include:

1. Review of the physical configuration and interrelationship of the system components.

2. Labeling and interconnection techniques used in the installation.

3. Applications of systems including any unique connections or interfaces required in the use of systems on site.

4. A review of warranty documents for the system.

5. A review of the Technical Manual prepared per "Closeout Submittals."

6. A Review of operation manuals and users guides for the system.

7. System operation and maintenance procedures.

8. Review of all user programmable options and how to modify options.

B. For each session, provide two DVD copies of recorded training. The Owner will not accept “train the trainer” models. Provide owner with complete user instructions used for training purpose as well as training log of all users who attended training classes.

3.12 CLEANING

A. Clean all equipment and work areas under this Section, prior to scheduling Owner training. Include, as necessary, wiping of Work areas and surfaces, and the removal of dust, streaks, stains from all equipment specified. Leave installed systems and components clean and undamaged.

END OF SECTION

Division 31
Earthwork

SECTION 310125

LANDSCAPE MAINTENANCE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Provide continuous Landscape Maintenance, complete and as specified during progress of the work, after installation, for Preliminary Review and for the 90 day Maintenance Period. Also included is the Warranty Period Close Out and Final Acceptance.

1. Refer to Section 311320 Existing Plants to Remain
2. Refer to Section 328400 Irrigation System
3. Refer to Section 329000 Planting
4. Refer to Section 329200 Lawns and Grasses

1.03 RELATED WORK

A. The following related work is to be performed under the designated Sections.

1. Existing Plants to Remain - Section 311320
2. Irrigation System – Section 328400
3. Planting - Section 329000
4. Soil Preparation - Section 329113
5. Lawns and Grasses - Section 329200

1.04 REFERENCES

A. "Arboriculture: Care of Trees, Shrubs and Vines in the Landscape" by Richard W. Harris, Prentice-Hall, Inc. 2004.

B. Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

C. Massachusetts Pesticide Control Act (MPCA, Chapter 132B of the Massachusetts General Laws). Chapter 333 of the Code of Massachusetts Regulations (333 CMR).

1.05 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 013300 – Submittals.

B. Materials

1. Slow Release Fertilizer for Lawns - manufacturer's product analysis and applicable data.
2. List of replacements plants including botanical name, common name, size, and nursery/supplier.
3. Lawns and grasses.
4. Mulch.

C. Quality Control

1. The Landscape Architect can reject replacement plants at any time due to poor condition, quality, size and genus or species match to the specified material.
2. Resume of maintenance foreperson.
3. Copy of licenses, permits and insurance required by law to complete maintenance work.
4. Schedule of Maintenance Operations
    a. Schedule of maintenance operations to be completed each week including application of fertilizers for the duration of the 90 Day Maintenance Period.
    b. Anticipated day(s) of the week workers will be on site.
    c. Watering schedule.

D. Monthly Records

1. Weekly summary of all maintenance activities.
2. All materials, fertilizers, insecticides, and disease control chemicals used for the project. Record when used, for what purpose and rates of application.
3. Plants replace including: List of replacements plants including botanical name, common name, size, and nursery/supplier.
4. Watering record.

E. 90 Day Maintenance Close Out Submittals

1. Single Three-ring binder and USB drive to include the following:
    a. Materials Submittals.
    b. Quality Control information.
    c. List of plant materials replaced including botanical name, common name, size and name of the nursery the plant was acquired from.
    d. Monthly Records.

F. One Year Plant Warranty Close Out Submittals

1. Single 3-Ring Binder and USB drive to include the following:
    a. List of plant materials replaced including botanical name, common name, size and name of the nursery the plant was acquired from.
    b. Documentation and records of work performed including pruning and fertilization during the One Year Warranty Period.

1.06 QUALITY ASSURANCE

A. Qualifications

1. Job Foreperson
    a. Full time employee of the Landscape Contractor or approved Maintenance Contractor assigned to the project for the duration of the work. Foreperson shall have a minimum of (4) years' experience in landscape maintenance supervision, with training in turf management, entomology, pest control, soils, fertilizers and plant identification.
2. Labor Force
    a. Labor force shall be thoroughly familiar with and trained in the work to be accomplished and shall perform the task in a competent efficient manner.
3. Certified Arborist
    a. Person licensed by the State of Massachusetts in the pruning and care of trees and shrubs.
4. Supervision: The foreperson shall directly supervise the labor force at all times.
5. Identification: Vehicles, equipment and labor force must have proper identification. Labor force must be uniformly dressed in a manner satisfactory to Owner.

1.07 PROJECT/SITE CONDITIONS

A. Site Visit: At beginning of maintenance period, visit and walk the site with the Owner's representative to clarify scope of work and understand existing project/site conditions.

B. Documentation of Conditions: Document general condition of existing trees, shrubs, vines, groundcovers and lawn recording all plant materials which are healthy, thriving, damaged, dead or dying.

1.08 SEQUENCING AND SCHEDULING

A. Perform all maintenance during the hours mutually agreed upon by the Contractor and Owner.

B. Work force must be present at the site at least once per week and as often as necessary to perform the maintenance work in accordance with the approved maintenance schedule.

1.09 PRELIMINARY REVIEW

A. Preliminary Review: As soon as ALL Lawns and Plantings for the entire project are completed per Contract Documents, the Contractor shall request in writing Preliminary Review to determine the condition of the work in the affected Sections listed below:

1. Within 10 days of the receipt of the written request, the Owner's Representative, the Contractor and the Landscape Architect will review the work completed for conformance to the Contract Documents.
2. Corrective Work:
    a. Work requiring corrective action or replacement shall be performed within ten calendar days of the review(s).
3. Pruning: All pruning shall be done during the Preliminary Review unless otherwise required by the Landscape Architect.

1.10 SEQUENCE OF REVIEW AND ACCEPTANCE

A. Preliminary Review: Contractor shall request, in writing, a Preliminary Review of the project to review the condition of the work and to determine if the work is Substantially Complete.

1. Affected Sections:
    a. Section - 311320 Existing Plants to Remain
    b. Section – 328400 Irrigation

1) Refer to Section 328400 Irrigation for all maintenance requirements necessary until the irrigation system the 90 Day Maintenance Review is accepted.

c. Section - 329000 Planting

d. Section - 329200 Lawns and Grasses

2. Project Review: Within ten days of receipt of the written request by the Contractor, the Contractor and Landscape Architect will review the work completed for conformance to the Contract Documents and review corrective items to be included on a Punch List.

3. Punch List: Within ten days after the Project Review the Landscape Architect will prepare a list of items requiring corrective actions or replacement.

   a. Corrective Work: Perform corrective work and materials replacement in accordance with the Punch List, drawings and specifications. Contractor shall perform corrective work and request, in writing, a Punch List Review to determine if the corrective work has been completed.

4. Corrective Work Review: Within ten days of receipt of the written request that the Corrective Work has been completed by the Contractor the Landscape Architect will review the work to determine if all items have been corrected or replaced. If all Corrective work is completed, the 90 Day Maintenance Period will begin. If the Corrective Work is not completed, the contractor shall complete the corrective work and ask for a Corrective Work Review.

   a. Continue maintenance of all landscaped areas until such time as all corrective measures have been completed and accepted for Preliminary Review.

5. Start of the 90 Day Maintenance Period: Upon completion, review and acceptance of the Corrective Work at the Corrective Work Review, the Landscape Architect shall issue the Punch List indicating that the Corrective Work has been completed. The 90 Day Maintenance Period will begin on the date of the Corrective Work Review if all of the work is completed in conformance with the Contract Documents and Punch List.

B. 90 Day Maintenance Period

1. The 90 Day Maintenance begins on the date of the Corrective Work Review if all of the work is completed in conformance to the Contract Documents and Punch List.

2. The 90 Day Maintenance includes the months of April 1 through November 30. Lawn cutting and plant maintenance is suspended for the months of December through March and are not included in the 90 Day Maintenance Period. All other aspects of the 90 Day Maintenance remain in effect from December through March and the 90 Day Maintenance Period time extends into the next year. For instance, if the 90 Day Maintenance Period Begins on October 15, the maintenance time would be suspended during the month of December through March and begin again in April, with the 90 Day Maintenance Period ending on May 14.

C. 90 Day Maintenance Period Acceptance

1. Sections Affected:
   a. Section 311320 - Existing Plants to Remain
   b. Section 329000 – Planting
2. 90 Day Maintenance Review: Within ten weekdays of receipt of the written request the Owner's Representative, Contractor and Landscape Architect will review the work completed for conformance to the Contract Documents. This acceptance is exclusive of the Final Acceptance of the Irrigation System and the One Year Plant Warranty.
3. Conditions for Acceptance of the Work
   a. All items listed under Part 3 Execution must be completed and the project must be in perfect condition.
   b. 90 Day Maintenance Acceptance: Upon review, the Landscape Architect shall determine if the project is acceptable and issue a Letter of Acceptance and determine the date of when the contractor's maintenance ends and the Owner's maintenance begins. If it is determined by the Landscape Architect that the work is not in conformance with the Contract Documents the Maintenance Period will be extended until the work is accepted by the Landscape Architect.
   c. Each plant shall be alive and thriving, showing signs of growth and no signs of stress. For additional conditions of acceptance, see the respective sections below:

D. 90 Day Lawn and Grasses Acceptance and Warranty

1. Sections Affected:
   a. Section - 329200 Lawns and Grasses
2. The 90 Day Lawn and Grasses Warranty is for the duration of the 90 Day Maintenance Period. The Warranty ends at the end at the acceptance of the 90 Day Maintenance Period.

3. Warrant that lawns and grasses shall be in a healthy and flourishing condition of active growth until acceptance by the Landscape Architect of the 90 Day Maintenance Period.

4. Lawns and grasses shall be free of dead or dying patches, disease, weeds and all areas shall show foliage of a normal density, size and color.

5. The flourishing grass coverage for the lawns and grasses shall mean that a minimum of 95% of the area planted shall be covered with the specified grasses, and cut a minimum of eight times, by the end of the 90 Day Maintenance period in order to qualify for the acceptance of the 90 Day Maintenance Period.

E. One Year Plant Warranty

1. The One Year Plant Warranty begins on the date of the 90 Day Maintenance Acceptance. Refer to Section 329000 for specific Warranty Requirements.

2. Contractor Review during the One Year Warranty Period:

   a. Prune and fertilize the plants as required.

   b. Contractor shall request in writing a review with the Owner. Contractor will review the plants with the Owner and agree to and provide a list to document plants that are dead, dying or with more than 25% of the stems, branches and/or crown damage or dead that need to be replaced.

3. Replacement Plants: Match accepted plant materials, size, caliper and quality.

F. Final Acceptance

1. Affected Sections:

   a. Section 311320 - Existing Plants to Remain

   b. Section 329000 – Planting

2. Contractor shall confirm that all plants agreed to be replaced have been replaced and the Contractor shall request in writing a Final Acceptance Review with Owner at the end of the Warranty Period for Planting.

3. Within (10) days of receipt of request the Owner's representative and Contractor will review the work for conformance to the Contract Documents.

   a. Final Acceptance: If the work is complete the Owner will issue a Letter of Final Acceptance.

G. Irrigation Maintenance and Warranty:

1. Refer to Section 328400 for specific requirements.

1.11 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.12 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architect's designated representative.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: All materials and equipment shall be provided by the Contractor, except as specified below.

B. Water: Clean, potable and fresh, as available from Owner.

C. Fertilizers

1. Refer to Confirmatory Soils Testing and Amending in Section 329113 – Soil Preparation for these items.

D. Chemicals, Insecticides, and Fungicides for plant disease or pest control.

1. If required due to plant disease and pests, only those persons licensed to use these in State where this project is being built shall apply these.
2. Use only those accepted for use by meeting all applicable Local, State and Federal laws and regulations.
3. Best quality materials with original manufacturers' containers, properly labeled with guaranteed analysis.
4. Use non-staining materials.
5. A record of all herbicide applications done, the herbicide used and how much applied shall be kept by the Contractor and submitted at the end of the (1) year Warranty for Plants, Lawns and Meadows.
6. Protect adjacent plant and grasses when herbiciding. Any plants which are killed or damaged in the opinion of the Landscape Architect shall be replaced by the Contractor to match those plants damaged. Remove damaged plant and dispose of legally off site.

E. Trees, Shrubs, Groundcovers, Perennials and Bulbs: Match accepted materials Nursery-grown in pots, full, healthy plants. Annuals shall be in the same flowering state as those remaining in healthy condition.

F. Lawns and Grass Mixes: Match accepted materials.

G. Landscape soil (s) and backfill mix(s): Match Accepted Materials for lawns and Grasses and Plants. Refer to Section 329113 Soil Preparation.

H. Mulch: Match the accepted material. Refer to Section 329000 – Planting.

I. Irrigation: Match accepted materials.

2.02 REPLACEMENT PLANTS AND LAWN AND GRASSES

A. Match approved plants and Lawn and Grass Seed Mix(s).

2.03 EQUIPMENT

A. General: All equipment is to be provided by the contractor. Use only the proper tool for each job. Maintain all tools in sharp, properly-functioning condition. Clean and sterilize pruning tools prior to usage.

B. Insect/Disease Prevention: Take all measures to prevent introduction of insect or disease-laden materials onto the site. Planting - Section 329000.

PART 3 EXECUTION

3.01 REMOVAL, REPAIR AND REPLACEMENT OF DAMAGED WORK

A. Remove, repair and replace any work in Section 311320 - Existing Plants to Remain, Section - 329200 - Lawns and Section 329000 - Planting or any of the Owner's Existing Property or any Work in the Contract which has been damaged by Maintenance work to match the requirements of the damaged work at no additional cost to the Owner.

B. Refer to Section 328400 – Irrigation System.

3.02 MAINTENANCE PREPARATION

A. Protection:

1. Protect all lawns and planting areas from damage of all kinds from beginning of work until the Acceptance of the 90 Day Maintenance.
2. Provide temporary protection fences, barriers and signs as required for protection.

B. Replacements

1. Immediately treat or replace all plants which become damaged or injured as a result of Contractor's operations or negligence, as directed by Landscape Architect, at no cost to Owner.
2. Replacement plants shall match size, condition and variety of plants replaced.

C. Repair any damage done as a result of any maintenance work to Lawns or the Work of any other Section of the Specification to match the work specified therein.

3.03 INSECTS, PESTS, AND DISEASE CONTROL

A. Inspection: Inspect all plant materials for signs of stress, damage and potential trouble from the following:

1. Presence of insects, moles, gophers, ground squirrels, snails and slugs in planting areas.
2. Discolored or blotching leaves or needles plant diseases and insect infestation.
    a. Unusually light green or yellowish green color inconsistent with normal green color of leaves.

B. Personnel: Only licensed, qualified, trained personnel shall perform spraying for insect, pest and disease control.

C. Application: Spray with extreme care to avoid all hazards to any person or pet in the area or adjacent areas.

3.04 SEASONAL MAINTENANCE DURING THE 90 DAY MAINTENANCE PERIOD

A. Irrigation: Refer to Section 328400 for Seasonal Maintenance, Spring start up and winterization of the Irrigation System.

B. Plant and Lawn Replacements

1. Immediately remove and replace dead, dying, injured and unsightly plants with replacement plants that match the size and variety approved during the Construction of the work.
2. Immediately overseed, slice seed or replace any Lawns and Grasses so that at the end of the 90 Day Maintenance Period the Lawns and Grasses meet the coverage acceptance requirements.

C. Spring Clean Up

1. Rake all beds and lawns. Prune, trim plants as required. Edge all plant beds and re-mulch.
2. Remove all leaves and debris.
3. Irrigation: Refer to Section 32 84 00.

D. Fall/Winterization

1. Tie any shrubs that could be damaged during heavy snowfall or ice accumulation.
2. Place (3-4) inches of salt marsh hay or leaves over perennial beds
3. Apply anti-desiccants as recommended.
4. Remove all leaves and debris.

E. Spring Maintenance

1. Clean leaves from planting beds.
2. Reestablish tree and shrub saucer/watering basins. Do not cover the tree root flares.
3. Edge all plant beds.
4. Cut perennial stalks to 2-inches above the soil.
5. Spread new mulch as required.

6. Pull all weeds and remove debris.
7. Prune all dead wood from plant materials.
8. Mow lawn weekly to an even height of (2.5-2.75) inches. Trim all bed edges to a neat even height equal to the height of the lawn.
9. Seed Mix #2 and #3: Mowing shall take place when the seeded area is (12) inches tall and shall result in a height of (6-8) inches.
10. Apply slow release fertilizer designed for trees, shrubs and perennials at a rate recommended by the manufacturer.
11. Apply pre-emergent fertilizer with crabgrass control on all lawn areas at a rate recommended by the manufacturer.
12. Apply granulated lime if recommended.
13. Fungicide and insect control as required at a rate recommended by the manufacturer.
14. Hand water trees, shrubs, perennials and lawn as needed.
15. Repair and replace all damaged or dead plants.
16. Remove all lawn clippings, leaves, branches and debris from the site.

F. Summer Maintenance

1. Clean leaves from planting beds.
2. Reestablish tree and shrub saucers/watering basins. Do not cover the tree root flares.
3. Edge all plant beds.
4. Spread new mulch as required.
5. Pull all weeds and remove debris on a weekly basis.
6. Prune all dead wood from plant materials.
7. Deadhead flowers as the flowers begin to fade.
8. Mow lawn weekly to an even height of (2.75 – 3.0) inches. Trim all bed edges to a neat even height equal to the height of the lawn.
9. Seed Mix #2 and #3: Mowing shall take place when the seeded area is (12) inches tall and shall result in a height of (6-8) inches.
10. Apply fertilizer with weed control on all lawn areas at a rate recommended by the manufacturer.
11. Fungicide and insect control as required at a rate recommended by the manufacturer.
12. Hand water trees, shrubs, perennials and lawn as needed.
13. Repair and replace all damaged or dead plants.

14. Remove all dead plants, lawn clippings, leaves, branches and debris from the site.

G. Fall Maintenance

1. Clean leaves from planting beds and lawn areas.
2. Reestablish tree and shrub saucers/watering basins. Do not cover the tree root flares.
3. Edge all plant beds
4. Spread new mulch as required.
5. Pull all weeds and remove debris.
6. Prune all dead wood from plant materials.
7. Deadhead flowers as the flowers begin to fade.
8. Place salt marsh hay or leaves over perennial beds
9. Mow lawn weekly to an even height of (2.5 – 2.75) inches. Trim all bed edges to a neat even height equal to the height of the lawn.
10. Seed Mix #2 and #3: Mowing shall take place when the seeded area is (12) inches tall and shall result in a height of (6-8) inches.
11. Apply fertilizer on all lawn areas at a rate recommended by the manufacturer.
12. Apply winterization fertilizer on all lawn areas at a time and rate recommended by the manufacturer.
13. Fungicide and insect control as required at a rate recommended by the manufacturer.
14. Hand water trees, shrubs, perennials and lawn as needed.
15. Repair and replace all damaged or dead plants.
16. Remove all dead plants, lawn clippings, leaves, branches and debris from the site.

H. Winter Maintenance

1. Clean leaves from planting beds and lawn areas.
2. Cut back ornamental grasses to a height of six to eight inches.
3. Cut back perennial stalks to two-inches above the topsoil.
4. Remove all dead plants, leaves, branches and debris from the site.

I. Refer to 3.06 for mowing of Seed Mix #2 and Seed Mix #3.

3.05 PLANT MAINTENANCE

A. Water shall be applied by the Contractor in sufficient quantities to keep the plants in a healthy thriving condition. Care shall be taken not to over water plants.

B. Watering Basins

1. Maintain all watering basins around plants so that enough water can be applied to establish moisture through major root zones.

2. For supplemental hand watering of watering basins, use a water wand to break the water force. Do not permit use of "jet" type watering equipment. Do not permit crown roots to become exposed to air through dislodging of soil and mulch.

3. Maintain originally called for depth of mulch to reduce evaporation and frequency of watering.

4. In rainy season, open basins to allow surface drainage away from the root crown where excess water may accumulate. Restore watering basins at end of rainy season.

C. The Contractor shall review the plant rootballs and adjacent soil(s) and the plants for watering requirements and deficiency or excessive watering symptoms.

1. If sufficient water is found to be retained in the plants rootball, and/or adjacent soil, the watering may be reduced.

a. The Contractor shall excavate and examine the rootballs and adjacent soil(s) with an acceptable moisture sensing device designed for this purpose and also make his own professional review and additional sampling and testing as necessary to determine the adequacy of the watering.

b. The Contractor shall also review the plants for determination of over or under watering needs and symptoms.

D. Resetting: Reset plants to proper grades and upright position using the specified materials.

E. Weed Control

1. All areas between plants, including plant beds and watering basins, shall be weed free at all times.

2. Avoid frequent soil cultivation that destroys shallow roots.

F. Tree and Shrub Pruning: All persons performing pruning operations shall possess a current Arborist License or be directly supervised by and individual who does for the state in which this project is located.

1. Prune trees and shrubs to select and develop permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached. In reference to trees, prune branches that have vertical spacing of 18 inches to 48 inches and radial orientation so as not to overlay onto one another.
2. Prune trees and shrubs to eliminate diseased or damaged growth, and narrow V-shaped branch forks that lack strength. Reduce toppling and wind damage by thinning out crowns.
3. Prune trees and shrubs to maintain growth within space limitations, maintaining a natural appearance and balancing crown with roots.
4. No stripping of lower branches ("raising up") of young trees or shrubs will be permitted.
5. Retain lower branches in a "tipped back" or pinched condition to promote caliper trunk growth (tapered trunk). Do not cut back to fewer than six buds or leaves on such branches. Only cut lower branches flush with the trunk after the tree is able to stand erect without staking or other support.
6. Thin out and shape evergreen trees when necessary to prevent wind and storm damage. Do primary pruning of deciduous trees during the dormant season. Do not permit any pruning of trees prone to excessive "bleeding" during growth season.
7. Prune damaged trees or shrubs or those that constitute health or safety hazards at any time of year as required.
8. Make all cuts clean and close to the trunk, without cutting into the branch collar. "Stubbing" will not be permitted. Cut smaller branches flush with trunk or lateral branch. Make larger cuts (one-inch in diameter or larger) parallel to shoulder rings, with the top edge of the cut at the trunk or lateral branch.
9. Branches too heavy to handle shall be precut in three or more stages to prevent splitting or peeling of bark. Make the first two cuts 18 in. or more from the trunk to remove the branch. Make the third cut at the trunk to remove the resulting stub.
10. Do not prune or clip shrubs into balled or boxed forms unless specifically called for by design.
11. Hedge Pruning – Review plants that are noted in the plant list to be pruned into hedges with the Landscape Architect for shaping requirements.
12. Take extreme care to avoid transmitting disease from one infected plant to another. Properly sterilize pruning tools before going from one infected plant to all other plants.

G. Remove all vine stakes and ties at the completion of the warranty period.

H. Plant Disease(s)

1. Treat any plants which are diseased.

a. If the plants which are diseased do not respond to treatment in the opinion of the Landscape Architect, they shall be removed and replaced with matching healthy plants, at no Additional cost to the Owner.

I. Shovel Cut Bed Edging: Redo as necessary to keep shape.

J. Remove all dead plants immediately. Replace as soon as possible within the planting season.

K. Mulch: Apply mulch as necessary to restore beds to accepted condition.

L. Plant fertilization and amending: apply fertilizers and amendments as provided per Confirmatory Soils Testing and Amending in Section 329113 – Soil Preparation.

3.06 LAWN AND GRASSES MAINTENANCE UNTIL ACCEPTANCE OF THE 90 DAY MAINTENANCE PERIOD

A. Watering

1. Watering for all lawns shall be daily for the first week after installation unless site or weather conditions require adjustment of watering or as directed by the Landscape Architect.

2. General Watering: Water lawns at such frequency as weather conditions require to replenish soil moisture and keep the Lawns and Grasses in a flourishing thriving condition.

3. Care shall be taken not to over water lawns since adjacent plants or plants in lawn areas might be damaged by over watering.

B. Weed Control

1. Control broadleaf weeds and remove.

2. Lawns: Control and remove all crabgrass and weeds and replace and rehydroseed lawn areas within the specified planting season(s).

3. Control thatch buildup of lawns.

C. Mowing

1. Hydroseeded Lawns and seeded areas

a. Refer to Seasonal Maintenance During The 90 Day Maintenance Period for mowing height.

1) Do not girdle trees with weed wackers or other trimmers.

b. Mowing along Shrub and Groundcover bed edges: Shovel cut or mechanically trim lawn bed edges at least twice a month or as needed for neat appearance. Vacuum clippings and dispose legally off site.

2 Seed Mix #2 and Seed Mix #3: First Year after installation.

a Mowing shall take place when the seeded area is (12) inches tall and shall result in a height of (6-8) inches. It is anticipated that 3-5 cutting, at a minimum may be necessary the first year.

b If good establishment does not occur as determined by the landscape architect, continue mowing as stated in a. above the following year.

3 Seed Mix #2 and Seed Mix #3: One Year After Installation (if the seeded area is established as determined by the Landscape Architect).

2. a Mow once a year between November 15 and December 15 to a height of (8) inches in height.

D. Fertilization and Amending of Hydroseeded Lawn

1. Apply fertilizers and amendments as provided per Confirmatory Soils Testing and Amending in Section 329113 – Soil Preparation.

2. Apply fertilizer when grass is dry and preferably after mowing. Do not apply during hot weather or when grass is under stress. Water immediately after application.

E. Plant Disease(s)

1. Treat any plants (grasses) which are diseased.

a. If the plants which are diseased do not respond to treatment in the opinion of the Landscape Architect, they shall be removed and replaced with matching healthy plants, at no Additional cost to the Owner.

F. Replace any damaged, washed out or diseased hydroseeded lawns areas with the specified grasses for the areas.

3.07 MULCH AREAS MAINTENANCE

A. Replace any disturbed mulch immediately.

3.08 CLEAN UP

A. Dispose of all pruned materials, vacuum all lawn clippings and leaves, sweep all walkways and rake smooth all mulch areas.

B. Remove from the site all containers and evidence of maintenance activities.

END OF SECTION

SECTION 311000

SITE PREPARATION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Perform the following work, as shown on the Drawings and specified herein:

1. Site demolition and removal operations, including the removal of designated plantings, curbing, rubbish, lawn and other materials, within the limit of work line, not specifically designated to remain. Dispose of materials legally off site. Stockpile for reuse on the project those materials as shown on the drawings and specified herein.
2. Perform complete clearing and grubbing operations in areas shown on the drawings and remove all cleared and grubbed materials.
3. Inform the Architect of any materials or structures not shown on the site survey and various sitework plans and arrange or its removal from the site or protection as directed upon the Architect's request.
4. Construct construction fencing, barricades, shoring, bracing or other temporary structures to perform the work of this Section and protect existing materials to remain. Perimeter construction fencing shall remain in place for the Owner's continued use after the completion of this contract.
5. Protect all existing utilities, structures, plants and materials to remain from damage due to construction.
6. Construct and maintain siltation control fencing.

B. Items for removal and disposal include, but are necessarily limited to:

1. Bituminous concrete pavement and curbing at street utility crossing.
2. Stumps, shrubs and lawn.
3. All other items of removal and disposal necessary for completion of work.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. The following related work is to be performed under the designated SECTIONS.

1. Earthwork: SECTION 312000 - EARTHWORK
2. Erosion and sediment controls: SECTION 312500 – EROSION AND SEDIMENTATION CONTROLS
3. Cutting and patching of bituminous paving for new drainage piping crossing the street: SECTION 321200-FLEXIBLE PAVING.
4. Loam has previously been stripped from this project site and stockpiled for reuse on site under a previous contract to the Owner. Refer to SECTION 011000-SUMMARY OF WORK.

1.04 QUALITY ASSURANCE

A. This Contractor shall verify dimensions and elevations on the ground and report any discrepancies immediately to the Architect in writing. Any discrepancies reported prior to construction shall not be the basis for claims for extra compensation.

1.05 PROJECT CONDITIONS

A. Examination of Conditions: The Contractor shall examine the premises before submitting a bid for the work and to be fully aware of the existing conditions under which the work will be performed or that will in any way affect the work under this Contract.

1.06 ORDER OF CONDITIONS

A. This project is subject to the regulations of the City of Amesbury's Conservation Commission and is herein part of the Contract Documents. Refer to SECTION 013500-ORDER OF CONDITIONS.

B. **The Contractor shall submit the Stormwater Pollution Prevention Plan (SWPPP) to the Amesbury Conservation Commission for approval at least 30 days prior to starting earthwork on the site.**

C. Prior to any excavation or earth removal, adequate siltation control measures shall be constructed to prevent the runoff-silted water from the site. All catch basins within the Limit of Work Line shall be protected with filter fabric and straw bales or silt sacks as indicated in the Drawings to prevent siltation into the drain lines during construction.

D. Site conditions, including erosion and siltation control, as required by the Order of Conditions shall remain in place and shall be maintained by the Contractor throughout the construction period.

PART 2 PRODUCTS

2.01 SITE CONSTRUCTION FENCING AND BARRICADES

A. The Contractor shall be responsible for providing temporary construction fencing and barricades around the Limit of Work areas and as otherwise may be necessary to assure the safety of all persons, authorized and unauthorized. Any such fencing or barricade shall be maintained in an orderly condition.

B. Unless otherwise specified, construction fence shall be 6 feet high and of chain link construction with scrims for vision and dust control, erected in a substantial manner, straight, plumb and true as approved by the Architect. Refer to drawings for locations where fence posts are to be driven and where fencing is to be movable.

C. Gates shall be built into the fence at such approved locations as are necessary, well cross braced and hung on heavy strap hinges with proper post and hook for double gates. Provide heavy hasps and padlocks for each gate. Provide keys to the Owner, and to the Police and Fire Departments to facilitate emergency access. Provide Knox Box with keys at all gates.

D. **Upon completion of the work, driven post fencing and gates shall be removed and disposed of. Movable construction fencing shall remain the property of the City of Amesbury. Refer to SECTION 015000-TEMPORARY FACILITIES AND CONTROLS.**

2.02 EROSION CONTROL

A. Refer to SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS.

PART 3 EXECUTION

3.01 PROTECTION

A. Erect and maintain temporary lights, barricades, warning signs, and guards necessary to protect streets, sidewalks and adjoining property from damage, all in accordance with applicable rules and regulations. Refer to SECTION 015000-TEMPORARY FACILITIES AND CONTROLS.

B. Protect all areas and structures to remain undeveloped whether inside or outside the Contract limit lines. Should these areas be damaged, the Contractor shall restore them to the satisfaction of the Architect. This includes repairing and replacing all damaged elements, structures and materials. Materials required for repair, replacement and patching shall be provided by the appropriate Subcontractor.

C. Protection of Existing Plant Materials.

1. Within the limit of work lines protect all plant materials to remain as indicated on the Drawings. No such plant materials shall be used as guys or other fastening.

2. If, in order to perform excavation work, it becomes necessary to cut roots of plants to be saved, such roots shall be neatly cut and painted with an approved tree paint after consulting the Architect.

3. This Contractor shall be responsible for the protection of all trees within the Limit of Work Line that are to remain. Existing trees, subject to construction damage, shall be boxed, fenced or otherwise protected before any work is started. Do not permit heavy equipment or stockpiles within branch spread. Any tree damaged by operations under this Contract shall be repaired to the satisfaction of the Architect by competent tree surgeons at the expense of the Contractor, and any trees damaged beyond repair shall be replaced by an equivalent tree.

D. Wet down areas as required to prevent dust and dirt from rising and leaving the site.

3.02 CLEARING AND GRUBBING

A. Clearing shall consist of the cutting and removal of all trees, logs, stumps, brush, roots and other objectionable material from within the Limit of Work Line unless otherwise shown on the plans or directed by the Architect.

B. Grubbing shall include the removal and disposal of all stumps and roots.

3.03 CUTTING PAVEMENT

A. Paving and curbs to be removed that intersect with paving and edging to remain, and portions of pavements which must be removed for utility installation shall be saw cut in straight lines with power saws. Sawing shall extend through paved topping.

3.04 OTHER REMOVALS

A. All other existing material not designated to remain shall be removed in its entirety including both above and below grade components of each item.

B. All existing items noted above not reused in this project shall be deposited or neatly piled or stacked in a location proposed by the Contractor for approval by the Architect.

C. Any item not reused in this project and not selected by the Architect or specified as salvaged for the Owner shall become the property of the Contractor and shall be removed from the site and legally disposed of.

3.05 EROSION CONTROLS

A. Refer to SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS.

END OF SECTION

SECTION 311320

EXISTING PLANTS TO REMAIN

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Provide Plant Protection, Plant Protection Fencing, relocation of plant protection fencing, relocation of the site perimeter security fence to protect the existing trees and provide, pruning, root pruning and other care which may be required of all EXISTING TREES and SHRUBS within the property and the adjacent property where construction activities may impact the health of the trees and shrubs.

1.03 RELATED WORK

A. The following Related Work to be performed under the designated Sections:

1. Site Preparation, including Demolition – Section 311000
2. Landscape Maintenance – Section 310125
3. Earthwork - Section 312000
4. Finish Grading – Section 312219
5. Fencing – Section 323100
6. Planting - Section 329000
7. Soil Preparation - Section 329113
8. Lawns and Grasses – Section 329000

1.04 PROJECT CONDITIONS

A. Review: Visit and walk the site with the Owner's representative to clarify scope of work and understand project conditions.

B. Documentation: Confirm location of all trees within the areas to be protected. Record all discrepancies and all conditions, which threaten existing plantings.

1.05 DEFINITIONS

A. Plant Protection: Plant protection fencing, silt fencing, and site perimeter/security fencing that secures the limit of work area.

B. Protected Area: Areas within the property, adjacent property that is or could be impacted by construction activity.

C. Arborist: Person certified and licensed in the State of Massachusetts in the care of plant materials and application of chemicals.

D. References to Landscape Architect shall mean Architect or the Architect's designated representative.

1.06 PERIOD OF PERFORMANCE

A. From Award of Contract to Final Acceptance for Landscape Planting One Year Warranty. Refer to Section 310125 – Landscape Maintenance.

1.07 QUALIFICATIONS

A. The Arborist shall be licensed and certified Arborist in the State of Massachusetts with a minimum of (10) years of experience in the care of large trees during the construction process.

1.08 WARRANTY

A. Existing Trees and Shrub Warranty:

1. General: Similarly warrant all EXISTING TREES AND SHRUBS which are within the Protected Area that are part of the work to be protected against decline resulting from damage and or lack of watering during construction until Final Acceptance of the new planting to be installed.

B. Damaged or Dead Existing Tree(s) Warranty

1. The Warranty shall be the same as for new trees and shrubs. See Section 329000 Planting

C. Exclusions: Damage due to vandalism, Acts of God, or neglect by Owner.

1.09 REPLACEMENT OF DAMAGED EXISTING TREES AND SHRUBS

A. Replacement of Existing Trees to be Protected: Existing trees to be protected which exhibit conditions which are determined by the Landscape Architect as unacceptable due to inadequate protection and or watering during construction shall be removed (including stumps and roots), disposed, and replaced and warranted (the same as for new planting) by General Contractor at no expense to Owner.

B. Replacement trees shall be the same species as the damaged tree.

C. Replacement Tree Schedule:

1. Deciduous trees (10) inch caliper and over: Replace with (one) (9) inch to (10) inch caliper B&B specimen trees per damaged tree. The locations and type of tree shall be chosen by the Landscape Architect.

2. Deciduous trees (10) inch caliper and less: Replace with (one) B&B specimen tree of the same caliper per each damaged tree. The locations and type of tree shall be chosen by the Landscape Architect.

3. Evergreen trees (14) feet tall and over: Replace with (one) (14) foot tall B&B specimen trees per damaged tree. The locations and type of tree shall be chosen by the Landscape Architect.

4. Evergreen trees (14) feet and less: Replace with (one) B&B specimen tree of the same height per damaged tree. The locations and type of tree shall be chosen by the Landscape Architect.

D. Replacement Shrub Schedule

1. Shrubs: Replace with (one) B&B specimen shrub per damaged shrub at the same size as the damaged or dead shrub. The location and species shall be chosen by the Landscape Architect.

E. Replacement Trees and Shrubs shall be considered new trees and all applicable requirements as for trees and shrubs are as specified under Planting and all the related sections.

1.10 ACCEPTANCE OF EXISTING PLANTS TO REMAIN AND ANY REPLACEMENT PLANTS

A. Acceptance Requirements: For Preliminary Review, 90-Day Maintenance Period, and Final Acceptance, See Section 310125 - Landscape Maintenance.

1.11 SUBMITTALS AND SAMPLES

A. Submit the following in accordance with the provisions of Section 013300 – Submittals.

B. Resume of qualified Company and Arborists including a list of similar projects of the licensed and certified Arborist that the General Contractor proposes to use on the project.

C. Arborist Reporting: For the area within the Limit of Construction, the property area and Trees and Shrubs on adjacent properties that may be impacted by construction activities.

1. Arborist Initial Report and Evaluation:

    a. Walk the site with the Landscape Architect after the erosion control and construction fencing is installed and before any site clearing or grading is to begin to review the existing Trees and Shrubs to Remain.

    b. Prepare a Key Plan indicating the trees and shrubs at the time of the walk that need to be evaluated both on and off site due to construction activities and impacts.

    c. Prepare a written report of the condition of the trees and shrubs that are being evaluated and recommend pruning, root pruning, air spading, fertilization, watering and other care that should be completed by the arborist before construction begins.

    d. Document trees and shrubs that will be impacted during construction that the Arborist should be on site caring for the trees and shrubs that are directly impacted by construction activities as construction progresses.

2. Monthly Arborist Reporting: Monthly report by the Arborist on the condition and care performed for the Trees and Shrubs within the project site, protected area which have been impacted or could be impacted by construction activity.

    a. Add new trees and shrubs to the Key Plan that are impacted by construction activities.

    b. Written evaluation of the trees and shrubs identified on the plans and new trees and shrubs that are impacted by the work for work performed and work recommended including but not limited to pruning, air spading, root pruning, fertilization, watering and other means and methods required to be completed by the Arborist and Contractor during Construction to preserve Existing Trees and Shrubs.

    c. Recommendation for care to be undertaken by the Contractor due to stress, encroachment into the Protected Area by vehicles, foot traffic or stored materials.

    d. Recommendations for new Fencing, movement of Fencing and for care for trees and shrub areas in preparation for construction in the area of tree protection.

3. Temporary Tree Irrigation:

    a. Drawing indicating temporary and automatic irrigation system including but not limited to irrigation piping, irrigation heads, timer, pipe connections to the water source and any other equipment necessary to water the trees at intervals recommended by the arborist.

D. Submit (one) pound of pine bark mulch.

1.12 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.13 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architect's designated representative.

PART 2 PRODUCTS

2.01 PLANT PROTECTION FENCING

A. This fence shall be installed at the direction of the Arborist and Landscape Architect if the site security fence or erosion control is compromised and the Existing Trees to Remain are accessible to vehicular and/or foot traffic and storage of materials and equipment.

B. Temporary chain link fencing which shall have a 9 gauge mesh and be (6) feet high above the ground (Salvaged chain link fencing may be used). Line posts shall be (2) inch o.d. steel pipe. Provide hardware as required for attaching fence. All fabric shall be knuckled selvage.

1. If posts are on paved areas, provide footings which will stabilize fence and not damage paving.
2. Gate: Provide (one) (3) foot wide x (6) foot high chain link fence gate for access to each tree protection area.
3. Lock: Provide a pad lock and chain for the gate.

2.02 MULCH

A. Type: Wood chip mulch as recommended by the Landscape Architect.

2.03 TEMPORARY TREE IRRIGATION

A. Provide materials acceptable to the Landscape Architect.

2.04 SAFETY: Provide all reflective signage and/or flashers as required by all codes and ordinances affecting protected plantings to remain.

PART 3 EXECUTION

3.01 PLANT PROTECTION FENCE ERECTION

A. Install shown on the plans and as directed by the Landscape Architect.

B. Post shall be a maximum of (6) feet on center.

C. Drive posts (3) feet into ground leaving (6) feet exposed.

D. Stretch and install fabric leaving approximately (1) inch between finish grade and the bottom selvage. Pull fabric taut and tie to posts.

E. Maintain the fence in a true, upright and secure alignment

F. Remove when directed by the Landscape Architect.

3.02 OPERATIONS

A. Storage: Do not store materials or equipment under the branches of all existing trees to remain.

B. Traffic: Do not operate nor park equipment within the drip line of existing trees to remain. Keep foot traffic out of existing planted areas.

3.03 PROTECTION OF EXISTING TREES AND SHRUBS

A. Protect existing trees and shrubs and other associated vegetation to remain in place, against unnecessary cuttings, breaking or skinning of roots, skinning or bruising of bark, smothering of tree roots by stockpiling construction materials within drip line. Protect vegetation from excess foot traffic, vehicular traffic or parked vehicles within the drip line.

B. During construction, all recommendations for care of the Existing Trees and Shrubs to Remain by the Arborist and Landscape Architect, shall be performed to assure the health and vigor of the trees at no cost to the Owner.

C. Trees and Shrubs damaged by construction operations which are scheduled to remain.

1. Repair trees and shrubs that are damaged by construction operation in a manner acceptable to the Landscape Architect. No roots greater than 2" inches in diameter shall be cut from plants to remain without the prior approval. Provide protection for roots over (1) inch diameter during construction operations by installing a (2) inch layer of mulch.

2. Prune roots that are either cut or broken with a smooth clean cut. Temporarily cover exposed roots with wet burlap to prevent roots from drying out, cover with earth as soon as possible.

3. Replace trees and shrubs damaged beyond repair, as determined by the Landscape Architect. Replacement of trees and removal and disposal of damaged material shall be at the General Contractor's expense.

   a. Refer to REPLACEMENT OF DAMAGED EXISTING TREES as specified in Part 1 of this Section.

4. Trees and shrubs damaged beyond repair as determined by the Landscape Architect shall be removed immediately.

5. Replacement trees and shrubs shall be planted as soon as weather conditions permit and within the specified planting season.

3.04 TEMPORARY TREE IRRIGATION

A. Verification of Conditions:

1. Verify that the tree protection fencing has been installed.

2. Verify that the approved mulch has been installed in the location and to the depth required by the Arborist.

B. Install the temporary tree irrigation as shown on the approved shop drawings.

1. Set automatic timer to achieve the watering time or water volume as required by the arborist.

3.05 MULCH LAYER

A. Mulch shall be installed at the direction of the Landscape Architect if the site security fence is compromised and the Existing Trees to Remain are accessible to vehicular and/or foot traffic and storage of materials and equipment.

B. Install a (4) inch deep maximum layer of wood chip mulch to the drip line of the tree or shrubs and or in areas designated during construction if required by the Landscape Architect. Remove mulch upon completion of construction and install materials as indicated on the drawings or a (2) inch layer of bark mulch if a material is not indicated on the drawings.

3.06 EXCAVATING AND GRADING IN TREE AND SHRUB PROTECTED AREAS

A. Cutting: Do not permit machine excavation within the Protected Area. All such work shall by hand labor unless otherwise authorized by the Landscape Architect.

B. Filling: Do not permit stockpiling of soil within the Protected Area.

3.07 REPLACEMENT PLANTS FOR DAMAGED EXISTING PLANTS

A. All replacement plants shall be considered new plants and all applicable planting details and specification requirements shall apply.

3.08 MAINTENANCE OF PROTECTED TREES

A. General: During the Maintenance Period for new planting, similarly maintain all protected trees. See Section 329113 - Landscape Maintenance.

1. Add mulch as necessary to replace washed or otherwise depleted mulch areas and as required by the Landscape Architect.

3.09 CLEAN UP

A. Repair all grades and remove all debris, stumps, plants, trees and shrubs and excess material and legally dispose offsite.

B. Remove all temporary tree irrigation materials and equipment and legally dispose offsite.

END OF SECTION

SECTION 312000

EARTHWORK

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine and be familiar with all conditions as they exist at the project site and project-related areas prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Based on known environmental conditions at the property, some of the activities described in this SECTION will require handling and management of arsenic-impacted soil. All excavated and/or disturbed soil will be managed as specified in this SECTION, SECTION 312600 MANAGEMENT AND DISPOSAL OF CONTAMINATED MATERIAL and the Soil and Groundwater Management Plan (SGMP) attached to SECTION 312600.

B. Provide labor, materials, and equipment to perform the following work, as shown on the Drawings and specified herein (Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to SECTION 312600 for additional requirements):

1. Strip all topsoil/loam from areas designated on the Drawings and remove and dispose from the site:

   a. Approximately 1,500 cubic yards of topsoil/loam stripped from the location shown on the Drawings shall be stockpiled on site at the location designated on the Drawings. This material has been pre-characterized in situ and is shown to be below reportable levels for arsenic and other contaminants and is acceptable to be re-used on site.

   b. The balance of the loam, approximately 10,000 CY, has been pre-characterized to be above reportable levels for arsenic, shall be stripped and disposed of by this Contractor. Refer to paragraph 1.04D within this SECTION.

2. Strip all fill/subsoil to the depths indicated and areas designated on the Drawings and remove and dispose from the site:

   a. Approximately 5,200 cubic yards of excavated fill is anticipated to be suitable for reuse on the site. Existing fill that is free of debris and organics may be reused below slab/pavement/play area base course elevation or in landscaped areas below topsoil, provided it is compacted to the degree required herein. Fill with trace amounts of debris or organics may be reused below pavement base course.

1) The determination of where this material may be used is based on material testing and characterization. Refer to 3.03.J within this SECTION.

b. Should less than the 5,200 cubic yards of excavated fill be determined suitable for reuse, offsite fill meeting the requirements of this SECTION shall be substituted for the difference, according to SECTION 012200-UNIT PRICES.

c. Should more than 5,200 cubic yards of existing fill be determined suitable for reuse, the reduced amount of offsite fill required shall be credited to the Project, according to SECTION 012200-UNIT PRICES

3. Material Testing: The Contractor shall be required to perform soil characterization testing of all excavated material to determine where the material may be used on site and/or how material is to be disposed of. Refer to SECTION 312600-MANAGEMENT AND DISPOSITION OF CONTAMINATED MATERIALS for additional information.

a. Payment for subsoil excavation will be based on measurement as outlined in paragraph 1.05 BENCHMARKS, LINES AND GRADES, within this SECTION.

4. Offsite fill required to augment reusable on site fill to achieve the finish grades as shown on the plans shall be included in the Base Bid.

5. Excavation and Backfill Quantities

a. Quantities, are to include excavation, loading, transportation and disposal, to be adjusted upward or downward in accordance with SECTION 012200-UNIT PRICES.

b. General Excavation:

1) Arsenic impacted fill (and subsoil), unsuitable for reuse on site:

15,400 cubic yards

2) Arsenic impacted topsoil: 10,000 cubic yards

3) For conversion from cubic yards (CY) to tons. The following factor shall be used:

1 CY = 1.6 Tons

c. Refer to Drawings 1.3.27, 1.3.28 and 1.3.29 for the limits of excavation at the building, stormwater management features, playground and parking areas.

6. Preparation of footing and slab subgrades within the proposed building area. Up to approximately 8 feet of over excavation below proposed bottom of footing (and up to about 10 feet below existing ground surface) is anticipated to be required in portions of the building area where natural, undisturbed granular soil is not encountered at the proposed foundation subgrade. Where proposed bottom of footing is within the undisturbed natural granular soils, the natural soils shall be excavated to 1 foot below bottom of footing and a compacted Sand-Gravel or ¾-inch Crushed Stone "pad" placed to bottom of footing. Where used, Crushed Stone shall be wrapped in non-woven filter fabric (Mirafi 140N or equivalent). Over excavation of subsoil and existing fill materials shall be performed within the bearing zone of footings. The bearing zone is defined as the zone extending at a 1H:1V sloping down and outward from 1 foot horizontally from the bottom exterior edge of the footing. Excavation for and placement of the Sand-Gravel or Crushed Stone footing "pad" shall not be measured separately for payment and shall be part of the base bid. Excavation to the contours shown on the Drawings shall be part of the base bid.

7. Remove and legally dispose of all earth materials not required or accepted for on site reuse. Disposal of unaccepted material in excess of the quantities identified in this Section shall be at the contract Unit Prices. Refer to SECTION 312600 MANAGEMENT AND DISPOSITION OF CONTAMINATED MATERIALS for additional information.

    a. The Contractor shall be responsible for sample collection and laboratory analysis of representative disposal characterization samples to obtain acceptance of all excavated materials from the site by off-site recycling/disposal facilities (Refer to SECTION 312600 MANAGEMENT AND DISPOSAL OF CONTAMINATED MATERIAL.

    b. The Contractor shall also be responsible for the management of miscellaneous materials accumulated from the Contractor's dewatering operations (Refer to SECTION 312319 DEWATERING).

8. Perform all excavation required for the construction access drive, utilities, electrical manholes/structures, duct lines, sight lighting conduit, erosion control features, pavement areas, storm water management features, building, parking, playfield areas and other work indicated on the Drawings and for which excavation would be required.

    a. All excavation to limits of shown on the Drawings and specified herein required to achieve finish grades shall be considered part of the Base Bid.

    b. The contract amount shall be adjusted upward or downward in accordance with SECTION 012200-UNIT PRICES based on the actual quantities removed within the building, stormwater management and parking areas relative to the limit of excavation contours shown on the Drawings.

9. Perform all filling and backfilling required for pavement, utility corridors, site grading, stormwater management features, erosion control, buildings and other items requiring fill to establish subgrades within areas indicated on the Drawings and/or referenced herein.

    a. All filling and backfilling from limits of excavation shown on the Drawings and specified herein required to achieve finish grades shall be considered part of the Base Bid.

    b. The contract amount shall be adjusted upward or downward in accordance with the Contract UNIT PRICES based on the actual quantities removed within building, stormwater management and parking areas relative to the limit of excavation contours shown on the Drawings.

    c. Filling and backfilling for utilities will not be measured separately for payment but will be considered incidental to utility installation.

10. Furnish and install compacted base courses for concrete slabs and for pavements except as specified under other SECTIONS.

11. Furnish and install ¾-inch Crushed Stone building slab base course.

12. Obtain all required permits, licenses, and approval of appropriate municipal and utility authorities, prior to commencing the work of this SECTION, and pay all costs incurred there from.

13. Protect exposed areas of the site from disturbance by weather and working conditions.

14. Proof-roll natural soil and foundation subgrades in proposed building and pavement areas in the presence of Architect or their authorized representative and abide by their sole judgment in determination of suitability of subgrade.

15. Proof-rolling of fill and natural soil subgrades prior to placement of fill or concrete.

16. Furnish, install and remove temporary excavation support, where required, for the construction of foundations, buildings, structures and utilities. See SECTION 315000-EXCAVATION SUPPORT for additional requirements.

17. Dust control, control of mud tracked off site, and clean-up.

18. Furnish and install perimeter foundation drains.

19. Furnish and install filter fabric at perimeter and under slab drains and elsewhere as identified on the Specifications and Drawings.

20. Furnish and install warning tape above all water main piping, sanitary sewerage piping and stormwater drainage piping where existing excavated material is reused that has been tested and reported to contain arsenic above reportable levels. See Section 331000 – WATER DISTRIBUTION, Section 333000 – SANITARY SEWERAGE UTILITIES and Section 334000 – STORM DRAINAGE for more information.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. The following related work is to be performed under the designated SECTIONS:

1. Clearing and grubbing, including removal of existing shrubs, site demolition, and construction of erosion and siltation controls: SECTION 311000-SITE PREPARATION and SECTION 312500-EROSION AND SEDIMENTATION CONTROLS.
2. Spreading topsoil, finish grading and seeding: SECTION 312219-FINISH GRADING, SECTION 329113-SOIL PREPARATION and SECTION 329200-LAWNS AND GRASS.
3. Drainage fill at playground surfaces: SECTION 321810-PLAYGROUND SAFETY SURFACING.
4. Paving and curbs including gravel backfill for setting curbing and drainage fill at porous pavement: SECTION 321200-VEHICULAR FLEXIBLE PAVING and SECTION 321300-VEHICULAR RIGID PAVING.
5. Furnish and install underground utilities: SECTION 260001-ELECTRICAL, SECTION 331000-WATER DISTRIBUTION, SECTION 333000-SANITARY SEWERAGE UTILITIES and SECTION 334000-STORM DRAINAGE.
6. Furnish and install excavation support: SECTION 315000-EXCAVATION SUPPORT.
7. Perform all dewatering required to maintain excavations free of water and legally dispose of pumped water: SECTION 312319-DEWATERING.
8. Radon mitigation system: SECTION 230001-HVAC.
9. Handling, stockpiling, transporting, tracking, and disposing of contaminated soils: SECTION 31260 – MANAGEMENT AND DISPOSITION OF CONTAMINATED MATERIAL.
10. Demolition of existing concession structure and existing utilities: SECTION 024100 – DEMOLITION.
11. Coordinate connections of underslab drainage system to perimeter foundation drains: SECTION 220001 – PLUMBING.

1.04 SUBSURFACE DATA

A. Subsurface explorations have been made in certain locations on the site and the results are included within the geotechnical report for the project prepared by GZA GeoEnvironmental, Inc. dated January, 2020. This report is provided for informational purposes and is not part of these specifications. However, the boring logs, test pit logs, and geotechnical laboratory testing (referred to as SUBSURFACE EXPLORATION DATA) appended to the report are considered part of the project specifications.

B. The Contractor shall review and become familiar with SUBSURFACE EXPLORATION DATA prior to bidding to enhance their understanding of site conditions. The Contractor shall also be aware that subsurface conditions between the exploration locations and over time might be different since material layers and elevations can change, and groundwater elevations may differ. The strata and groundwater data shown on the logs include interpretations of approximate elevations and boundaries between subsurface materials. The actual transition may be gradual or may different from those indicated. After obtaining Owner's permission, take whatever additional subsurface explorations deemed necessary at no expense to the Owner.

C. SUBSURFACE EXPLORATION DATA are for general information and are accurate only at the particular locations and times the subsurface explorations were made. It is the Contractor's responsibility to make interpretations and draw conclusions based on the character of materials to be encountered and the impact on its work based on its expert knowledge of the area and of earthwork techniques.

D. In July and August 2020, Environmental & Construction Management Services, Inc. collected pre-construction surface and subsurface soil samples for laboratory analysis in order to characterize the soils that may require off-site disposal. Soil sampling results indicated the presence of arsenic at concentrations above applicable standards in every location sampled across the proposed work site. Additional surface soil samples were subsequently collected on July 31, 2020 from the two baseball infields (Randall and Packer Little League Fields) at the site to verify that arsenic was not present in the imported red clay soils on either field. No arsenic was detected over any reportable concentration in any of the eight surface infield samples analyzed. In addition, one soil sample collected on August 12, 2020 from the outfield on Randall field at a depth of approximately 2 feet below grade did not have arsenic above its reportable concentration.

The assessment revealed elevated arsenic concentrations in 28 of 28 shallow soil samples (excluding the soil samples collected from both infields and one sample from the outfield of Randall Field). The concentrations of generally exceeded reportable thresholds of 20 milligrams per gram (mg/kg), and in some cases exceeded Imminent Hazard (IH) Threshold of 40 mg/kg. No soil sample had a concentration of arsenic detected over its applicable Upper Concentration Limits (UCL) of 500 mg/kg.

Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to SECTION 312600 – MANAGEMENT AND DISPOSITION OF CONTAMINATED MATERIAL for additional requirements.

1.05 BENCHMARKS, LINES AND GRADES

A. The Contractor shall employ, within the Contract Price, a competent, independent Land Surveyor, registered in Massachusetts, who shall perform the following work.

1. Verify all locations, lines, grades, work lines, and other dimensioned points indicated on the Contract Drawings for the Work.

2. Submit, to the Architect, a written confirmation of locations of all lines, and any discrepancies between conditions and locations as they actually exist and those indicated on the Contract Drawings. Such confirmation shall bear the Surveyor's registration stamp.

3. Perform a topographic survey of the interim condition showing the finished excavation work prior to the installation of fill for all areas of the site work. The surveys will be performed to document the bottom of excavation elevations as excavation work proceeds. Upon completion of excavation work, prepare a Topographic Survey Plan of the excavation elevations with spot grades and one foot contour interval. Plans shall be provided in AutoCAD and PDF digital format at the same scale as the Contract Drawings. Based on the as-built excavation elevations and the Limit of Excavation plans (1.3.27, 1.3.28 and 1.3.29), compute the volume of materials excavated.

4. Provide calculations of the volumes of fill materials and rock excavation and promptly submit to the Architect any measured discrepancy between Contract and actual volumes, positive or negative, for resolution of payment based on sole judgment of Architect.

B. The Contractor shall not commence any excavation or site work until the Surveyor's verification has been received by the Architect, and the Architect has reviewed the verification and authorized such commencement.

1.06 FINISH GRADES

A. The words "finish grades" as used herein, mean the required final grade elevations indicated on the Drawings. Where not otherwise shown on the Drawings, areas shall be given uniform slopes to the existing grades, except that vertical curves or roundings shall be provided at abrupt changes in the slope.

1.07 DISPOSITION OF UTILITIES

A. Conform to the requirements of the municipality and other authorities having jurisdiction over the existing utilities, and notify the appropriate municipal officials in advance of performing any work prior to commencing same. Protect active utilities from damage and remove or relocate only as indicated or specified. If, in the progress of excavation, any utility should become damaged and result in any damage to public or private property, the Contractor shall restore to the original condition, at no additional cost to the Owner, anything which has been damaged or disturbed.

B. Should any utility that is not indicated on the Drawings be encountered in the excavation work, notify the Architect and the Owner in writing and request disposition for same, before proceeding to perform any work on same.

C. Remove to source, cut, and cap inactive utilities and utilities which have been disconnected.

D. Coordinate all work on existing utilities with Subcontractors, as applicable, and the authority having jurisdiction over same.

1.08 PERMITS AND CODES

A. Procure all permits and licenses required for the work of this SECTION, prior to commencing the work. Refer to SECTION 011000 – SUMMARY OF WORK.

B. Comply with all applicable codes, ordinances, rules, regulations and laws of all local, municipal, state and federal authorities having jurisdiction over the work.

C. Federal NPDES Phase II Compliance: The Contractor is responsible for compliance with the U.S. EPA – National Pollution Discharge Elimination System, Permit for Construction Activities Requirements. This includes, but is not limited to, the preparation of a Stormwater Pollution Prevention Plan (SWPPP) and the filing of a Notice of Intent with the U.S. EPA. The SWPPP shall be consistent with the erosion control information contained on the plans and with other state and local laws regulation and permit requirements for the project.

1. In accordance with the Order of Conditions, **the Contractor shall submit the SWPPP to the Conservation Commission not less than thirty (30) days prior to the start of earthwork operations on the site**.

D. In case of conflict between regulations or between regulations and Specifications, the Contractor shall comply with the strictest applicable codes, regulations, or Specifications.

1.10 DUST MONITORING

A. An Environmental Health and Safety Plan (HASP) (attached to this SECTION) outlines minimum requirements for the Contractor's HASP to be used by construction workers and ancillary construction support staff during construction of a new school building at the New Amesbury Elementary School property in Amesbury, Massachusetts (subject property). This plan was prepared by Environmental & Construction Management Services, Inc. at the request of DiNisco Design, which is the designer for the project. The construction project will occur primarily in a currently-open field area located north and west of the current school building, but includes activities within the current school grounds.

B. Environmental & Construction Management Services, Inc. will designate and provide a Field Safety Officer (FSO) to perform field monitoring during the phases of construction that include potential exposure to soil.

C. Direct reading instruments or instantaneous measurement techniques will be used for the assessment of worker exposures to site-generated dust. The types of measurements to be conducted on this project are based upon analysis of the contaminants believed to exist at the site, along with their potentials for exposure.

D. All contractors and sub-contractors are responsible for the safety of their own workers and for compliance with the minimum requirements set forth in this HASP. The scope of this plan is limited to environmental conditions resulting from elevated metals concentrations in soil. Safety-related aspects of general construction work covered by 29 CFR 1926 will remain the responsibility of the general contractor and its subcontractors.

E. The table below indicates the air monitoring work zone action levels as described in the HASP.

Air Monitoring Work Zone Action Levels		
Parameter	Action Level	Action Required
Total Dust (As PM10)	<0.02 mg/m3 sustained 15 min. >0.02 mg/m3 in work zone or >0.05 mg/m3 at the project fence line >0.02 mg/m3 sustained 15 min.	• Level D • Monitor continuously. Implement dust suppression methods. • Level C. Continue dust suppression methods. Do not re-enter until total dust concentrations are below 0.02 mg/m3 for 15 consecutive minutes.
Volatile Organic Compounds (VOCs) (Photoionization Detector readings taken continuously and calibrated to read as benzene.)	< 1 ppm 1 to 5 ppm sustained 15 min. 5 to 50 ppm sustained 15 min > 50 ppm sustained 15 min.	• Level D • Monitor continuously. • Level C w/ full-face piece, organic vapor cartridges. Use vapor control methods. • Stop work. Evacuate personnel from the EZ and reevaluate. Do not re-enter until PID readings are below 1 ppm for 3 consecutive measurements taken 5 minutes apart.

Breathing zone instrument readings for at least 15 minutes (i.e., sustained) will determine the need for upgrading/downgrading of PPE and the corresponding action level.

F. Perimeter dust monitoring will be conducted by the Owner's Environmental Consultant, using a minimum of two PDR-1000 Mini-RAM instruments (or equivalent) equipped with active air intake pumps. The monitoring locations will be determined by the Owner's Environmental Consultant, as noted in the Soil and Groundwater Management Plan (SGMP). Daily wind direction will be measured prior to establishing the monitoring locations. All readings will be data-logged. Perimeter dust concentrations should not range above 0.05 mg/m3, measured on a time-averaged 8-hour basis. If the limit is exceeded, additional dust control methods shall be implemented immediately.

1.11 EXAMINATION OF SITE AND DOCUMENTS

A. By submitting a bid, the Contractor warrants that it has carefully examined the project site and all conditions and related areas affecting work under this SECTION, and is sufficiently familiar with such to submit an accurate bid. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.

B. Plans, survey, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined the information during the bidding period, as no additional compensation will be made for errors or inaccuracies that may be found therein.

1.12 DRAINAGE AND DEWATERING

A. Upon entering the premises, the Contractor shall assume responsibility for project site and project-related areas and subsurface drainage and shall maintain such drainage during the life of this Contract in a manner acceptable to the Architect, at all times protecting and maintaining the existing conditions in adjacent areas.

B. Contractor shall obtain proper permits and legally remove by pumping, draining or bailing, all water which may accumulate or be found on the site within the contract limits, where excavation and grading are to be performed. Newly constructed and existing concrete and masonry shall be protected from injury resulting from dewatering work by the use of canvas, tar paper or by such other sufficient method as the Architect may approve. When constructing structures that may be subject to buoyant forces, maintain dewatering operations until sufficient structure dead weight or backfill is in place to resist uplift forces

C. Maintain site and subsurface drainage in an acceptable manner during the course of the Work.

D. Maintain site grades to direct surface runoff to collection points. Prevent surface water from running or collecting over prepared subgrades or fill surfaces. Do not permit standing water to accumulate in excavations.

E. Refer to SECTION 312319-DEWATERING for additional requirements.

F. Refer to SECTION 312600-MANAGEMENT AND DISPOSITION OF CONTAMINATED MATERIAL and the Soil and Groundwater Management Plan (SGMP) that is attached to that Section for additional requirements.

1.13 SAMPLES AND TESTING

A. All fill materials and their placement shall be subject to quality control testing. Testing of fill compaction and materials will be performed by a qualified representative provided by the Owner and paid for by the Owner outside of the Contract Price. The Architect or their authorized consultant will observe placement and compaction of fill, removal of unsuitable soils, and foundation subgrade preparation, and will test soils for gradation, moisture-density relationships (Proctor), field moisture content, and field compaction at frequencies and locations that he/she shall select. All work shall conform to the placing, compaction, and moisture control requirements determined by these tests and as specified herein. The results of these tests will be submitted to the Contractor on a timely basis so that the Contractor can take such action as is required to remedy any indicated deficiencies. During the course of construction activities, the Architect will advise the Owner and Contractor in writing, if at any time the work does not, in the opinion of the Architect, conform to the contract documents.

Contractor shall engage an independent testing laboratory to perform all sampling and analytical testing of all excess materials as necessary for characterization, handling, transportation, and disposal at Owner-approved off-site disposal facilities. The Contractor is responsible for stockpiling excess soils to be disposed of in such a manner to allow sampling. Refer to SECTION 312600-MANAGEMENT AND DISPOSITION OF CONTAMINATED MATERIAL for additional requirements.

B. Provide samples of each fill material from the proposed sources of supply at least 2 weeks before intended use. Submit samples from alternate sources if required. Architect will be sole and final judge of suitability of all material. Fill material samples shall be a minimum of 50 pounds. With each sample provide the following written documentation:

1. Location and name of material source.
2. Proposed on site use and applicable specification section.

Samples that do not contain sufficient identifying information will be rejected.

C. Do not use materials in question pending test results. If the Contractor elects to use the material and it subsequently fails to meet project specifications, the non-conforming materials shall be removed and replaced at no additional cost to the Owner.

D. Maximum density and optimum water content shall be determined for each submitted type of fill (other than Crushed Stone) that meets gradation requirements in accordance with ASTM-D 1557.

E. Cooperate with the Architect in obtaining field samples of in-place materials after compaction and in the field compaction testing. Furnish incidental field labor in connection with such tests. Provide free and clear access to the work at all times.

F. Representative of the Owner (geotechnical engineer, civil engineer, OPM, architect, testing agency) presence does not include supervision or direction of the actual work by the Contractor, its employees, or agents. The presence of the Owner's representatives or any observations and testing performed by their representatives, or any notice or failure to give notice, shall not excuse the Contractor from defects discovered in the Work nor shall warranties be affected.

G. Submit representative samples of any filter fabric, reinforced stabilization fabric, or other materials proposed for use, with manufacturer's specifications and product literature at least 2 weeks in advance of use of these materials.

H. As construction proceeds, notify the Architect prior to the start of earthwork operations that require observations and testing. A minimum of 72 hours notification shall be provided for work that requires observation or testing.

I. Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to SECTION 312600 for additional Sampling and Testing requirements.

1.14 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in SECTION 013500-ORDER OF CONDITIONS.

B. In accordance with the Order of Conditions, prior to any excavation or earth removal, adequate siltation control measures shall be constructed to prevent the runoff of silted water from the site. All catch basins that may be impacted by construction shall be protected with filter fabric and hay bales as indicated in the Drawings to prevent siltation into the drain lines during construction.

C. Site conditions, including erosion and siltation control, as required by the Order of Conditions and contract documents shall remain in place and shall be maintained at no additional cost by the Contractor throughout the duration of this Contract.

1.15 REFERENCED STANDARDS

A. References herein to any technical society, organization, group or body are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable:

ASTM: American Society for Testing and Materials

OSHA: Occupational Safety and Health Administration

AASHTO: American Association of State Highway Transportation Officials

EPA: Environmental Protection Agency

1.16 DEFINITIONS

A. Rock

Rock is defined as bedrock that cannot be broken or removed by normal job equipment (power shovels, scoops, or D-8 bulldozers with ripper attachment) without the use of explosives, drills or hoe-ramming equipment.

B. Obstruction

An obstruction is defined for payment purposes as masonry or concrete over 2 cubic yards in volume in open areas and 1 cubic yard in volume in trenches that cannot be broken or removed by normal job equipment (power shovels, scoops, or D-8 bulldozers with ripper attachment) without the use of explosives, drills or hoe-ramming equipment. The classification does not include materials that can be removed by means other than drilling and blasting, drilling and wedging or hoe-ramming. The word “trench” shall mean excavations having near-vertical sides; the depths of which exceed the width, made for drain, sewer, water, and gas pipes; electric and steam conduits; and the like. Trenches in excess of 10 feet in width and pits in excess of 20 feet in either length or width are classified as open excavation.

C. Boulder

A boulder is defined for payment purposes as rock over 2 cubic yards in volume in open areas and 1 cubic yard in volume in trenches that cannot be broken or removed by normal job equipment (power shovels, scoops, or D-8 bulldozers with ripper attachment) without the use of explosives, drills or hoe-ramming equipment. The classification does not include materials that can be removed by means other than drilling and blasting, drilling and wedging or hoe-ramming. The word “trench” shall mean excavations having near-vertical sides; the depths of which exceed the width, made for drain, sewer, water, and gas pipes; electric and steam conduits; and the like. Trenches in excess of 10 feet in width and pits in excess of 20 feet in either length or width are classified as open excavation.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. The Contractor shall provide chemical testing results to show that the imported soil does not contain contamination and does not contain metals, total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs) or polyaromatic hydrocarbons (PAHs) at concentrations above background levels for natural soils, as published by the Massachusetts Department of Environmental Protection. As a minimum, environmental testing shall include total petroleum hydrocarbons (TPH) by ASTM D3328/EPA method 8100, semi-volatile organic compounds (semi-VPC) by EPA method 8270, PCBs by EPA method 8082A and metals (RCRA 8) by EPA methods 6010/7471a at one sample per 500 cubic yards of soil to be imported, unless otherwise waived by the Owner. Asbestos testing shall be conducted at one sample per 500 cubic yards of processed concrete or processed soil to be imported, unless otherwise waived by the Owner.

B. Sand-Gravel Fill (aka Gravel Borrow): Sand-Gravel shall be used as the footing "pad," and backfill within 3 feet of retaining walls. Sand-Gravel shall consist of durable sand and gravel and shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter. Sand-Gravel shall conform to the following gradation requirements: Sand-Gravel Fill shall conform to the following gradation requirements:

Sieve Size	Total Percent Passing by Weight
3 inches	100%
1/2 inch	50-85%
No. 4	40-75%
No. 40	10-35%
No. 200	0-8%

The material shall meet the above gradation and shall meet the Unified Soil Classification System definition of Well Graded with a Coefficient of Uniformity (Cu) of greater than 4 and a Coefficient of Curvature (Cc) of 1 to 3.

C. Common Fill (aka Common Borrow, Ordinary Borrow, Ordinary Fill): Friable soil containing no pieces larger than 2/3 of the loose lift thickness in longest dimension, and shall be free of trash, snow, ice, organics, roots, tree stumps, and no more than 35 percent passing the No., 200 sieve. Common borrow can be used as general backfill provided it can be compacted and stabilized for the intended purpose.

D. Granular Fill (aka Free Draining Granular Borrow): Fill to raise the grade below pavements, walkways, driveways, and building up to the base course layer or where otherwise shown on the Drawings. The material shall consist of inert natural material (Bank Run) or a processed sand and gravel that is hard, durable stone, gravel and coarse sand, free from loam and clay, surface coatings, and deleterious materials. The material shall be well graded between the following limits:

Sieve Size	Total Percent Passing by Weight
2/3 of loose lift thickness	100%
No. 10	30-90%
No. 40	10-70%
No. 200	0-15%

The material shall meet the above gradation and shall meet the Unified Soil Classification System definition of Well Graded with a Coefficient of Uniformity (Cu) of greater than 4 and a Coefficient of Curvature (Cc) of 1 to 3.

In specific areas fill areas where Free Draining Granular Fill (aka Free Draining Granular Borrow) is required for stormwater management facilities, the material passing the 200 sieve is reduced to not more than 5% and 100% shall pass the 2-inch sieve.

Granular Fill shall not be used within 3 feet of building or site retaining walls unless no more than 8 percent passes the No. 200 sieve.

E. Backfill for Trenches: Fill for pipe or conduit trenches shall be as follows, unless otherwise specified:

1. Pipe bed shall be as specified by respective site utility sections.
2. Backfill material designated herein as graded gravel directly above Pipe Bed shall consist of fill free of all stones larger than 2-inch diameter, clay, dry or frozen lumps, and foreign objects. Fill shall be tamped by hand with a flat tamper to a minimum of 12 inches above pipe.
3. Backfill material 12 inches above pipe may be material that was excavated for trench, provided that fill is free from stones larger than 6-inch diameter, clay, dry or frozen lumps and foreign objects, and can be compacted to the required degree.

F. Crushed Stone: Crushed Stone shall be used as building slab base course, concrete slab base course, to aid in dewatering and as shown on the Contract Drawings. Crushed Stone shall be durable crushed rock consisting of angular fragments of natural rock, and shall be free of clay, loam, or any deleterious material. Crushed Stone shall be uniformly graded as follows:

Sieve Size (Square Openings)	Total Percent Passing by Weight
1 inch	100%
3/4 inch	90-100%
½ inch	10-50%
3/8 inch	0 – 20
No. 4	0-5%

1. For “Washed Stone” for filter berms, temporary filter berm, and sub-drains, stormwater basin sub-drains, and seepage pits, see SECTION 334000 – STORM DRAINAGE.
2. When greater than 4-inches thick, Crushed Stone shall be wrapped in non-woven filter fabric such as Mirafi 140N or equivalent.

G. Dense Graded Crushed Stone: Dense Graded Crushed Stone for pavement base shall consist of well graded inert angular material derived from a combination of crusher run coarse aggregates and fine aggregates of natural sand or stone screenings uniformly premixed. Coarse aggregates shall consist of hard, durable stone and natural sand, crushed sand or stone screenings, free from loam and clay, surface coatings, and plastic materials. Gradation shall conform to M2.01.7 and the following:

Sieve Size	Total Percent Passing by Weight
2 inches	100%
1 – 1/2 inch	70-100%
3/4 inch	50-85%
No. 4	30-55%
No. 50	8-24%
No. 200	3-10%

The material shall meet the above gradation and shall meet the Unified Soil Classification System definition of Well Graded with a Coefficient of Uniformity (Cu) of greater than 4 and a Coefficient of Curvature (Cc) of 1 to 3.

H. Controlled Low Strength Material or Controlled Density Fill: Controlled low strength material or controlled density fill shall be a cement concrete backfill material that flows like a liquid, supports like a solid when cured, and levels without tamping or vibrating to reach 100 percent compaction. The material shall be used primarily as a backfill in lieu of compacted fill in confined areas, or as otherwise shown on the Drawings. The material shall be proportioned to yield a 28-day minimum compressive strength (f'_C) of 200 pounds per square inch (psi), except where placed around utility pipes and structures, where the f'c shall be between 40 and 80 psi such that the cured material can be excavated. The material shall be produced and installed in accordance with ACI 229R, and ACI 116R following the recommendations provided in the Massachusetts Department of Transportation (MassDOT) Supplemental Specifications (February 25, 2010), Division III – Materials.

Specifications, Section M4 – Cement and Cement Concrete Materials, SubSection M4.08.0, Controlled Density Fill. The mix formulation is to be submitted and approved prior to placement of the material in the project.

2.02 PERIMETER FOUNDATION DRAINPIPE

A. 6-inch diameter schedule 40 perforated polyvinyl chloride (PVC) pipe, meeting requirements of ASTM D 1784.

2.03 FILTER FABRIC

A. Geotextile Fabric shall be used to prevent soil intrusion into drains, crushed stone layers and/or assist in stabilizing soil subgrades to be laid on approved soil subgrades prior to placement of fill materials.

1. Contractor shall use Mirafi 140N or equivalent filter fabric systems between Crushed Stone and granular soils or where indicated on the Contract Drawings.

2. Filter Fabric used to help stabilize soft or saturated subgrades shall be as Mirafi 600X or equivalent.

2.04 DEMARCATION WARNING TAPE

A. Refer to 3.03.B Stockpile Delineations for how on-site arsenic impacted soils may be used.

B. Warning tape shall be installed above all water main piping, sanitary sewerage piping and stormwater drainage piping to indicate where on-site material is used for backfilling. Warning tape to have the following characteristics:

1. 3 in. wide, continuous roll
2. 2.2 mil PVC
3. Color: Yellow
4. Text: Black
5. Custom Print:

   Line 1: CAUTION

   Line 2: Arsenic Impacted Soils

PART 3 EXECUTION

3.01 STRIPPING TOPSOIL

A. The suitability of stripped materials for on-site re-use as loam or topsoil shall be determined by the Architect, and its decision shall be final.

B. Topsoil shall be stripped to its entire depth within the designated areas and 1,500 CY stored on site as designated on the Drawings. Topsoil shall be stripped and stored before any underlying excavating is begun. Stripped topsoil shall be cleaned, free of clay, large stones, debris and peat, and shall be stockpiled apart from other materials.

3.02 TEMPORARY EARTH SUPPORT

A. Comply with the more stringent of local safety regulations, the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc. or applicable sections of 29 CFR Part 1926 (OSHA).

B. Refer to SECTION 315000 – EXCAVATION SUPPORT.

C. Leave no temporary earth support in place without the written approval of the Designer and consent of the Architect, and prominently indicate all such installations on the design Drawings.

3.03 EXCAVATION

A. Include the excavation of earth and all other materials to the depths, form and sizes as shown on the Drawings, and as specified hereunder for utilities, utility structures, site improvements, paved areas, building and other structures necessary for the completion of the construction.

B. Stockpiling shall be in accordance with requirements of this SECTION and SECTION 312600-MANAGEMENT AND DISPOSITION OF CONTAMINATED MATERIAL and the Soil and Groundwater Management Plan attached to that Section.

Up to four distinct stockpile areas for excavated material shall be created as follows:

- Stockpile 1 – Arsenic-Impacted Soil – All soil excavated from the site suitable for potential re-use beneath buildings, rubberized playground or pavement, at depths of greater than 1 foot below grade in landscaped areas, and at depths of greater than 2 feet below grade in other unpaved recreational areas (such as playing fields).
- Stockpile 2 – Contaminated Soil (other than arsenic) – Excavated soil exhibiting characteristics that indicate contamination (visible or olfactory evidence) will be characterized and disposed off-site. Soil contaminated with other than arsenic, if encountered, will not be reused on site.

- Stockpiles 3 & 4 – Non-Arsenic-Impacted Soil – Excavated topsoil/loam and borrow that has been analyzed and is not arsenic-contaminated and can be reused unrestricted on the site.

C. Excavations shall be performed to elevations and dimensions indicated or specified, plus sufficient space to permit erection of forms and shoring, drains, and the inspection of foundations.

D. If any part of the excavation is carried through error beyond the depth and dimensions indicated on the Drawings or specified herein, the Contractor shall at its own expense, furnish, place and compact fill materials all as specified hereunder to restore excavations to depths and dimensions shown on the Drawings or specified herein.

D. The word "trench" shall mean excavation having vertical sides whose depths exceed their width, such as drain, sewer, water and gas pipes, electric and steam conduits and foundations. Trench shall not refer to footing excavations.

E. Soil subgrade should be prepared smooth. Smooth subgrade may be achieved by completing final excavation using a smooth-edged excavator bucket, finishing with hand tools, and rolling with a smooth-drum roller.

F. Protect bottoms of excavations from frost and from disturbance due to construction activities, traffic, wetting and/or drying. Subgrades that become disturbed shall be re-compacted or removed to undisturbed soil and replaced with crushed stone or applicable fill for the location to be placed, in sole judgment of Architect.

G. As excavation approaches underground utilities and structures, excavate using hand tools. Such manual excavation is incidental to normal excavation and no special payment will be made.

H. Excavation for utility lines and utility structures shall conform to all of the following:

1. Excavate and trench, as required for all utility lines and utility structures, where shown on the Drawings or specified herein.
2. Unless otherwise shown, provide separate trenches for each utility. Excavate to base invert in each trench.
3. Excavate trenches of sufficient width for proper installation of the work. Banks of trenches shall conform to OSHA standards.
4. Keep the trenches free of water until pipe joint material has hardened and in accordance with dewatering requirements herein.
5. Grade the bottom of trenches evenly to insure uniform bearing for full length of all pipes.
6. Should latent soil conditions necessitate special supports for piping and/or appurtenances, the Contract Price will be adjusted accordingly.

I. Excavation for Loamed and Seeded Areas – Excavate to subgrade elevations, in areas designated on the Drawings to receive loaming and seeding.

J. Payment Lines for Earth Excavation – Include in the general bid price the excavation of existing topsoil, subsoils, organic materials and debris to the grades shown on the Drawings. Payment for actual excavation performed shall be determined as follows:

1. After stripping all topsoil/subsoil from the site and fill from within the zone of influence of footings, and prior to placing any fill, the Contractor shall have the bottom of excavation surveyed by an independent registered land surveyor retained by and paid by the Owner. Compare the actual volume removed to that shown by the contract drawing contours. The contract amount shall be adjusted upward or downward based on the actual quantities removed in accordance with SECTION 012200-UNIT PRICES.

2. For subgrades within the building area, payment lines shall be as follows:

   a. Foundations – To 12 inches below the bottom of footing or top of natural subgrade below the fill, whichever is deeper; and within the bearing zone of footings. bearing zone is defined in Article 3.04.A of this SECTION.

   b. Building Retaining Walls – To 12 inches below bottom of wall foundations and extending upward from 3 feet laterally from bottom edge of foundations at a 2 horizontal to 1 vertical slope.

   c. It is recognized that within the approximate northern two-thirds of the building footprint, the depth of the natural soils below proposed bottom of footing will result in excavation of all, or almost all, fill below the slab. However, in the southern one-third of the building footprint, it is anticipated that some of the existing fill may be left in place below bottom of slab basecourse between footings provided the fill is stable during proof compaction.

3. Subgrades for site work outside of the building area, stormwater management areas, (play surface) and parking areas (excluding utility work), payment lines shall be established as follows:

   a. Areas designated to receive topsoil:

      1) Lawn areas –12 inches

      2) Plantings –24 inches

      3) Recreational Areas – 24 inches

   b. Utility structures – to 12 inches below bottom of structure, and 12 inches outside manhole wall extremities except as otherwise indicated on Drawings.

   c. Utility lines – as indicated on Drawings.

   d. New paved drives and walks as indicated on the Drawings.

   e. Curbs and unspecified site improvements – to bottom elevation of item plus ample working space on all sides, or as indicated on the Drawings.

f. Constructed stormwater wetland area as indicated on the Drawings.

g. Site Retaining Walls (in cut areas) – to 12 inches below bottom of wall foundations and extending upward from 3 feet laterally from bottom edge of foundation at a 2 horizontal to 1 vertical slope.

3.04 EXCAVATION OF UNSUITABLE MATERIAL

A. General: Excavate all unsuitable material to firm natural ground in the manner specified below and in the Contract Drawings. Unsuitable material includes topsoil, subsoil, organic soils (including peat), frozen soils, and soil containing debris, in sole judgment of Architect. Within the bearing zone of footings, unsuitable materials also include existing fill. The bearing zone is defined by line extending 1 foot horizontally from bottom edge of footing and then down and away at a 1 horizontal to 1 vertical (1H:1V) slope to top of undisturbed natural granular soils.

B. Notify Architect when unsuitable soils are encountered below subgrade elevations identified on the Contract Drawings, and remove unsuitable soils only after authorization by Architect.

C. Follow a construction procedure which permits visual identification of firm natural ground. Maintain groundwater levels below excavation bottom.

3.05 UNANTICIPATED SUB-SURFACE CONDITIONS

A. Removal of unsuitable materials within the scope of work areas shall be included in the bid price. If unsuitable materials are encountered at depths that are not consistent with the subsurface explorations, or that can be reasonably assumed based on the subsurface explorations, notify the Architect of the unanticipated subsurface conditions prior to removal of these materials. Remove unsuitable materials only when authorized by Architect. If unsuitable bearing materials are encountered deeper than anticipated, carry excavations deeper and replace the excavated materials with compacted Granular Fill.

B. Additional Excavation

1. Excavation (other than excavation of rock as herein defined) below the anticipated depths for the work indicated, if ordered to be removed by the Architect with the prior written approval of the Owner because of "Differing Site Conditions," will be paid for, in accordance with SECTION 012200 – UNIT PRICES.

2. Adjustments in base bid excavation and backfill quantities specified under Article 1.02.B shall be in accordance with SECTION 012200-UNIT PRICES.

3. The Contractor shall employ an independent registered surveyor for all survey and volume calculation for the purpose of determining payment, which may be subject to independent verification by the Architect at the Architect's option.

C. Additional Borrow

1. The Contractor shall provide, place, and compact additional specified fill materials for any unanticipated filling or backfilling requirements if ordered in writing by the Architect.

2. Payment for additional in-place fill materials will be made in accordance with SECTION 012200 – UNIT PRICES

3.06 ROCK REMOVAL

A. Rock is defined in Article 1.16.A of this specification.

B. When rock is encountered during excavation, such material shall be uncovered and exposed, and the Architect shall be notified by the Contractor, before proceeding further. The areas in question shall then be cross-sectioned as stipulated in Article 3.06.D. The Contractor shall not proceed with excavation of material claimed as rock until the material has been classified by the Architect. Should the Contractor proceed with the excavation without notifying the Architect or prior to the survey, it shall forfeit its right to extra payment in the subject area.

C. Adjustments in base bid rock excavation quantities shall be in accordance with SECTION 012200-UNIT PRICES and Article 3.06.E of this specification.

D. The Contractor shall employ an independent registered surveyor to survey and take cross-sections of rock before removal of same, and to provide computations of cross-sections and volumes within the pay-line limits. At the Architect's option, an independent verification of calculations may be performed. The contract price shall be adjusted upward or downward based on actual in-place quantities of rock removal.

E. Rock Excavation for Utilities

1. Payment shall be based on the following pay-lines: Eighteen inches on both sides of any pipe and six inches below the bottom of the pipe.

2. "Trench" shall be defined as a confined area where the shortest distance between any vertical pay-line does not exceed 10 feet, 0 inches. Pay-lines for trench shall be stepped outward 1-foot at 5-foot intervals of depth. Footing excavations shall not be considered trenches.

F. Rock Excavation for Footings:

1. Payment shall be based on the following paylines: 12 inches below and 1 foot laterally from edges of footing.

G. Rock Excavation Outside of the Building Footprint

1. Payment shall be based on the following paylines:

a. 12 inches below pavement base course

b. 12 inches below final grade, outside of paved areas

H. Blasting – Obtain written permission and approval of method from the local Authorities before proceeding with rock excavation. Explosives shall be stored, handled, and employed in accordance with the provisions of the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.

3.07 FILLING OR BACKFILLING FOR STRUCTURES, PAVEMENTS AND SITE IMPROVEMENTS

A. Sub-base fill in pavement areas shall be approved Granular Fill (also known on Drawings as Structural Fill) as specified herein above Article 2.01, D. Existing onsite fill, free of cobbles, boulders, debris and organics, may be reused as Granular Fill, provided it is placed and compacted in accordance with this specification Materials shall be placed in horizontal, maximum 12-inch-thick loose layers. Each layer shall be compacted to 95% of the maximum dry density as determined by the Modified Proctor compaction test ASTM D1557, with moisture contents within 2 percentage points of optimum moisture content. Successive layers shall be placed at right angles to previous layers and compacted as specified. Place successive layers until the surface is at specified sub-grade elevations. Granular Fill in paved areas at depths greater than 3 ft. below finished grade shall be compacted to at least 90% of the maximum dry density as determined by the Modified Proctor compaction test ASTM D1557, with moisture contents within 2 percentage points of optimum moisture content.

B. Fill placed in the building footprint plus zone of influence defined herein shall be approved Granular Borrow (also shown as Structural Fill on the Drawings) as specified in Article 2.01.B of this specification. Existing onsite fill, free of cobbles, boulders, debris and organics, may be reused as Granular Fill (more than 3 feet from retaining walls), provided it is placed and compacted in accordance with this specification. Materials shall be placed in horizontal, maximum 12-inch thick loose layers. Each layer shall be compacted to 95% of the maximum dry density as determined by the Modified Proctor compaction test ASTM D1557, with moisture contents within 2 percentage points of optimum moisture content.

C. Building slab base course shall be approved Crushed Stone as specified herein above Article 2.01.F. Crushed Stone shall be placed in maximum 1-foot thick lifts and compacted with a vibratory roller or large vibratory plate compactor to an unyielding surface.

D. Base course of pavement shall be approved Dense Graded Crushed Stone as specified herein above Article 2.01.G. Materials shall be compacted to 95% of the maximum dry density as determined by ASTM D1557, with moisture contents within 2 percentage points of optimum moisture content.

E. Refer to Article 3.09 for construction of base courses for pavements.

F. Within areas to receive fill including the building and pavements, prior to fill placement, proof roll the exposed subgrade to the lateral distance of 10 feet beyond the edge of building/pavement with a minimum of four passes of a vibratory drum roller having a drum weight of not less than 10,000 pounds (10,000 lbs. static weight) unless otherwise approved by the Architect. Compaction in confined areas shall be performed with a minimum of six passes of a walk-behind vibratory drum roller or vibratory plate compactor. The cost of all proof rolling shall be included in the Contract Sum. No work shall be done unless observed by the Architect. If soft or unstable areas are observed, the Architect may direct the contractor to remove the soft material to a firm subgrade and replace with Sand Gravel Fill. Compact materials to the required densities specified herein. Additional work authorized by the Architect will be paid for in accordance with the submitted unit prices on the Form for General Bids or SECTION 012200 – UNIT PRICES, as applicable.

G. Under no circumstances shall any fill be placed into or below standing groundwater, water or an insufficiently dewatered excavation as determined by the Architect.

H. Fill that becomes disturbed after compaction as a result of the Contractor's operations shall be removed and replaced or re-compacted to the specified degree of compaction at the Contractor's expense.

I. Materials that are within the moisture requirements specified above, but display pronounced elasticity or deformation under the action of earthmoving and compaction equipment, shall be reduced to Optimum Moisture Content, or below, and re-compacted until stable. If these materials cannot be stabilized, they should be removed and replaced at Contractor’s expense.

J. Materials that become frozen due to the Contractor’s failure to protect subgrades from freezing shall be removed and replaced with compacted, unfrozen materials at the Contractor’s sole expense.

K. Where the horizontal layer meets a natural rising slope, the layer shall be keyed into the slope by cutting a bench.

L. Contractor shall use extra care when compacting adjacent to walls. Where walls are buried on both sides, backfill and compaction shall proceed on both sides of the wall so that the difference in top of fill level on either side of the wall shall not exceed 2 feet at any stage of construction. Where backfill of a buried wall is only on one side, only hand-operated roller or plate compactor shall be used within a lateral distance of 5 feet of back of wall for walls less than 15 feet high and within 10 feet of back of wall for walls more than 15 feet high. Backfill basement wall only after concrete has cured and adequate bracing by structural members is in place, and as approved by the Architect.

M. In no case, shall any fill be placed over frozen material, and frozen material shall not be used as fill. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until moisture content and the density of the previously placed fill are as specified.

N. Loose-lift thickness shall not exceed 12 inches when compacted with a large (minimum static weight of 10,000 pounds) vibratory compactor. Maximum lift thickness is 6 inches for other compaction equipment. Thinner lifts may be required to achieve the compaction requirements in Article 3.07.O.

O. Compaction

1. Compaction Requirements: The degree of compaction is expressed as a percentage of the maximum dry density at optimum moisture content as determined by ASTM Test D1557, Method C. The compaction requirements are as follows:

Area	Minimum Degree of Compaction
Within Building Area	95%
Below sidewalks	95%
Pavement base course and subgrade	95%
Fill below pavement subgrade	92%
Landscape areas	90%
Pipe Bedding and Backfill	95%

2. Compaction percentages are based on the laboratory derived Maximum Density Values as determined by ASTM Method 1557 C.

3. Crushed Stone shall be compacted to an unyielding surface.

P. Moisture Control:

1. Fill that is too wet for proper compaction shall be harrowed or otherwise dried to a proper moisture content to allow compaction to the required density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier fill.

2. Fill that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be added to allow compaction to the required density.

3. Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.

Q. Protection of Fill

1. Protection of compacted fill shall be the responsibility of the Contractor. Newly graded areas shall be protected from the actions of the elements and traffic. Any settlement or washing that occurs prior to acceptance of the work shall be repaired and grades shall be established to the required elevations and slopes. Damage to any compacted lift (including those lifts previously tested and accepted by the Geotechnical Engineer) occurring at any time during the course of construction, which is caused by equipment, moisture entering the embankment, or from any other cause, shall be fully repaired by the Contractor prior to placement of overlying materials, at no additional cost to Owner.

2. In the event of and prior to the commencement of heavy rains, the Contractor shall suspend fill operations as required and shall take all necessary steps to keep the site as well drained as possible. Fill operations shall not be resumed until the moisture content of the fill is such as to permit compliance with the Specifications.

3. All corrective work or operations necessary to maintain proper moisture control of the fill material shall be at the expense of the Contractor.

R. Grading Tolerances

1. Grading shall be completed to meet or exceed the following tolerances of uniformity*:

Location	Tolerance
Top of Subgrade Beneath Structures	1/2 inch
Top of Subgrade Beneath Paving	1/2 inch
Top of Subgrade Beneath Landscape Areas	1 inch
Top of Gravel and Gravel Bases	1/4 inch

*Uniformity is defined as no variations in the surface materials, at the grades and slopes indicated on the drawings that exceed the listed tolerance over a length of 10 feet horizontally in any direction.

2. The bottom of excavations shall be formed to provide a smooth, uniform slope and grade. The bottom of the excavated grade shall be free of pockets, depressions or ridges that would collect or concentrate water, silts or other such objectionable material.

S. Finish

1. Upon completion of the work, ground surface shall be left in a firm, unyielding, true, uniform condition, free of ruts.

3.08 FILL AND BACKFILL FOR UTILITIES

A. Backfill trenches only after pipe has been inspected, tested and locations of pipes and appurtenances have been recorded, and the pipe has satisfactorily passed all such testing. Backfill by hand around pipe and for a depth of 1 foot above the pipe, and tamp firmly in layers not exceeding 6 inches in thickness, taking care not to disturb the pipe. Compact the remainder of the backfill in maximum 6-inch layers with approved mechanical tampers. Compaction in confined areas shall be performed with a minimum of six passes of a walk-behind vibratory drum roller or vibratory plate compactor.

B. Backfill material for manholes shall be placed symmetrically on all sides, in maximum 6-inch layers. Compaction in confined areas shall be performed with a minimum of six passes of a walk-behind vibratory drum roller or vibratory plate compactor.

C. The work of this SECTION shall provide a subgrade which shall be parallel to the finished grades or elevations shown on the Drawings and shall be below finished grades in accordance with the various depths shown on the Drawings and specified hereunder.

3.09 CONSTRUCTION OF COMPACTED BASE COURSES FOR PAVEMENTS

A. Dense Graded Crushed Stone shall be spread over a properly graded and compacted subgrade from self-spreading vehicles or with power graders of approved types or by hand methods. The Dense Graded Crushed Stone shall be spread to obtain the required compacted measure in layers not exceeding 12 inches in depth before compaction. The material shall be compacted with a minimum 10,000 pound (static weight) vibratory drum roller to not less than 95 percent of the maximum dry density of the material as determined by ASTM D1557. Compaction shall continue until the surface is even and true to the proposed lines and grades within a tolerance of 0.375 inch above or below the required cross sectional elevations and to a maximum irregularity not exceeding 0.375 inch under a ten foot line longitudinally. Any specific area that, after being rolled, does not form a satisfactory, solid, stable foundation, shall be removed, replaced, and compacted. Grade of base shall be carefully checked to provide positive pitch to all catch basins and drainage outlets.

B. Refer to SECTION 321200-VEHICULAR FLEXIBLE PAVING for base courses for porous pavements.

3.10 SUBGRADE MAINTENANCE

A. The work of this SECTION shall provide a subgrade which shall be parallel to the finished grades or elevations shown on the Drawings and shall be below finished grades in accordance with the various depths shown on the Drawings and specified hereunder.

B. Upon completion of rough grading operations, remove all debris and rubbish; leave areas ready for work of other trades. Subgrades specified above shall be maintained until work by other trades begins. Correct and restore settlement of fills and washouts by filling and compacting to required densities.

C. Should any area of the subgrade or subsequent fill become disturbed because of operations on the part of the Contractor which do not conform to these specifications, the disturbed soil shall be removed completely and replaced with compacted Granular Fill. The necessity and extent of such removal shall be decided by the Architect and shall be entirely at the Contractor's expense.

3.11 FROST PROTECTION

A. Do not excavate to full indicated depth when freezing temperatures may be expected. Protect subgrades from frost. Should protection fail, remove frozen materials and replace with Sand-Gravel Fill, at no cost to the Owner.

B. The Contractor, at no expense to the Owner, shall keep the operations under this Contract clear and free of accumulations of snow within the Limit of Work Line as required to carry out the work.

3.12 DUST CONTROL

A. Employ all methods required to effectively control dust created by the work of this SECTION.

B. Particular attention is called to the need to control and prevent site dust from entering the adjacent residential, school and recreational properties, and to the need to prevent tracking of mud and soil on public roads, by whatever means and methods required. (Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to SECTION 312600 – MANAGEMENT AND DISPOSITION OF CONTAMINATED MATERIAL for additional requirements.)

3.13 EROSION AND SILTATION CONTROLS

A. Install and maintain all erosion and siltation control measures as specified in the Contract Documents, and as required by the City of Amesbury and other state and federal permitting agencies. The Contractor shall also maintain the site in compliance with the Stormwater Pollution Prevention Plan (SWPPP) for the site and maintain update the SWPPP as necessary for compliance under the NPDES Permit during the course of performing the work of this SECTION, at no additional cost to the Owner. See SECTION 312500 – EROSION AND SEDIMENTATION CONTROLS.

END OF SECTION

Attachment A

Environmental Health & Safety Plan (HASP)

NEW AMESBURY ELEMENTARY SCHOOL
EARTHWORK
312000

ENVIRONMENTAL HEALTH & SAFETY PLAN (HASP)

For

Charles C. Cashman and New Amesbury Elementary School
193 Lions Mouth Road
Amesbury, Massachusetts 01913
MassDEP RTN 3-36397

Prepared for:

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November 23, 2020

ECMS Project No. 1009.073

This report has been prepared for the exclusive use of DiNisco Design and their client the City of Amesbury, Massachusetts. Environmental & Construction Management Services, Inc. acknowledges that DiNisco Design and the City of Amesbury may rely on this report. Photocopying of this document by parties other than those designated by DiNisco Design and the City of Amesbury, or use of this document for purposes other than intended, is prohibited without the prior written consent of Environmental & Construction Management Services, Inc.

Environmental & Construction Management Services, Inc.

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1.0 INTRODUCTION

This document is the Environmental Health & Safety Plan (HASP) for use by construction workers and ancillary construction support staff during construction of a new elementary school building on the Site of the existing Cashman Elementary School. This HASP shall be used as a supplement to the Contractor's own site health and safety plan. It shall not be used as a substitute for any other required HASPs.

DiNisco Design, Inc. (*DiNisco*) is the architect supporting the City of Amesbury for the project at 193 Lions Mouth Road in Amesbury, Massachusetts (subject property). Refer to Figure 1, Site Locus/Location Plan for the general location of the Site.

This HASP was prepared by *Environmental & Construction Management Services, Inc. (ECMS)* at the request of *DiNisco* to support construction of a new elementary school for PreK through 2nd grade, new parking and egress drive on a portion of the subject property that is currently occupied by the Packer and Randall Little League Fields and wooded area. Site work covered by this HASP is anticipated to include the following:

- clearing and grubbing;
- cutting, filling, and grading;
- excavation for utility installation;
- excavation for foundations and footings;
- excavation and grading for access roads and bioretention areas;
- dewatering as necessary to support excavation; and
- construction of a new building, roadways, parking, planted and play areas.

Based on known environmental conditions at the property, these activities will require handling and management of arsenic-impacted soil. All excavated and/or disturbed soil will be managed as specified in the Soil and Groundwater Management Plan (SGMP). All project personnel directly or indirectly involved in construction activities on the project site will adhere to the requirements of this HASP.

The General Contractor will designate a Superintendent to manage and oversee the implementation of the project. The Superintendent has responsibility for achieving project objectives including health and safety, initiating project activities, monitoring and adjusting efforts and resources as needed to ensure that established schedules are maintained, and managing the performance of all parties. The General Contractor will also designate a Site Safety Officer (SSO) with overall responsibility for safe execution of the project.

ECMS will provide support for the implementation of this HASP and the associated Soil and SGMP under separate cover. *ECMS* will designate a Field Safety Officer (FSO) to perform

field monitoring, provide training, and conduct daily safety meetings during the phases of construction that include potential exposure to soil and/or groundwater.

All contractors and sub-contractors are responsible for the safety of their own workers and for compliance with this HASP. The scope of this plan is limited to environmental conditions resulting from elevated metals concentrations in soil. Safety-related aspects of general construction work covered by 29 CFR 1926 will remain the responsibility of the general contractor and its subcontractors.

2.0 BACKGROUND

ECMS conducted a Phase I Environmental Site Assessment (Phase I ESA) in September 2018 to identify and evaluate actual and potential environmental liabilities associated with the subject property. The Phase I ESA did not reveal any recognized environmental conditions (RECs).

In July 2020, *ECMS* completed the collection of loam/topsoil and subsoil samples from representative areas proximate to the Cashman School and from the fields adjacent to the school for laboratory analysis for potential oil and/or hazardous material (OHM) prior to proposed site construction activities. Soil sampling results indicated the presence of the metal arsenic, at concentrations above applicable standards in the shallow soil samples across the area of proposed construction. Based on the concentrations detected, the condition was reportable under the Massachusetts Contingency Plan (MCP) 310 CMR 40.0000.

Given the presence of school-aged children, an emergency assessment was performed to assess the presence of these metals in shallow soil in other areas of the site, including infield of Randall and Packer fields. As described in Section 2.4, *Environmental Site Characterization,* arsenic was not detected in the surface soil samples from the infield of Randall or Packer Fields at concentrations above applicable standards.

2.1 Location and Legal Description of the Site

The Site is an irregularly-shaped 35.32-acre parcel of land located at 193 Lions Mouth Road in Amesbury, Essex County, Massachusetts 01913. According to the City of Amesbury Assessor, the property is listed as three (3) parcels including 50/6, 50/16 and 50/42. In addition, a portion of the adjacent Woodsom Farm (37/4) is part of the proposed project. The Site is occupied by the Charles C. Cashman Elementary School and associated athletic fields, playground, parking lots and landscaped areas. Refer to Figure 2 entitled Lot Location Plan.

The Site is depicted on the 7.5 x 15-minute U.S.G.S. topographic quadrangle for Newburyport, Massachusetts dated 1987. The Universal Transverse Mercator (UTM) coordinates of the Site within zone 19 are approximately 4,746,558 meters north latitude and 340,818.9 meters east longitude or 42° 51' 26.06'' north latitude and 70°

56' 54.07'' west longitude. Elevation at the site is approximately 105 feet above mean sea level (amsl). Figure 1 includes both a Site Locus Plan and a Street Location Map of the Site. The Site and surrounding properties are shown on Figure 2, Lot Location Plan attached to this report.

2.2 Site and Vicinity Characteristics

The Site is currently occupied by the City of Amesbury Cashman Elementary School housing grades Pre-kindergarten through 4th grade students (approximately 443 children). The Site is located within OSC – Open Space Conservancy. The school building is surrounded by a driveway and associated paved parking lots, a playground area and grass athletic field. Woodsom Farm is located to the west, and is accessed from Lions Mouth Road to the South. The north edge of the site is steeply sloping forested hill with an intermittent steam at the base. The Site is surrounded with pockets of densely settled residential neighborhoods.

2.3 Descriptions of Structures, Roads, Other Improvements on the Site

The 2-story school building is 61,472 gross square feet (GSF). The building is constructed of masonry block with brick veneer on slab on grade construction.

Assessor Office records indicate that the main Site building construction was completed in 1975. The school building is currently heated by natural gas and heated through forced air ducts. The roof is asphalt and on the roof are several HVAC units. Records indicate, the building is and always has been heated by natural gas.

The nearest surface water bodies to the Site is Lake Gardner that is located approximately 2,500 feet to the north-northeast. According to the City of Amesbury Health Department, there are no know public or private potable water supply wells in the vicinity of the Site.

The City of Amesbury obtains its drinking water from its watershed area that encompasses about 55 square miles; most of which reside in New Hampshire. Tuxbury Pond feeds the Powow River, which the treatment plant draws from. Lake Attitash and Meadowbrook also supplement the water source seasonally and in times of drought. All of Amesbury's wastewater empties into their municipal sewer system. The wastewater treatment facility is located at 19 Merrimac Street.

The site is currently supplied with natural gas and serviced by the municipal water and sewer systems. The existing Cashman School building has a sewage ejector system that was observed along the entrance driveway area south of the school.

2.4 Environmental Site Characterization

In July and August 2020, *ECMS* collected pre-construction surface and subsurface soil samples for laboratory analysis in order to characterize the soils that may require off-site disposal. Soil sampling results indicated the presence of arsenic at concentrations above applicable standards in every location sampled across the proposed work site. Additional surface soil samples were subsequently collected on July 31, 2020 from the two baseball infields (Randall and Packer Fields) at the site to verify that arsenic was not present in the imported red clay soils on either field. No arsenic was detected over any reportable concentration in any of the eight (8) surface infield samples analyzed. In addition, one (1) soil sample collected on August 12, 2020 from the outfield on Randall field at a depth of approximately 2 feet below grade did not have arsenic above its reportable concentration.

The assessment revealed elevated arsenic concentrations in 28 of 28 shallow soil samples (excluding the soil samples collected from both infields and one (1) sample from the outfield of Randall Field). The concentrations of generally exceeded reportable thresholds of 20 milligrams per gram (mg/kg), and in some cases exceeded Imminent Hazard (IH) Threshold of 40 mg/kg. No soil sample had a concentration of arsenic detected over its applicable Upper Concentration Limits (UCL) of 500 mg/kg. Soil analytical results are presented in Tables 1 through 7 and soil sampling locations are depicted on Figure 3.

Though arsenic detected in the site soils are background condition associated with known elevated arsenic concentrations in bedrock, their presence in soil poses a potential risk to construction workers at the site. Additional soil sampling (areas of topsoil/loam) is anticipated to be completed prior to commencement of construction activities, with the goal of assessing if the loam/topsoil has concentrations of arsenic.

2.5 Release Notification Retraction

After extensive soil sampling, including sampling with the MassDEP, *ECMS* concluded that the presence of the arsenic detected on the site was from naturally occurring sources.

Consistent with the provisions of 310 CMR 40.0335(1)(c), this release notification is being retracted on the basis that the subject release did not meet one or more of the sets of notification criteria specified in 310 CMR 40.0300. Specifically, releases of arsenic do not require notification pursuant to 310 CMR 40.0317(22) if they are in areas that are documented to have elevated arsenic measured in soil or groundwater that:

- is consistently present in the environment at and in the vicinity of the sampling location;
- is solely attributable to natural geologic or ecologic conditions; and

- has not been mobilized or transferred to another environmental medium or increased in concentration in an environmental medium as a result of anthropogenic activities.

The City of Amesbury lies within an area of Massachusetts that has been identified in studies by the United States Geological Survey (USGS) as being underlain by bedrock units, particularly the Merrimack and Nashoba formations, containing elevated arsenic concentrations (see *Arsenic and Uranium in Water from Private Well Completed in Bedrock of East-Central Massachusetts – Concentrations, Correlations with Bedrock Units, and Estimated Probability Maps*, John A. Colman, USGS, Scientific Investigations Report 2011-5013).

Elevated concentrations of arsenic were detected in native soil across the site at all depths sampled, with the most elevated concentration detected just below the grass cover to a depth of 2 feet below grade. No field evidence was encountered that indicated soil had been disturbed or mobilized, or that an anthropogenic activity might have resulted in the elevated arsenic concentrations.

On September 17, 2020, *ECMS* submitted a Retraction of Release Notification dated September 17, 2020 in accordance MCP 310 MR 40.0335 to the MassDEP via eDEP.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

ECMS is the consultant responsible for the development of this Environmental Health & Safety Plan (HASP). Mr. Kevin J. Kavanaugh, LSP, CHMM is the primary point of contact for this project. All correspondence concerning the content or implementation of this plan should be directed to him [via email at kevin.kavanaugh@ecmsinc.com; or via telephone at (617) 338-2121 ext. 2].

This plan will be implemented by *ECMS*, the general contractor, and its subcontractors during earthwork in support of this project.

An *ECMS* field scientist will be responsible for the execution of field activities, including monitoring, sampling, and stockpile management. *ECMS* field scientists have completed 40-hour OSHA Hazardous Waste Operations (HAZWOPER) training as well as 8-hour HAZWOPER Supervisor training and are experienced in excavation oversight and field screening techniques. Contact information for key contractors and individuals is as follows:

Client: *DiNisco Design, Inc.*
Site Name: Cashman and New Amesbury Elementary School
Site Location: 193 Lions Mouth Road, Amesbury, Massachusetts

General Contractor: To Be Determined

Site work contractor: To Be Determined

Field Safety Officer: *ECMS*
288 Grove Street #391, Braintree, Massachusetts 02184
Project Manager: Kevin J. Kavanaugh o: (617) 338-2121 m: (617) 212-9255
Field Scientist: To Be Determined
LSP: Kevin J. Kavanaugh, LSP o: (617) 338-2121 m: (617) 212-9255

Additional Subcontractors: _____

The general contractor's Superintendent will communicate with *ECMS* regarding this HASP and be responsible for its implementation.

4.0 SCOPE AND APPLICATION OF HASP

This HASP defines the requirements and protocols to be followed during excavation, other soil-disturbing activities, and dewatering activities during the construction project. Applicability extends to contractors, subcontractors, governmental officials, and visitors that enter the site while such activities are occurring. For the purposes of this HASP, the term "site" shall be used to identify construction areas associated with this project and under the direct control of the general contractor. This HASP is complementary to any contractor Safety Plan covering general construction site safety. In cases where both documents provide project standards or requirements, the more stringent requirements will apply.

All contractor personnel and their subcontractors (hereafter referred to as "project personnel") will be informed of the site emergency response procedures and any potential fire, explosion, health, or safety hazards posed by project operations. This HASP summarizes those hazards and defines protective measures planned for the site.

This HASP must be reviewed by all project personnel and visitors who may enter any active work area, regardless of whether the area has been designated an Exclusion Zone (EZ) or

Contaminant Reduction (Decontamination) Zone (CRZ). For purposes of this plan, work zones are referred to as EZ and CRZ whenever the provisions of this plan apply.

An agreement to comply with the requirements contained herein must be signed by all project personnel and visitors who may enter such areas (See Appendix A, HASP Acknowledgement Sheet). The EZ and CRZ will be designated based on the potential for contact with, or exposure to, identified contaminants at concentrations above established Occupational Safety & Health Administration (OSHA) Permissible Exposure Limits (PEL), Massachusetts Contingency Plan RC-S1 soil standards, or other applicable guidelines.

Lockout-tagout procedures are not included in this HASP. If installed lines or equipment will be energized during this phase of the project, OSHA lockout-tagout procedures shall be instituted.

5.0 SITE DESCRIPTION AND PROJECT OPERATIONS ANALYSIS

This section provides an overview of the scope of project activity, as well as a historical analysis of the project areas. The purpose of this section is to review the potential project chemical and physical hazards to which workers may be exposed when working in or near the site. Additional data will be gathered once construction begins, and this plan will be revised, if appropriate, based on the new data.

5.1 Summary of Work

The project scope includes construction of a new school building new parking lot, driveways, playground and planted areas on a portion of the subject property that is currently occupied by the Packer and Randall Little League Fields and wooded area. Preparation of the new building area entails the excavation of potentially contaminated soil. The excavation edges will be sloped, or trench shields will be used to protect workers in excavations. Depth of excavation will generally average 5 feet below current grade but may extend deeper at certain locations.

Although dewatering is not anticipated at the site, provisions are included in this HASP for groundwater management. If recovered, groundwater will be treated and discharged in accordance with the terms of an approved permit or contained on site pending off-site disposal.

Excavated soil will be stockpiled adjacent to the excavation, or in a primary stockpile area pending characterization as needed for off-site disposal/recycling, as specified in the SGMP.

Project activities will include:

Site Preparation:

- Establishment of work zones;
- Tree clearing; and
- Grubbing and removal of surface material

Excavation and Backfilling:

- Soil excavation, filling and grading;
- Dust, vapor and odor control;
- Soil classification;
- Soil management;
- Soil transportation and disposal;
- Equipment decontamination; and
- Excavation backfilling.

Construction and Demolition:

- Installation of utilities;
- Construction of a new building, roadways, parking, planted and play areas;

Water Management (not currently anticipated):

- Construction dewatering; and
- Water treatment and discharge.

5.2 Environmental Site Characterization and Chemical Hazards

The distribution of arsenic in surface (depths from just below the grass to a maximum depth achieved of 24 inches) soil is heterogeneous, possibly reflecting perturbations by some reworking of the native soils. Not including the eight (8) Randall and Packer Little infield red clay soil samples, twenty-nine (29) total soil samples were collected from a depth between just below the grass surface to a maximum of 24 inches below grade on both the Cashman School property and on the neighboring City of Amesbury owned Woodsom Farm property. Of the 29 samples collected 28 samples had arsenic concentrations greater than its applicable RCS-1 of 20 mg/kg and of those 28 samples, 15 had an arsenic concentration above its IH of 40 mg/kg. The one sample (designated SSS-28) that did not have an arsenic concentration over RCS-1 was collected from the outfield of Randall Field at a depth of 18-24 inches and consisted of a well-graded area that appeared to be fill related to the construction of the baseball field.

The highest arsenic found in site soils is in the deepest samples, and at several locations the arsenic concentration increases with increasing depth. This was noted in the samples collected by *ECMS* and MassDEP in what was considered to be a "background" or unworked portion of the Cashman School property (listed as samples "SSS-26" and "SSS-27" collected by *ECMS* and "DEP S-3 Background" and "DEP S-4 Background" collected by MassDEP). Surficial application of arsenic would yield a concentration gradient that is the opposite of that observed at the site.

Elevated soil arsenic was also found at on the Woodsom Farm property at the same depth range as found on the Cashman School property. Soils appeared to be the same on both properties consisting of dry, brown, fine to coarse sand with little silt and trace gravel and trace root fibers in the top 6 inches below the grass cover.

No evidence has been found for the existence of a historical "point source" for arsenic at the school site, such as a pesticide manufacturer, tannery, or other industry using large quantities of arsenic. Historic and aerial maps also do not indicate the presence of any apple orchards in the area in the late 19th century, where arsenical pesticides (e.g., lead arsenate) may have been used on the Site and adjoining Woodsom farm property. Concentrations of lead were not found to be elevated beyond typical background levels thus eliminating the application of lead arsenate.

Arsenic concentrations in soil exceed the Massachusetts Contingency Plan (MCP) standard for soils, regardless of soil classification (20 milligrams per kilogram [mg/kg]).

Although the contaminants detected in soil at concentrations above the applicable thresholds have been shown to be attributable to naturally-occurring background conditions, but their presence in soil still poses a potential risk to construction workers at the site as well as to populations that may be impacted by offsite migration of soil. The table below presents locations of constituents that exceed their applicable MCP Method 1 soil standards and the maximum detected concentrations:

Compounds Exceeding MCP Method 1 Soil Standards

Compound	Sample Location	Maximum Detected Concentration (mg/kg)	MCP Soil Standard Exceeded (mg/kg)
Arsenic	28/29 samples >RC 15/28 samples >IH 0 samples > UCL	82.3	Method 1 S-1, S-2, S-3 = 20 IH Threshold = 40 UCL = 200

mg/kg milligrams per kilogram.
UCL Upper Concentration Limit.
IH Imminent Hazard (applies only to shallow soil samples).

No groundwater samples have been collected to date for the analysis of arsenic in groundwater.

5.3 Target Constituents for Monitoring

Soil samples were collected and analyzed as part of the characterization activities. Summary tables are presented in Appendix B.

Compounds of concern for the site are limited to arsenic. Field monitoring will be conducted using a dust meter to monitor exposure to dust potentially impacted by metals.

Monitoring will be performed in the typical worker breathing zone via hand-held instruments, and at the project fence line by fixed monitoring stations.

5.4 Other Potential Chemical Hazards

As with any construction site, hazardous materials may be expected to be present in various forms, including in consumer commodities. Some common types may include:

- Fuel and lubricants (*e.g.*, gasoline, diesel fuel, hydraulic oil);
- Cleaning agents (*e.g.*, detergents, respirator sanitizers, hand cleaners);
- Firefighting agents (*e.g.*, chemical fire extinguishers); and
- Miscellaneous chemicals (*e.g.*, marking paint, bulk office supplies).

5.5 Physical Hazards

As an active construction zone, there are physical and safety hazards associated with working at the site, to include:

- Potential contact with energized electrical lines;
- Engulfment hazards associated with excavations;
- Injuries from contact with objects, such as items that may fall or trench shields that may suddenly move;
- Cuts and abrasions from contact with sharp objects such as nails, metal shards, and broken glass;
- Falling or tripping on slippery surfaces, uneven terrain, or congested work surfaces;
- Dangers related to working near heavy equipment and vehicular traffic; and
- Heat stress / Cold stress.

As such, workers must be aware of these physical hazards and exercise caution at all times. Proper personal protective equipment (PPE) must be worn at all times by

project personnel to protect against physical hazards. Minimum required PPE includes a hard hat, safety glasses, construction work shoes, and a reflective vest that must be worn by all project personnel at all times while on site.

5.6 Biological Hazards

Potential biological hazards on the site are relatively minor, yet not insignificant, and may include the following:

- ticks, bees, mosquitoes and other insects which may carry disease;
- rats/rodents, dogs, or other wildlife may pose a potential for bites and disease, such as rabies;
- poison ivy, oak, or sumac may be found in overgrown areas and pose skin irritation hazards.

Project personnel will avoid contact with poisonous plants. Insect repellants may be used by project personnel as necessary.

5.7 COVID-19 Virus Hazard

Refer to the OSHA "Guidance on Preparing Workplaces for COVID-19. https://www.osha.gov/Publications/OSHA3990.pdf

6.0 TASK BY TASK HAZARD ANALYSIS

The evaluation of potential health and safety hazards related to this project is based upon the available knowledge of site conditions and anticipated risks. This HASP is designed to address and minimize these risks to the greatest extent possible.

The following major project phases or tasks include:

- Mobilization and Maintenance/Demobilization;
- Material Handling: Excavating, Transporting, Backfilling, and Compacting;
- Construction; and
- Dewatering (not currently anticipated).

The subsections that follow describe each task and operation in terms of the specific hazards associated with it, and any protective measures to be implemented in order to reduce or eliminate those hazards. In addition, hazards and protective measurements associated with all phases of the project or general work tasks are also discussed. All noted protective measures will be implemented when appropriate throughout the duration of the various project phases.

At least three full working days (excluding weekends) before any new excavation, or when any excavation will be expanded beyond the pre-planned limits, DigSafe will be notified.

For activities not specifically listed below, hazards and preventative measures will be discussed at tailgate safety meetings prior to start of the activity.

6.1 General Project Hazards and Precautions

Certain hazards potentially exist throughout all phases of the project. These hazards and the preventative measures designed to minimize or eliminate the risk of these hazards are presented in the tables below.

General Project Hazards and Precautions

Potential Hazards	Preventative Measures
Back Strain	• Use proper lifting techniques. • Use two or more employees for lifting large, heavy items. • Take sufficient rest breaks.
Heat Stress	• FSO shall monitor heat stress. See Section 13.3 for details. • Take sufficient rest breaks and drink fluids.
Eye Injuries	• Safety glasses shall be worn at all times. • Goggles or face shield shall be worn as appropriate.
Hand Injuries	• Employees handling debris or sharp objects must wear leather gloves.
Foot Injuries	• Work boots shall be used.
Head Injuries	• Hard hats shall be worn at all times.
Hearing Damage	• Hearing protection shall be required for any operations at 85 dB and above.
Slips, Trips and Falls	• Good housekeeping shall be implemented. • Walkways and aisles shall be kept clear. • Wiring, plumbing, hoses, etc. shall be untangled and neat. • Workers shall remain alert while walking. • Tripping and poor footing hazards shall be repaired as they are discovered or must be clearly identified.
Electrical Shock	• Tools and cord shall be inspected prior to use. • Ground Fault Circuit Interrupt (GFCI) electrical outlets shall be utilized.
Fire Hazards/ Burns	• Air monitoring for flammable atmospheres. • Smoking in designated areas only. • Combustible chemicals shall be stored properly. • Firefighting equipment (fire extinguishers) will be available on site (see Section 15.2). • No fueling operations will be left unattended. • Personnel will be aware of mufflers and other hot parts of equipment while operating equipment. • Personnel will not attempt to service/fuel any piece of equipment until it has sufficiently cooled down.

Potential Hazards	Preventative Measures
Falling Hazards	• Fall protection such as harnesses, hand rails, and temporary fences shall be utilized.
Biological Hazards	• Avoid wildlife when possible. • Wear insect repellant as necessary. • Use good personal hygiene. • Personal inspections for ticks should be performed.
Moving Vehicles	• Employees will wear vests when appropriate.
Hot Work Hazards	• Fire extinguishers will be available. • FSO shall approve a hot work permit prior to hot work. • Appropriate PPE shall be worn. • Compressed gas shall be stored properly.
Chemical Exposure Hazards	• Air monitoring in worker breathing zones and within the work area shall be performed in accordance with Section 9.0 of this HASP. • Proper PPE shall be worn to minimize dermal and inhalation exposure to contaminants. • Dust and vapor controls shall be implemented. Proper decontamination procedures shall be followed.
Hazard Associated with Spills	• All chemicals will be kept in appropriate containers - closed and labeled. Chemical containers shall be stored indoors or provided with secondary containment. • All fuel spills will be cleaned up immediately and immediately reported to the FSO. • Spill and absorbent materials shall be readily available. • Employees will be instructed as to proper fueling techniques. • Fuel nozzle and hose will be secured in holder after use. • Fuel caps will be secured after fueling operations. Sealed containers will be used for transport of all hazardous materials.

6.2 Mobilization, Maintenance and Demobilization

Mobilization, Maintenance and Demobilization Hazards and Precautions

Potential Hazards	Preventative Measures
Injuries due to flying debris	• Personnel not directly involved with operations shall keep clear. • Windows and doors will be closed during equipment operation. • Proper PPE shall be worn, to include proper eye protection. • All appropriate guards shall be used on equipment. • Training of proper use of equipment shall be performed. • Eyewash will be readily available on site.

Pinching/injuries caused from objects/equipment in motion	• Guards shall be maintained on all equipment as appropriate. • Employees shall wear safety vests. • Heavy equipment and vehicles shall have back up alarms. • Equipment, cables, chains, and loads shall be inspected periodically. • Workers shall wear work gloves when handling rough or sharp material. • Spotters will be present during all movement of heavy equipment. • No personnel shall be permitted under the crane or heavy equipment swing radius during operation. • All operations shall be performed under the supervision of a competent person. • Hand signals shall be established.

6.3 Material Handling: Excavation, Transportation, Backfilling & Compacting

Material Handling: Excavation, Transportation, Backfilling & Compacting and Precautions

Potential Hazards	Preventative Measures
Pinching/injuries caused from objects/equipment in motion	• Guards shall be maintained on all equipment as appropriate. • Employees shall wear safety vests. • Heavy equipment and vehicles shall have back up alarms. • Equipment, cables, chains, and loads shall be inspected periodically. • Workers shall wear work gloves when handling rough or sharp material. • Spotters will be present during all movement of heavy equipment. • No personnel shall be permitted under the crane or heavy equipment swing radius during operation. • All operations shall be performed under the supervision of a competent person. • Hand signals shall be established. • All personnel will establish eye contact with operators prior to approaching equipment. • Personnel will avoid equipment swing areas and blind sides. • All slings, chains, and ropes will be rated for the load which it is expected to lift. • Only qualified and trained personnel will set up rigging prior to any hoist or lift.
Rollovers	• Equipment will have rollover protective structures and seat belts • Operators will wear seat belts when operating equipment. • Equipment will not be operated on grades that exceed

Potential Hazards	Preventative Measures
	manufacturer's recommendations.
Excavation Hazards	• Competent persons shall determine appropriate protection method (i.e., slopes, trench boxes, etc.) • Competent persons shall inspect excavations daily and following rain for any excavations over 4 feet in depth. • Ladders shall be placed at least every 25 feet for entrance/exit in excavations more than 4 feet. • Ladders shall be inspected periodically. • Ladders shall be securely tied off. • Contact Dig Safe at 811 at least three full working days prior to any new excavation.
Injuries due to falling items into excavations	• Barricades with visible barriers shall be placed around all open excavations. • Excavated material shall be kept at least 2 feet from the excavation depending on the depth of excavation. • All employees shall wear proper PPE. • All ground personnel will stay clear of suspended loads.

7.0 PERSONAL TRAINING REQUIREMENTS

7.1 Groundwater and Decontamination Water Storage

As a remedial effort under the MCP, all handling of potentially-contaminated soil falls under the requirements of 29 CFR 1910.120 *Hazardous Waste Operations and Emergency Response* (HAZWOPER). Therefore, the training requirements of §1910.120(e) apply to the project, as follows:

§1910.120(e)(3)(i) General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in…activities that expose or potentially expose workers to hazardous substances and health hazards must receive a minimum of 40 hours of instruction off the site and a minimum of three (3) days actual field experience under the direct supervision of a trained experienced supervisor.

§1910.120(e)(3)(ii) Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geophysical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

Each of these certifications carries an annual 8-hour refresher requirement.

Contractor personnel shall provide a copy of the certification of such training and/or refresher to the FSO prior to entering the active work area. Copies of training

certificates and documented experience will be maintained in a dedicated file during the project.

7.2 Competent Person

Prior to any excavation work, a "competent person" must assess excavation conditions and determine actions in order to ensure worker safety. A Competent Person is an individual who either through training or experience is "capable of identifying all predictable hazards" associated with the excavation activities. Additionally, he or she will have authorization to take prompt corrective action to eliminate any hazards, including but not limited to shutting down operations.

7.3 Initial Health & Safety Briefing

The FSO shall conduct a site-specific Health and Safety briefing for all contractors, visitors (*e.g.*, inspectors), or any others who will work on the site. The Health and Safety briefing shall include, at a minimum, the following:

- The contents of this site-specific Health and Safety Plan;
- Names of personnel and alternates responsible for site health and safety;
- Project roles and responsibilities;
- Potential health hazards associated with known or potential contamination present in the various work areas;
- Work practices that the employee can use to minimize risks to safety and health;
- Visitor requirements;
- Evacuation routes and signals;
- Health and safety emergency procedures;
- Reporting of fires, emergencies and first aid incidents;
- Emergency and contingency procedures;
- Location of First Aid, Eyewash, Decontamination areas, and Emergency Equipment;
- Location of Emergency Contact Phone List; and
- Hospital Route.

8.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Soil suitable for reuse will be backfilled into the excavation from which it was removed, to the maximum extent practicable, at the depth from which it was removed. Material that cannot be replaced into the initial excavation location will be backfilled in areas of similar characteristics and metals concentrations, and at appropriate depths, to the extent feasible.

8.1 Description of Levels of Protection

PPE will be used when project and support activities involve known or suspected atmospheric contamination, when contaminated vapors, gases, or particulates may be generated by site activities, or when direct contact with skin-affecting substances may occur. The specific levels of protection and necessary components for each have been divided into four categories according to the degrees of protection afforded: Levels A, B, C, D.

Modification of these levels is permitted and routinely employed during site work activities to maximize efficiency (e.g., Modified Level D). Likewise, the type of chemical protective ensemble will depend upon contaminants, concentrations, and degree of contact or potential exposure.

The level of protection selected shall be based upon the following:

- Type, measured concentration, and toxicity of the chemical substance in the ambient atmosphere.
- Potential for exposure to substances in air, splashes of liquids, or other direct contact with materials due to work executed.
- Knowledge of chemicals on site along with properties such as toxicity, route of exposure, and contaminant matrix (e.g., soil, water, air).
- Understanding of chemical, physical, and biological hazards that may be encountered.

In situations where the type of chemical, concentration, and possibilities of contact are not known or if unforeseen conditions are encountered, the appropriate level of protection will be selected based on professional experience and judgment of the FSO until the hazards can be better defined.

8.1.1 Level A PPE

Level A attire offers the highest level of respiratory and skin protection available through the use of self-contained breathing apparatus inside a fully encapsulated, air tight, vapor tight, chemical protective suit. Only specially trained and qualified

individuals may don Level A, usually only under emergency conditions. **The use of Level A is not anticipated on this project.**

8.1.2 Level B PPE

Level B attire offers the highest level of respiratory and less skin protection available through the use of supplied air and a chemical protective suit. **The use of Level B is not anticipated on this project.**

8.1.3 Level C PPE

Level C should be worn when the criteria for using air-purifying respirators are met and a lesser level of skin protection is needed. While **Level C is not anticipated on this project,** the FSO shall direct the usage of Level C if deemed necessary.

Level C PPE

PPE	Description
Respiratory Protection:	Air purifying respirator, full or half face, cartridge equipped with P-100 (HEPA) filter cartridge.
Clothing:	For job tasks where splashing of wet material is likely: Pro/Shield 2 or 3, or polyethylene coated Tyvek coveralls, with attached hoods. Where only dry material contact is likely: Any of the above, Tyvek, Pro/Shield 1, or NexGen.
Gloves (outer):	Nitrile rubber (leather/cotton type to be left inside the work zone may be substituted in dry conditions only).
Gloves (inner):	Latex or nitrile surgical type.
Boots:	Construction work boots.
Boot Covers (outer):	Latex (disposable) or slush boots (reusable).
Head Protection:	Hard hat.
Eye/Face Protection:	Chemical splash goggles or safety glasses with side shields at all time (if half face respirator is used.
Other:	Warning vests; fall protection devices, as needed; hearing protection, as needed.

8.1.4 Level D (Modified) PPE

Modified Level D should be worn when respiratory protection is not warranted but dermal protection is necessary. Modified Level D will be used in areas where elevated concentrations of contaminants are anticipated or encountered.

Level D Modified PPE

PPE	Description
Respiratory Protection:	None required.
Clothing:	For job tasks where splashing of wet material is likely: Pro/Shield 2 or 3, or polyethylene coated Tyvek coveralls, with attached hoods. Where only dry material contact is likely: Any of the above, Tyvek, Pro/Shield 1, or NexGen.
Gloves (outer):	Nitrile rubber (leather/cotton type to be left in the work zone may be substituted in dry conditions only).
Gloves (inner):	Latex or nitrile surgical type.
Boots:	Construction work boots.
Boot Covers (outer):	Latex (disposable) or slush boots (reusable).
Head Protection:	Chemical splash goggles or safety glasses with side shields at all time.
Eye/Face Protection:	Hard hat.
Other:	Warning vests as needed; fall protection devices, as needed; hearing protection, as needed.

8.1.5 Level D PPE

Level D provides minimal protection against chemical hazards. It is normally worn only as a work uniform and not in any area with significant respiratory or skin contact hazards.

Non-intrusive work or work conducted in areas designated as "clean" or consistent with background by the Site Superintendent, SSO, or FSO may be conducted in Level D PPE.

Level D PPE

PPE	Description
Respiratory Protection:	None required.
Clothing:	Cloth coverall or long sleeve shirt and full-length pants.
Gloves (outer):	Appropriate for work task.
Gloves (inner):	None required.
Boots:	Construction work boots.
Boot Covers (outer):	None required.
Head Protection:	Safety glasses with side shields at all times.
Eye/Face Protection:	Hard hat.
Other:	Warning vests as needed; fall protection devices, as needed; hearing protection, as needed.

8.2 Initial Levels of Protection

Initial Levels of PPE

Job Tasks	Initial Level of Protection
Mobilization	Level D
Excavation	Level D or Modified Level D*
Soil/Sediment Handling	Level D or Modified Level D*
Decontamination	Level D or Modified Level D*
Dewatering/Water Treatment	Level D or Modified Level D*
Demobilization	Level D
Other project activities without potential exposure to contaminated soil or groundwater	Level D, with routine precautions for specific activities
Mobilization	Level D
Excavation	Level D or Modified Level D*

8.3 Initial Levels of Protection

The level of protection provided by PPE selection shall be upgraded or downgraded based upon a change in site conditions or observations. Particular attention in this regard will be paid to air monitoring data. The reevaluation process will be ongoing during the project. The FSO will have discretion, in consultation with the Site Superintendent, to modify PPE ensembles as his/her observations dictate.

When a significant change occurs in the process or tasks performed, the hazards and PPE will be re-assessed. Some indicators of the need for reassessment are:

- Receipt of new site characterization data:
- Commencement of a new work phase, such as the start of work that begins on a different portion of the site;
- Change in job tasks during a work phase;
- Change of season/weather or ambient temperature;
- When temperature extremes or individuals' medical considerations limit the effectiveness of PPE;
- Contaminants other than those previously identified are encountered;
- Change in work scope, which affects the degree of contact with contaminants; and/or
- Capacity of personnel to work in PPE.

Before the workers actually begin work in their PPE ensembles, the anticipated duration of the work mission will be established. This will be determined at the daily tailgate safety briefing.

Situations that may affect the duration of work, include:

- Weather conditions;
- Job tasks;
- PPE permeation rates; and/or
- Respirator end of service life.

8.3 Standard Operating Procedures (SOPs) for PPE

Proper inspection of PPE features several sequences of inspection depending upon specific articles of PPE and frequency of use. The different levels of inspection are as follows:

- Inspection and operational testing of equipment received from the factory or distributor;
- Inspection of equipment as it is issued to workers;
- Inspection before each use;
- Inspection after use and prior to maintenance;
- Periodic inspection of stored equipment; and
- Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise.

The following PPE inspection checklist will be implemented and shall be conducted by the user. This ensures that the user has checked out the specific device or article and that the user is familiar with its use. Before use:

1. Determine that the clothing material is correct for the specified task at hand
2. Visually inspect for
   Imperfect seams;
   Non-uniform coatings; Tears;
   Malfunctioning closures; Defects
3. During the work task, periodically inspect for:
   Evidence of chemical attack such as discoloration, swelling, stiffening, and softening;
   Closure failure;
   Tears;
   Punctures;
   Seam discontinuities.

Workers will be reminded that chemical permeation can occur without any visible effects.

9.0 RESPIRATORY PROTECTION

Air purifying respirators and self-contained breathing apparatus are not anticipated to be required for this project. Information is provided herein in the event that unforeseen conditions are encountered. The following subsections define standard operating procedures for air purifying respirators and self-contained breathing apparatus.

All types of respiratory protection will be used as per the manufacturer's recommendations. The respirator will be put on in a non-contaminated area and taken off last after decontamination.

Respiratory protection will be worn in all EZs and CRZs as required by this HASP (*i.e.*, when conditions indicate that respiratory protection is required). Deviation from or non-adherence to respirator requirements will result in removal from such area followed by disciplinary action and possible termination.

All workers requiring respiratory protection will be fit-tested with their specific brand/model/size of respirator prior to donning the respirator for use in contaminated areas of the job site.

Appropriate documentation should be furnished to the site SSO prior to use. In the absence of appropriate documentation, the SSO will see that the worker is fit-tested and that the appropriate documentation is completed. As required, all personnel donning respiratory protection will be clean shaven.

All workers will be trained in compliance with 29 CFR 1910.134 on the proper use, care, limitations, maintenance, and fitting of respirators. The contractor will provide respiratory protective equipment for all contractor personnel. Subcontractors shall be responsible for supplying the necessary equipment, fit-testing, and medical monitoring for compliance with this plan.

While use of Level A, B, or C respiratory protection is not anticipated, the contractor and its subcontractors must be prepared for such upgrades when indicated by the SSO. Preparation should include procurement of equipment, fit-testing, training, and medical monitoring to avoid unnecessary delays in the resumption of work.

9.1 Air Purifying Respirators

Air-purifying respirators (APR) shall consist of those pieces of respiratory protection specified under Level C PPE. Typically, this will consist of either a half or full-face negative pressure respirator fitted with the appropriate filter cartridge or canister.

9.1.1 Cartridge Change-out Frequency

At the current time, no planned job tasks are anticipated to use APRs. If conditions warrant an upgrade to Level C protection, a cartridge change-out schedule will be developed and discussed at tailgate safety meetings prior to donning Level C PPE. Results of air monitoring will be used to determine levels of air contaminants. These data, along with cartridge maximum use and end of service life levels, will be used to determine the appropriate change-out schedule. At a minimum, cartridges will be changed daily when in use.

9.1.2 Daily Cleaning Procedure

Each user of a respirator is responsible for cleaning, maintaining, and inspecting his/her own respiratory protection devices. The steps to be followed for cleaning and disinfecting daily are as follows:

1. Respirator Disassembly – Respirators are taken to a clean location where the filters, cartridges, or canisters are removed. For a thorough cleaning, inhalation and exhalation valves, speaking diaphragm, and any hoses are to be removed.
2. Cleaning – In most instances the appropriate cleaning and disinfecting solution provided by the manufacturer is used and is dissolved in warm water in an appropriate tub. Using gloves, the respirator is placed in the tub and swirled for a few moments. A soft brush may be used to facilitate cleaning.
3. Rinsing – The cleaned and disinfected respirators are rinsed thoroughly in water to remove all traces of detergent and disinfectant. The rinse water will be containerized by the "Contractor" for offsite disposal/discharge with dewatering fluids.
4. Drying – The respirators may be allowed to air dry in the room on a clean surface. They may also be hung upside down, but care must be taken not to damage or distort the face pieces.
5. Re-assembly and Inspection – The clean, dry respirator face piece should be re-assembled and inspected in an area separate from the disassembly area to avoid contamination.

Special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This problem appears most often under the seat of the exhalation valve and can cause valve leakage or sticking.

9.1.3 Inspection & Checkout

1. Each respirator user will visually inspect the entire APR unit for any obvious damages, defects, or deteriorated rubber.
2. Make sure that the face piece harness is not damaged. The serrated portion of the harness can fragment, which will prevent proper face seal adjustment.
3. Inspect lens for damage and proper seal in face piece.
4. Exhalation Valve – Pull off plastic cover and check the valve for debris or for tears in the neoprene valve (which could cause leakage).
5. Inhalation Valves (two) – Screw off cartridges/canisters and visually inspect neoprene valves for tears. Make sure that the inhalation valves and cartridge receptacle gaskets are in place.
6. Make sure a protective cover lens is attached to the lens.
7. Make sure the speaking diaphragm retainer ring is hand-tight.
8. Make sure that you have the correct cartridge.
9. Don respirator and perform negative and positive pressure tests.

9.1.4 Storage of Air Purifying Respirators

OSHA requires that respirators be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, damaging chemicals, and mechanical damage. Storage of respirators should be in a clean, secure area that minimizes the chance for contamination or unsanitary conditions. APRs will be stored in a secure area.

9.2 Self-Contained Breathing Apparatus (SCBA)

Positive pressure demand, full-face self-contained breathing apparatus (SCBA), or pressure demand supplied-air respirator (SAR) with escape air bottle (NIOSH approved), will be used when the highest level of respiratory protection is needed. SCBA/SARs may be required for standby use at the job site if the SSO or Competent Person determines their use may be necessary. The contractor shall supply all SCBA or SAR equipment when required for its employees. Subcontractors shall supply respirator protection for their employees along with documentation of required certifications and training.

SCBA cleaning, inspection, checkout, and storage procedures shall be discussed on site by the SSO with the employees that may be required to don SCBA equipment prior to the use of such equipment.

9.3 Air-Line Breathing Air Compressors

The contractor will be responsible for the operation of any air compressor to supply breathing air. The steps to be followed for performing inspections of the air compressors are as follows:

1. Prior to job startup, the contractor will conduct an air test of the compressor air to verify Grade D status. Results of this test will be maintained by the SSO.
2. The compressor will be set up in an area so that the exhaust from vehicles, other equipment, and the compressor itself does not have an influence upon the quality of air at the air intake. The placement of the compressor should be such that no outside contaminants could be introduced into the compressor.
3. Perform required maintenance to the air compressor prior to use.
4. Inspect and test emergency backup air supply. Ensure that backup air supply is full.
5. Oil-lubricated air compressors must comply with OSHA 1910.134 and contain a temperature alarm and a carbon monoxide alarm. Alarms will be located in close proximity to the operation and monitored continuously by the "Contractor".
6. In addition, all manufacturers' maintenance and inspection requirements must be followed.

10.0 MEDICAL SURVEILLANCE REQUIREMENTS

Medical monitoring programs are designed to track the physical condition of all personnel on a regular basis as well as survey pre-employment or baseline conditions prior to potential exposures on project subject to the requirements of 29 CFR 1910.120 (HAZWOPER). All personnel that have the potential to enter the EZ or CRZ will provide proof that they are fit for duty and able to wear respiratory protection prior to reporting to the job site. The FSO will require documentation of acceptable medical clearance prior to each worker's entry into the EZ or CRZ.

10.1 Baseline and Pre-Assignment Medical Monitoring

Prior to being assigned to a hazardous activity involving direct exposure to toxic materials, each person must have received a HAZWOPER-type medical examination within the previous 12 months. In special cases, this period may be extended to 24 months based on a written authorization from the worker's physician.

As suggested by NIOSH, OSHA, and the EPA Occupational Safety and Health Guidance Manual:

- The minimum medical monitoring requirements for work at the site is as

follows:
- Complete medical and work history;
- Review of medical history and general exam by a Board-Certified Physician;
- Determination of fitness for duty.

- If using respiratory protection, all of the above plus:
  - Completion of OSHA Respiratory Protection Questionnaire and review by a Board-Certified Physician. If deemed necessary, the following will apply:
    Pulmonary function tests;
    Medical qualification to use a respirator; Respiratory fit test (yearly).

- If handling or removing hazardous material or wastes, all of the above plus:
  - Chest X-ray (every 2 years or as recommended by Board Certified Physician);
  - Eye examination and visual acuity;
  - Audiometry;
  - Blood chemistry, including hematology, and serum analyses;
  - Tetanus booster.

The pre-assignment physical will provide written clearance by a qualified physician that personnel are fit for duty and able to wear respiratory protection, if appropriate. Only those employees determined by the pre-assignment physical as fit for duty and able to wear respiratory protection will be allowed to work in potentially-contaminated work areas or handle contaminated soil or groundwater.

Those personnel having received the appropriate physical examinations and clearance within the past 12 months will be deemed acceptable to enter the EZ or CRZ for this project, providing that appropriate documentation is provided to the FSO. Such documentation will be maintained in a dedicated file during the project.

10.2 Medical Data Sheets

All personnel authorized to enter the EZ or CRZ will be required to supply proof that the appropriate medical examinations and surveillance were completed prior to the first day of work at the site. Emergency contact information and notification of allergies and/or previous medical conditions will be given to the FSO prior to work at the site. These submittals will be kept confidential and stored in a locked cabinet on site.

Medical data collected on the job site, as described in the sections below, will be recorded on Medical Data Sheets. An example form is provided in Appendix D.

10.3 Heat Stress

Temperatures inside protective equipment can be as much as 25% greater than external ambient temperatures with humidity near 100%. Excessive temperatures and loss of body fluids can result in health conditions ranging from heat rash, cramps, and exhaustion to heat stroke and possibly death.

Heat stress can be caused by a number of factors including workload, weather conditions, personal protective equipment, and physical condition of the individual. Work activities related to materials handling will require the use of personal protective equipment, increasing the risk of worker heat stress.

Prior to the start of work, each contractor will assess predicted PPE to be worn, weather, and all work site conditions and tasks in order to determine the level of work demand with the following table as a guide.

Screening Criteria for Work Demand Category

Categories	Example Activities
Resting	• Sitting quietly • Sitting with moderate air movements
Light	• Sitting with moderate arm and leg movements • Standing with light work at machine or bench while using mostly arms • Using a table saw • Standing with light or moderate work at machine or bench and some walking about
Moderate	• Scrubbing at a standing position • Walking about with moderate lifting or pushing • Walking on a level at 6 km/hr while carrying 3 kg weight load
Heavy	• Carpenter sawing by hand • Shoveling dry sand • Heavy assembly work on a non-continuous basis • Intermittent heavy lifting with pushing or pulling
Very Heavy	• Shoveling wet sand

Contractors will monitor their employees for heat stress as needed. Two methods of monitoring for heat stress may be utilized: heart rate and core body temperature. The following table provides guidelines for monitoring of core temperature.

Heat Stress Action Levels

Work Demands	Action Level	Action
Light	85° F WBGT	• Tympanic temperatures monitored at least every two (2) hours
Moderate	82° F WBGT	• Tympanic temperatures monitored at least every two (2) hours
Heavy	79° F WBGT	• Tympanic temperatures monitored at least every two (2) hours
Very Heavy	77° F WBGT	• Tympanic temperatures monitored at least every

Work Demands	Action Level	Action
		two (2) hours
Any work utilizing impermeable clothing or using respiratory protection	70º F WBGT	• Tympanic temperatures monitored at least hourly

Individuals pulse rate can also be monitored when and if the action levels above are exceeded. Pulse or heart rate is the best indicator of overall stress being applied to the body. The most widely accepted pulse measurement and evaluation method is known as the "Age Adjusted Maximum Heart Rate" (AAMHR). The AAMHR is considered to be the maximum heart rate which an individual can maintain for extended periods without damaging heart muscles. However, this limit may be lower for individuals with pre-existing medical conditions.

$$AAMHR = 220 - Age$$

If a measured pulse rate exceeds 85% of the AAMHR, the individual should be restricted from additional work activities until the pulse rate returns to within 5% of the pre-work baseline and less than 90 beats per minute.

10.3.1 Heat Stress Related Symptoms

Heat stress includes several types of heat related illnesses, each with specific symptoms, listed below:

- Heat rash caused by continuous exposure to heat and humid air. Decreases the body's ability to tolerate heat.
- Heat cramps caused by excessive perspiring without proper and adequate electrolyte replacement. Symptoms include:
  - pain in the hands, feet, and abdomen; and muscle spasms.
- Heat exhaustion caused from inadequate blood circulation due to cardiovascular dehydration. Symptoms include:
  - pale, cool skin; excessive perspiring;
  - fainting;
  - nausea; and dizziness.
- Heat stroke, most serious form of heat stress, body temperature regulation fails and body temperature rises rapidly. Immediate action must be taken to cool the body. Medical attention is required. Symptoms include:
  - red, hot, dry skin;

- lack of perspiration;
- nausea / dizziness; rapid pulse;
- and coma.

10.3.2 Heat Stress Management

When necessary, these general controls will be used to control heat stress:

- Workers will be given verbal instructions and reminders during tailgate safety meetings;
- The drinking of water in small volumes (about 1 cup) throughout the day will be encouraged.
- Worker will be allowed to self-limit their exposures if they detect signs and symptoms of heat strain in themselves or others;
- Individuals taking medications which may put them at greater risk, such as for blood pressure, cardiovascular medication, body temperature regulation, renal or sweat gland functions, and those who abuse or are recovering from alcoholism, will be counseled on the dangers. A healthy lifestyle will be encouraged;
- Personnel must be able to recognize signs and symptoms of heat stress and administer immediate attention;
- Work/rest schedules planned according to weather conditions, workload, and level of personal protective equipment;
- Provide shaded rest area on sunny or hot days;
- Allow personnel to become acclimated to site conditions, personal protective equipment, and workload. Rotate teams of personnel in hot weather;
- Utilize cooling devices to assist body cool down (i.e., showers, cooling jackets, etc.);
- Encourage personnel to maintain their physical fitness.
- Also, if air temperatures rise above 80 °F, shelter or shaded areas should be provided and daily safety briefings should include awareness items for heat stress.

10.4 Cold Stress

Personnel working in extreme cold, even for a short time, may experience severe injury to the surface of the body (frostbite), or profound generalized cooling (hypothermia). Frostbite usually occurs to parts of the body having high surface to volume ratios, such as fingers, toes, ears, and nose. Incipient frostbite is characterized by a blanching or whitening of the skin. Superficial frostbite is characterized by skin with a waxy or white appearance that is firm to the touch, but the skin underneath is resilient. Deep frostbite is characterized by cold pale skin that is solid to the touch.

Systematic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms include shivering, apathy, listlessness, sleepiness, unconsciousness, freezing of the extremities, and even death.

The extent of frostbite and hypothermia is influenced greatly by wind speed, wind chill, and wetness of the skin. Thus, the body can cool rapidly when chemical protective equipment is removed and the clothing underneath is soaked with perspiration. Workers experiencing signs of hypothermia should be immediately removed from the environment, placed in a warm location, covered with dry blankets and provided with warm liquids. Wet clothing should be removed and replaced with dry clothing and outerwear.

11.0 AIR MONITORING PROGRAM

This section explains the general concepts of air monitoring as they pertain to personal protection and related surveillance activities taking place at the site. The purposes of air monitoring are to:

- Identify the potential presence of chemical contaminants in air;
- Warn of hazardous atmospheres before confined space entry;
- Quantify worker exposures to airborne contaminants;
- Assess whether current levels of personal protection are sufficient;
- Assist in the determination of proper and /or additional levels of protection, when needed.

Direct reading instruments or instantaneous measurement techniques will be used for the assessment of worker exposures to site-generated dust. The types of measurements to be conducted on this project are based upon analysis of the contaminants believed to exist at the site, along with their potentials for exposure.

This worker-exposure air monitoring program includes provisions for ambient and perimeter air monitoring program while soil-intrusive work is being conducted.

11.1 Air Monitoring Plan

11.1.1 Direct Reading/Instantaneous Monitoring

Prior to the start of work each day, all operational work areas will be surveyed by the FSO. In addition, periodic measurements will be taken in the worker breathing zone throughout the day.

Respirable dust will be measured using a Thermo Electron DustScan Scout with a PM_{10} cutoff or equivalent instrument in the work area and set up at each of two perimeter air monitoring stations. Results will be compared to action levels for both short-term and long-term averaging periods.

Total volatile organic vapors will be measured using a Photoionization Detector (PID). These measurements also will be compared to exposure limit values listed in the table below. Unless unforeseen conditions are encountered, vapor measurements will be limited to septic system and UST removal activities.

The first air monitoring survey of the day will be completed before work begins. Completion of this survey and the initial air monitoring results will be documented on the site Air Monitoring Log (See Appendix E). Follow up (periodic) results will also be recorded on the log at least hourly. High priority areas of monitoring include open excavations, excavator cabs, spoils piles, and the work area boundary.

If real time air monitoring results in any work area exceed the action levels, the level of protection will be upgraded or actions taken as necessary to ensure that personnel are protected for the worst-case contaminant of concern until the presence of that compound can be negated. Actions will be taken to ensure that personnel in the work area are protected for the worst-case contaminant of concern.

11.1.2 Action Levels

Air Monitoring Work Zone Action Levels

Parameter	Action Level	Action
Total Dust (as PM_{10})	<0.02 mg/m^3 sustained 15 min. >0.02 mg/m^3 in work zone or >0.05 mg/m^3 at the project fence line >0.02 mg/m^3 sustained 15 min.	• Level D • Monitor continuously. Implement dust suppression methods. • Level C. Continue dust suppression methods. Do not re-enter until total dust concentrations are below 0.02 mg/m^3 for 15 consecutive minutes.
Volatile Organic Compounds (VOCs) (Photoionization Detector readings taken continuously and calibrated to read as benzene.)	< 1 ppm 1 to 5 ppm sustained 15 min. 5 to 50 ppm sustained 15 min > 50 ppm sustained 15 min.	• Level D • Monitor continuously. • Level C w/ full-face piece, organic vapor cartridges. Use vapor control methods. • Stop work. Evacuate personnel from the EZ and re- evaluate. Do not re-enter until PID readings are below 1 ppm for 3 consecutive measurements taken 5 minutes apart.

Breathing zone instrument readings for at least 15 minutes (*i.e.*, sustained) will determine the need for upgrading/downgrading of PPE and the corresponding action level. Numerical derivation of the project action level for dust is presented in Appendix F.

11.2 Integrated Sampling

Sustained elevated levels of hazardous substances are not anticipated. Consequently, no integrated sampling is included in this program. Action level responses will be based upon instantaneous readings.

11.3 Equipment Calibration

All instrument calibration will be checked in accordance with manufacturer instructions and acceptable industrial hygiene protocol. Instruments will be recalibrated if calibration checks yield erroneous results, or at the minimum frequency as required by the manufacturer, whichever occurs first. In addition, the instrument will be calibrated in the temperature at which it will be used, or the calibration will be corrected mathematically for differences in temperature, humidity, and barometric

pressure, where appropriate. All calibrations required by this HASP will be recorded in writing and will be maintained on site for the duration of the project.

No calibrations are necessary for the dust meters. However, the dust meter should be "zeroed" in accordance with manufacturer instructions on a daily basis before use and before start of work. The instruments will also be checked by a factory-trained technician prior to field deployment.

The PID will be calibrated per the manufacturer's recommendations. The appropriate photosensitivity will be set on the instrument to read as benzene.

11.4 Perimeter Monitoring

In addition to the monitoring described herein, monitoring will be performed at the project perimeter for dust when soil-intrusive work is being conducted. Data logging will be continuous. The program is designed to protect human health and the environment surrounding the site through the collection of air monitoring data and establishment of contingencies to mitigate off- property airborne contaminant levels exceeding project action levels.

Perimeter dust monitoring will be conducted using a minimum of three (3) PDR-1000 Mini-RAM instruments (or equivalent) equipped with active air intake pumps. The monitoring locations must be approved by the project owner and will be in upwind and downwind locations along the project site perimeter, with at least one station situated between the active work area and the school and the work area and the residences along Lions Mouth Road. Daily wind direction will be measured prior to establishing the monitoring locations.

All readings will be data-logged. Perimeter dust concentrations should not range above 0.05 mg/m^3, measured on a time-averaged 8-hour basis. If the limit is exceeded, dust control methods shall be implemented immediately.

11.5 Dust Suppression Methods

When work zone action levels are reached, measures to control or reduce dust and vapor emissions will be employed. Potential methods to reduce emissions are as follows:

- Use of low permeability tarpaulin or suitable means to cover exposed areas and materials;
- Limiting the amount of exposed areas, as much as possible;
- Water or mist spray for dust suppression;
- Expedient restoration of disturbed surfaces.

12.0 SITE CONTROL MEASURES

The following section defines measures and procedures for maintaining site control. Site control is an essential component in the implementation of the site health and safety program.

In the event that work zones are determined to be necessary, all personnel are to be accounted for when on the job site by a system that will be established at the start of the project. This system may incorporate electronic badges, a foreman sign-in/out procedure, or other methods designed to ensure that all personnel are accounted for when the job site is secured for the day. An example Sign In/Sign Out Log is provided in Appendix G.

A site safety checklist for the project is provided in Appendix H and will be completed for the site on a weekly basis and maintained in the job site trailer.

12.1 Work Zone Definitions

Site contaminants are present at concentrations that exceed applicable risk-based standards, even though they may be attributable to background conditions. As a result, an EZ, CRZ, and Support Zone (SZ) will be established as a component of site control. The zones are described below:

The EZ will be located only in those specific areas where potential for over exposure to the identified contaminants exists. The EZ is defined as the area where contamination is either known or likely to be present, or because of activity, will provide a potential to cause harm to personnel or exposed populations. This area will be demarcated with orange construction fencing or barrier tape, as appropriate for site conditions and activities. Entry into the EZ requires the use of PPE and proper training. The EZ for this project will be established by the FSO. No eating, drinking, or smoking will be permitted in this area.

The CRZ is the area where personnel conduct personal and equipment decontamination. This zone provides a buffer between contaminated areas and clean areas. Activities to be conducted in this zone will also require PPE and training. No eating, drinking, or smoking will be permitted in this area.

The SZ is situated outside the EZ and the CRZ in a clean area in which the chance to encounter hazardous materials or conditions is minimal. All external roadways leading to the site, other than those identified as possibly contaminated, are considered to be in the clean zone. The SZ will generally be positioned upwind of the EZ when possible.

12.2 Site Security

All work areas will be secured during non-working hours. At a minimum, open excavations will be covered to protect the general public. During the course of work, all site visitors will sign in and out of the site. See Appendix H, Site Sign In/Sign Out Log.

12.3 Buddy System

During intrusive activities, the implementation of a buddy system is mandatory. A buddy system requires at least two people who work as a team, each looking out for the other and in voice or visual contact.

12.4 Project Communication

Successful communications between project personnel is essential. The following communications systems may be available during activities on the site.

- Two-way radios;
- Intrinsically safe radio (if deemed necessary);
- Air horns;
- Hand signals;
- Cellular phones.

12.4.1 Air Horn Alerts

Air Horn Alerts

Signal	Definition
One long blast	Attention
Two long blasts	Leave when possible
Three long blasts	Leave area immediately (Emergency)
Repeated short blasts	Send backup support
Very Heavy	Shoveling wet sand

12.4.1 Hand Signals

Hand Signals

Signal	Definition
Hands clutching throat	Out of air – cannot breathe
Hands on top of head	Need assistance
Thumbs up	OK / I am OK / I understand
Thumbs down	No / Negative
Arms waiving upright	Trouble / Send backup support
Grip partner's wrist	Exit area immediately

12.5 Spill Prevention

Contractors will take all necessary precautions to prevent any spill of a hazardous substance during this project. To ensure this, all containers will meet legal requirements for size, shape, and material compatibility and will be properly stored. All chemicals will be stored upright in properly closed or sealed containers that are compatible with the material being stored, and shall be stored indoors, over secondary containment or on an impermeable surface as appropriate.

Refer to Section 15.0 for Emergency Procedures for spill response.

13.0 DECONTAMINATION PLAN

Decontamination involves the orderly, controlled removal of contaminants. Standard decontamination sequences are presented in the examples below. All site personnel should minimize contact with soil and groundwater, when possible, in order to minimize the need for extensive decontamination.

Personnel decontamination will consist of safe work practices, use of disposable PPE, good personal hygiene, and personal decontamination before breaks and at the completion of each day. Decontamination for workers using Modified Level D is described below. The primary objective of personnel decontamination, regardless of PPE level, is to prevent movement of contaminated soil from the site on workers skin and clothing.

The level of protection for decontamination personnel working in the CRZ will be one level lower that the personnel exiting the EZ.

13.1 Routine Personal Decontamination – Modified Level D

1. All liquid resistant suits will be scrubbed with water and industrial soap solution, if needed, in a total body wash pool with a long handle brush, followed by a freshwater rinse. The boots will be included in this step of the decontamination.
2. Disposable coveralls will be removed and placed in a plastic trash bag.
3. Disposable gloves will be removed and placed in a plastic trash bag.
4. Respirators will be decontaminated with a damp paper towel prior to removal to remove gross contamination as required. Respirators shall be washed in a respirator sanitizing solution, rinsed, and then air-dried at least daily, when in use.
5. Hands, face and any other potentially contaminated area will be thoroughly washed with a water/mild soap solution, rinsed, and dried with paper towels.
6. Hard hats shall be thoroughly washed with a water/industrial soap solution,

rinsed and dried. (OR the dirty hard hat may be kept in the EZ for reuse there)

7. If leather/cotton work gloves are used, they will be removed and stored in the work area.

Station 1: Equipment Drop
Deposit equipment used on site (tools, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down stations may be set up within this area.

Station 2: Outer Garment, Boots, and Gloves, Wash Rinse
Wash outer boots, outer gloves, and splash suit (if being used) with water and detergent solution. Rinse off using large amount of water.

Station 3: Outer Boot and Glove Removal
Remove outer boots and gloves. Place in storage area.

Station 4: Boot, Gloves and Outer Garment Removal
Boots, chemical resistant splash suit (if being used), inner gloves removed and deposited in storage area.

Station 5: Field Wash
Hands and face are thoroughly washed.

13.2 Emergency Decontamination

Should a worker be splashed with hazardous chemical contaminants, the worker will immediately be escorted to the field decontamination station and be decontaminated as follows:

1. Wash off under pressurized shower or sprayer
2. Remove all contaminated clothing
3. Remove all wet clothing
4. Cover with blanket or dress in clean, dry clothing
5. Transport to hospital if necessary

13.3 Equipment Decontamination

Equipment must be decontaminated in order to prevent the spread of contaminated soil from the project site onto roadways or other properties. All earthmoving/transportation equipment that has been used within an EZ will be decontaminated with a dry decontamination method, high pressure steam, or pressure washer at the decontamination pads prior to the removal of the equipment from the

site. If necessary, an industrial grade, non-phosphate detergent may be utilized. Decontamination of EZ equipment during the project will take place in a localized temporary decontamination pad constructed of crushed stone of sufficient thickness to support the equipment and underlain by polyethylene sheeting with bermed edges.

Anti-Tracking Pad(s) will be placed in the CRZ to ensure trucking operations do not spread contamination through the site. Tracking pads will consist of crushed stone underlain by polyethylene sheeting.

Contractors will minimize contact of equipment with the contaminated soil and groundwater to the greatest extent possible. Whenever possible, excavation and transportation equipment will be based on clean, undisturbed soil, allowing only the bucket to contact contaminated soil.

13.4 Disposition of Contaminated Wastes

All equipment shall be decontaminated or disposed of properly.

All wash water from equipment decontamination will be containerized and disposed with dewatering fluids.

Disposable PPE and soil generated during equipment decontamination will be disposed of as other project wastes in a manner acceptable to treatment facility needs.

14.0 ILLUMINATION AND SANITATION

14.1 Illumination

Site operations will not begin until lighting is adequate at dawn and will cease in time to permit personnel to secure the site prior to dusk. If work schedules require work outside of these time constraints, then portable lights providing adequate lighting will be provided.

14.2 Sanitation

Potable water will be provided for workers at each work area. All workers are required to wash their hands, at a minimum, before eating lunch and before leaving the site.

14.3 Housekeeping

To minimize potential accidents and cross contamination, the site will be maintained in a generally clean and orderly condition. Personal waste materials, such as PPE, paper towels, and respirator cartridges, etc. will be disposed of in waste containers.

The site will be set up so as to be reasonably free from significant safety hazards. Wires and hoses will be positioned so they do not obstruct or present a safety hazard in walkways and evacuation routes.

15.0 EMERGENCY PROCEDURES

This section describes contingencies and emergency procedures to be implemented at the site. This plan should be coordinated with local disaster and emergency management plans as appropriate. In addition, meetings or other communication with the local hospital, rescue squad, hazardous materials unit, and fire department will occur so as to advise the emergency response representatives of the nature and type of contaminants victims may have been exposed to while on site. Directions to the hospital will be posted on site when this HASP is in effect. Emergency procedures will be posted and covered in daily site briefings.

15.1 Pre-Emergency Planning

During the site briefings held periodically, all employees will be trained in and reminded of provisions of the emergency response plan, communications systems, and evacuation routes.

15.2 Emergency Equipment and Facilities

Contractors are responsible for providing their own emergency equipment, which should include:

- First-aid kit;
- Fire extinguisher appropriate to potential fire hazards;
- Portable eye wash near any areas of chemical use or splashing;
- Mobile phone and/or two-way radio; and
- Chemical spill kits and/or absorbents.

15.3 Personnel Roles and Lines of Authority

The Site Superintendent has primary responsibility for responding to emergencies upon consultation with, and advice from, the FSO. This includes taking appropriate measures to ensure the safety of site personnel and the public. Possible actions may

involve evacuation of adjacent personnel. The Site Superintendent is responsible for ensuring that corrective measures have been implemented, appropriate authorities are notified, and follow up reports completed.

15.4 Incident, Accident, and Illness Reports

All HASP non-conformance incidents will be recorded in the site log by the FSO and will be reported to the general contractor Project Manager at the time of incident. Any inquires by the general public, news media, or regulatory agencies will immediately be referred to the general contractor PM and project owner.

Written confirmation of verbal reports is to be submitted within 24 hours. An Incident Report Form will be used for this purpose whenever any contractor or subcontractor employee is injured, or equipment damage occurs. A copy of the form is included in Appendix I. Completed forms will be maintained on site for the duration of the project.

Information released from the health care provider and not deemed confidential patient information is to be attached to the appropriate form. Any medical information not released by patient consent is to be filed in the individual's medical record and treated as confidential.

15.5 Evacuation Procedures

If anyone discovers a fire, chemical spill or release, or other process upset necessitating emergency action, he or she will immediately notify the Site Superintendent. An immediate decision will be made as to whether to evacuate the site or take other action.

An evacuation map will be developed by the Site Superintendent and posted on site in the field trailer. This will be reviewed at a tailgate safety meeting prior to work. The evacuation map shall show two entrances/exits and off-site assembly points.

The primary response to any emergency will be to protect the health and safety of employees, contractors, and visitors on site, as well as individuals at the school and in the surrounding community. Steps will be taken to identify, contain, treat, and properly dispose of the materials involved as a secondary response.

15.6 Alerting System

When notified to evacuate, all personnel will be expected to proceed to the closest site exit and mobilize to the predetermined safe distance assembly area associated with the evacuation route. Personnel will remain at that area until an authorized individual provides further instructions.

15.7 Emergency Medical Treatment

Any person who becomes ill or injured in the EZ must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is life threatening, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics.

Any person being transported to a clinic or hospital for treatment will take with them information on the chemical(s) they have been exposed to at the site, along with a copy of the individual's medical clearance certifications.

Prior to the start of work, the FSO shall confirm the nearest hospital's location and phone number. This information along with directions from the site to the facility shall be posted in the office trailer.

SITE ADDRESS:
68 Elm Street
Amesbury, MA

HOSPITAL ADDRESS:
Lawrence General Hospital
1 General Street
Lawrence, MA (978) 638-4000

DIRECTIONS TO HOSPITAL:

1. Depart site west and turn left onto Lions Mouth Rd
2. Continue onto Friend St
3. Slight right onto Highland St
4. Turn right onto Highland St
5. Turn right onto MA-150 S/Hillside Ave
6. Turn right to merge onto I-495 S toward Haverhill
7. Follow I-495 to Marston St in Lawrence
8. Take the exist 45 from I-495 S
9. Merge onto Marston St
10. Slight right towards Prospect St
11. Continue onto Prospect St
12. Take exit 45B to merge onto Marston St
13. Continue onto Prospect St
14. Turn left onto General St. Destination will be on the right

A map showing the route to the hospital, including directions, is included as Figure 4 - *Hospital Route Map*. The travel time is approximately 15 minutes.

15.8 Emergency Contacts & Notification Systems

The table attached in Appendix J provides names and telephone numbers for emergency contact personnel and key project contacts. It will be kept on site for the duration of the project. In the event of a medical emergency, personnel will take direction from the Site Superintendent and FSO and notify the appropriate emergency organization. In the event of a fire or spill, the Site Superintendent will ensure that the appropriate local, state, and federal agencies are notified.

Prior to posting, the Site Superintendent and FSO shall confirm the appropriate contact names and phone numbers are listed.

15.9 Non-Emergency Medical Care

Conditions requiring non-emergency medical care may be treated by the Occupational Health provider. When a condition is a non-emergency and can be addressed on a walk-in basis, the contractor's employer may specify a walk-in clinic. Chemical exposures of any kind shall be routed to the emergency facility listed above.

15.10 Fire and Explosion Procedures

In the event of a fire or explosion, the local Fire Department should be summoned immediately. Upon their arrival, the Site Superintendent or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials on site.

If it is safe to do so, site personnel may:

1. Use firefighting equipment available on site to control or extinguish the fire, and
2. Remove or isolate flammable or other hazardous materials that may contribute to the fire.

15.11 Spill and Leak Procedures

In the event of a spill or leak that may enter any surface water, sanitary sewerage pipeline, storm sewer, or other off-site conveyance, site personnel will:

1. Inform supervisor immediately;
2. Terminate work activities (at the discretion of the Site Superintendent of FSO);
3. Prevent entry of spill materials into any waterways;
4. Follow site emergency notification and evacuation procedures, when

necessary;

5. Locate the source of spillage and stop the flow if it can be done safely; and
6. Begin containment and recovery of the spilled materials if it can be done safely.

If the spill or release is expected to pose significant hazards or is beyond the capabilities of the available personnel, then the FSO will be contacted immediately. When contacted, the FSO will obtain and assess the following information:

1. The material spilled or released;
2. Location of the release or spill;
3. An estimate of the quantity released and the rate at which it is being released;
4. Any injuries involved;
5. Fire and/or explosion or possibility of these events occurring; and
6. The area and materials involved in the location of the fire or explosion.

In the event of a chemical spill that is not contained within a dike or bermed area, an area of isolation will be established around the spill and the material(s) involved. When any spill occurs, only those persons involved in the oversight or performance of the emergency cleanup will be allowed within the designated hazard area. If possible, this area will be roped, fenced, barricaded, or otherwise blocked off.

If an incident may threaten the health or safety of the surrounding community, the public will be informed and possibly evacuated from the area. The Site Superintendent will notify the proper agencies in the event that this is necessary. The telephone numbers of emergency response organizations are listed in Section 15.10, above.

If the control and cleanup of the spill or release is within the capabilities of on-site personnel and the release does not migrate beyond the perimeter of the site, the Site Superintendent will notify the FSO, who will determine reporting requirements. Reporting of spills or releases in accordance with federal, state, and local regulations is the responsibility of the Site Superintendent.

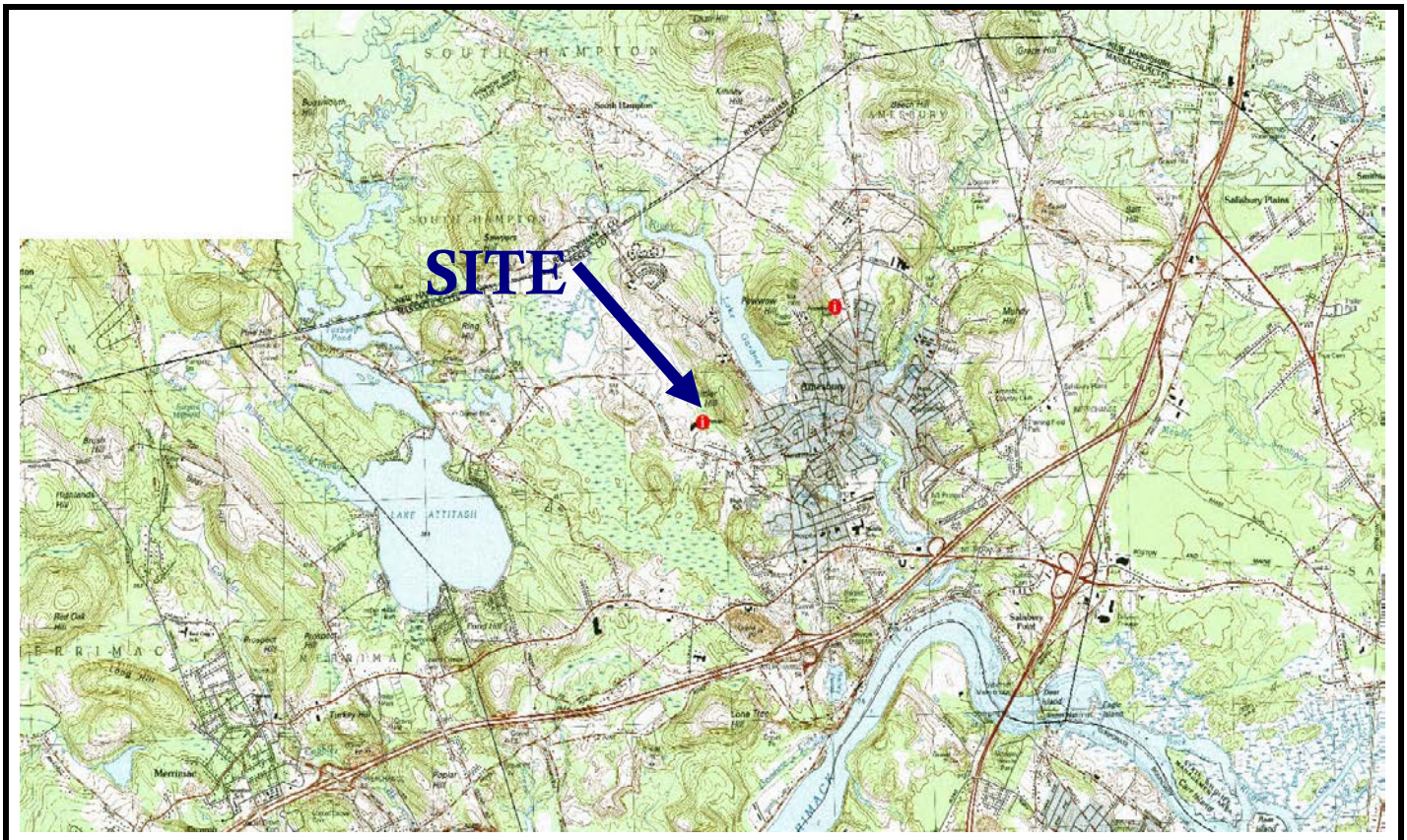
Contractors that have the potential to generate a spill or release (such as heavy equipment operators) should be equipped with the following spill response equipment:

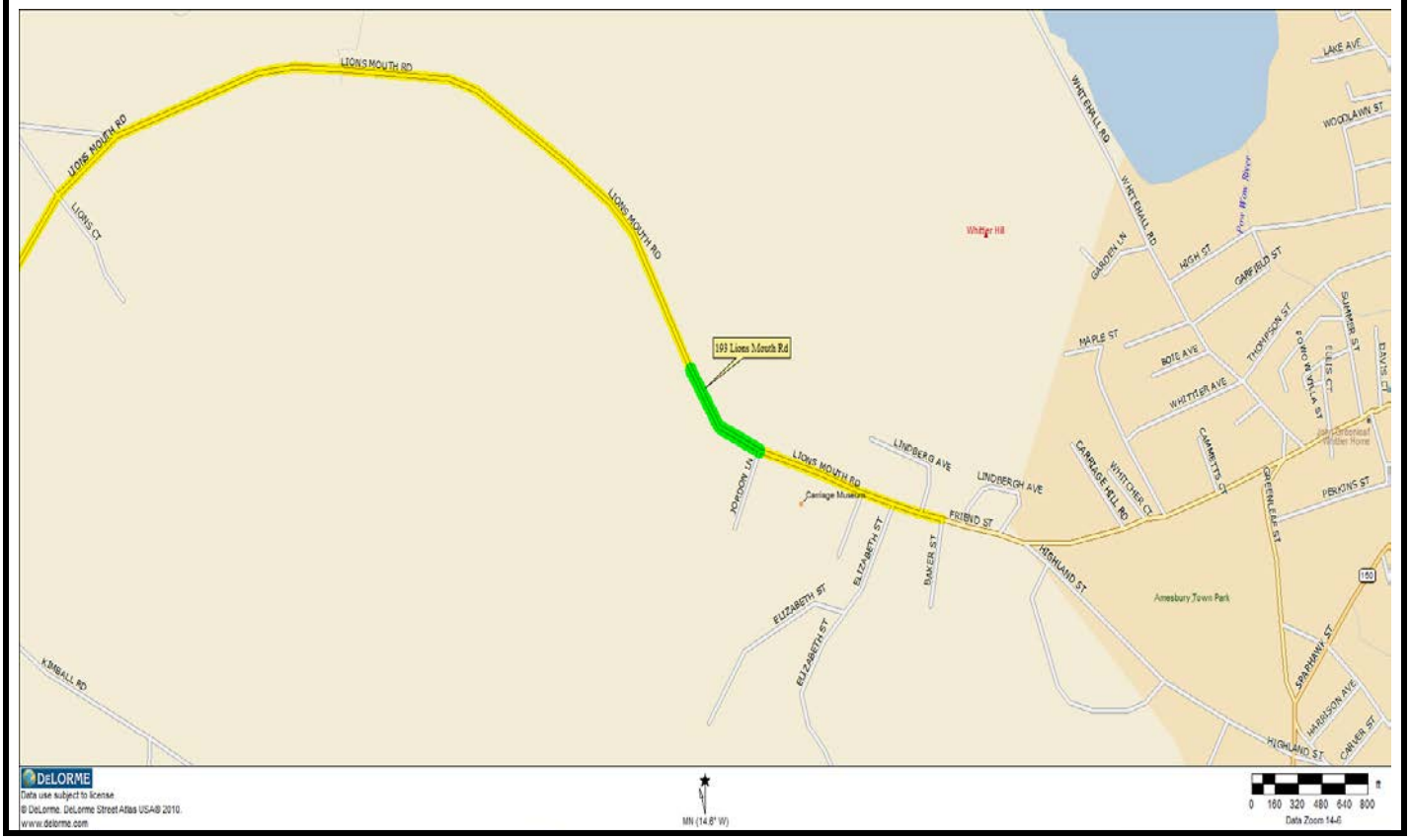
- Loose dry absorbent (e.g., sawdust, vermiculite, multipurpose sorbent);
- Oil containment booms and pads;
- Shovels - wooden handle, steel type;
- Brooms - wooden handle, push type; and
- Wrenches and tools for tightening fittings and valves.

15.12 Incident Follow-up and Critique

Following all emergency response actions and activation of this plan, the Site Superintendent will conduct a debriefing session of all key personnel involved. The response will be critiqued, documented, and response plans revised, if necessary. Corrective actions will be listed where procedures were inadequate or need improvement. Responsible persons will be listed and held accountable for follow-up.

FIGURES





Cashman Elementary School **193 Lions Mouth Road** **Amesbury, Massachusetts** **01913**	**Environmental & Construction Management Services, Inc.**	**Project No.** 1009.073	**Figure 1**
		Site Locus / Street Location Plan	
		Drawn By: KJK	**Date:** 8/24/18

N

CITY OF AMESBURY, MASS.

Assessor Maps



LEGEND

- Parcel Line
- Building Footprints
- Prior Parcel Line with Common Ownership
- 5 Condo Unit Number
- Right of Way
- Map Index
- Town Boundaries
- Easements
- Hydrographic Features
- Streams
- Wetlands

Exempt Lands

- Federal
- State
- Municipal
- Private

N

SCALE: 1" = 100'

100 0 100 200 300 400

NOTE:
THE AREAS, BOUNDARIES, AND DIMENSIONS SHOWN ON THIS TAX MAP ARE DERIVED FROM AERIAL PHOTOGRAPHS, GROUND SURVEYS, AND RECORDED PLANS, MAPS, DEEDS, AND WILLS, AND ARE INTENDED TO BE USED FOR PROPERTY ASSESSMENT PURPOSES ONLY AND NOT FOR CONVEYANCE.

MAP REVISION DATE		
As of January 1, 2018		

Data Sources: The data for this map was supplied by the Merrimack Valley Planning Commission, the Town of Amesbury and the Executive Office of Environmental Affairs/MassGIS.

Merrimack Valley Planning Commission
plan • develop • promote

J:\ArcGIS\Amesbury\AmesburyAssessorMap_24x36.mxd

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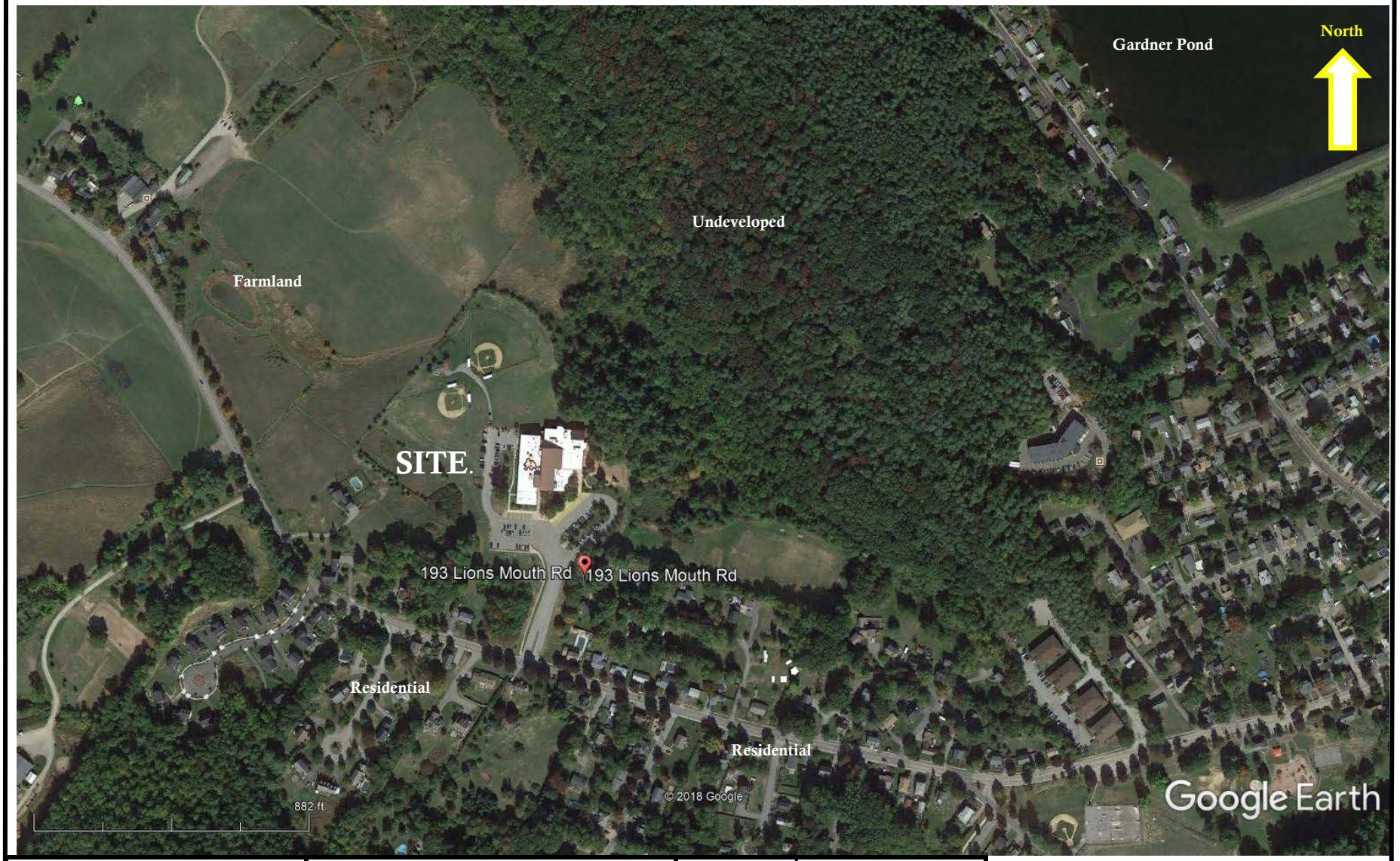
	82	83	84	85	86	87	88	89	90	91	92			
	93	94	95	96	97	98	99		100	101				
	102	103	104	105	106	107								
		108	109	110	111									

Map 50



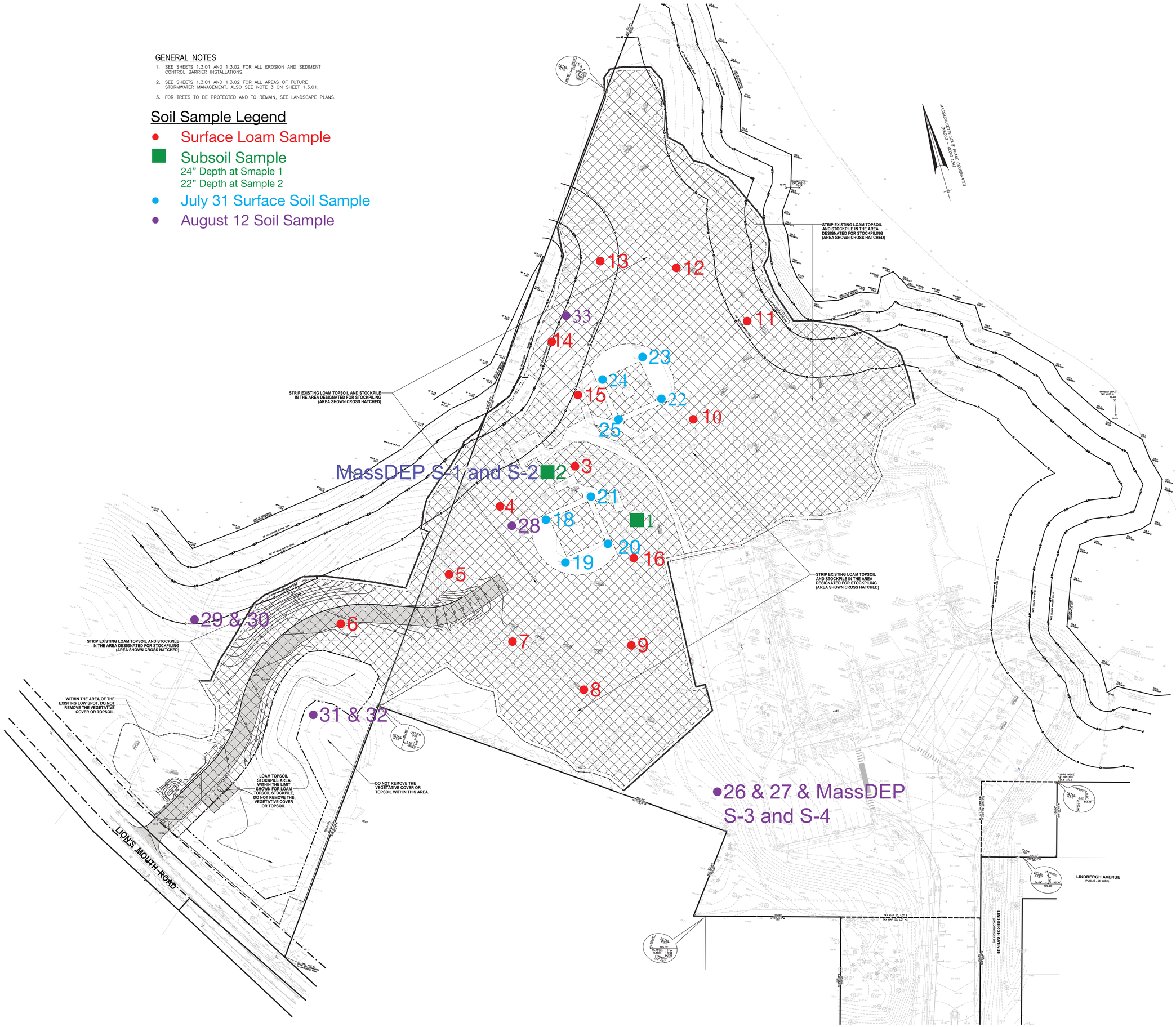
Cashman Elementary School **193 Lions Mouth Road** **Amesbury, Massachusetts** **01913**	**Environmental & Construction Management Services, Inc.**	**Project No.** 1009.073	**Figure 3**
		Aerial Photograph Site Location Plan	
		Drawn By: KJK	**Date:** 8/24/2018

GENERAL NOTES

1. SEE SHEETS 1.3.01 AND 1.3.02 FOR ALL EROSION AND SEDIMENT CONTROL BARRIER INSTALLATIONS.
2. SEE SHEETS 1.3.01 AND 1.3.02 FOR ALL AREAS OF FUTURE STORMWATER MANAGEMENT. ALSO SEE NOTE 3 ON SHEET 1.3.01.
3. FOR TREES TO BE PROTECTED AND TO REMAIN, SEE LANDSCAPE PLANS.

Soil Sample Legend

- Surface Loam Sample
- Subsoil Sample
  - 24" Depth at Smaple 1
  - 22" Depth at Sample 2
- July 31 Surface Soil Sample
- August 12 Soil Sample



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KEY PLAN

NORTH ARROW — STAMP

Date: 6 JULY 2020

Drawn By: KMR

Scale: 0 40 80

Revisions

Number	Date	Description

Figure 4 - Soil Sample Location Plan

G:\Condocs\ active\ 2320\Dwg\ 2320ss .Dwg 8/5/2020

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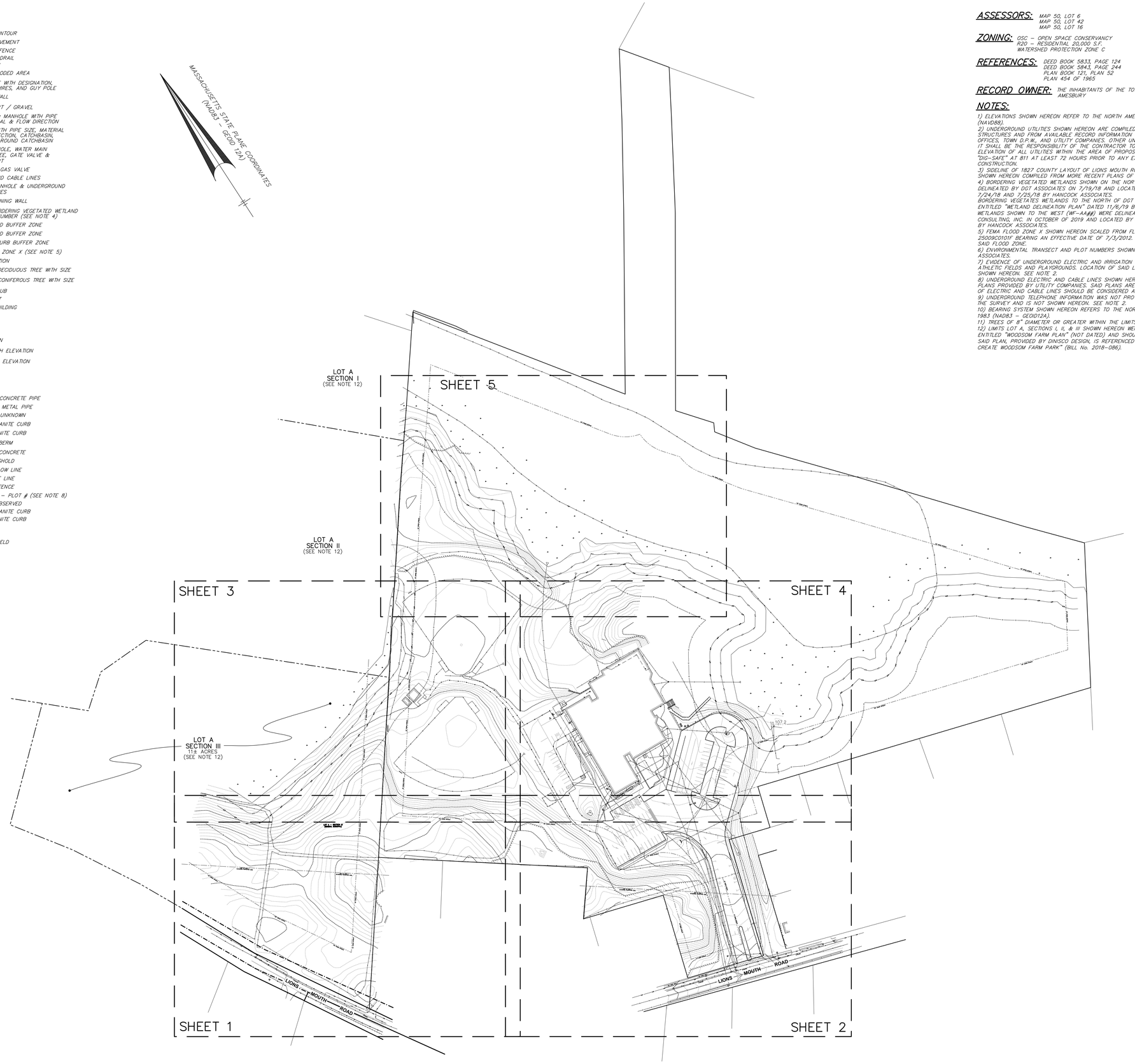
LEGEND

102	SURFACE CONTOUR
	EDGE OF PAVEMENT
x x x	CHAIN LINK FENCE
	METAL GUARDRAIL
	WOOD FENCE
	EDGE OF WOODED AREA
UP#17 OHW	UTILITY POLE WITH DESIGNATION, OVERHEAD WIRES, AND GUY POLE
	RETAINING WALL
	EDGE OF DIRT / GRAVEL
8" S	SEWERLINE & MANHOLE WITH PIPE SIZE, MATERIAL & FLOW DIRECTION
12"RCP D	DRAINLINE WITH PIPE SIZE, MATERIAL & FLOW DIRECTION, CATCHBASIN, MANHOLE & ROUND CATCHBASIN
W 12"	WATER MANHOLE, WATER MAIN WITH SIZE, TEE, GATE VALVE & FIRE HYDRANT
GV G	GAS LINE & GAS VALVE
C	UNDERGROUND CABLE LINES
E	ELECTRIC MANHOLE & UNDERGROUND ELECTRIC LINES
	STONE RETAINING WALL
WFA2	LIMIT OF BORDERING VEGETATED WETLAND WITH FLAG NUMBER (SEE NOTE 4)
	100' WETLAND BUFFER ZONE
	50' NO-BUILD BUFFER ZONE
	25' NO-DISTURB BUFFER ZONE
	FEMA FLOOD ZONE X (SEE NOTE 5)
×100.7	SPOT ELEVATION
114.0 12"	PROMINENT DECIDUOUS TREE WITH SIZE
114.0 12"	PROMINENT CONIFEROUS TREE WITH SIZE
	TYPICAL SHRUB
DS	DOWN SPOUT
	LIGHT ON BUILDING
	LIGHT POLE
FD	FIRE ALARM
	SIGN
	2-POST SIGN
TP-03 114.0	TEST PIT WITH ELEVATION
GZA-2 120.1	BORING WITH ELEVATION
DH	DRILL HOLE
I.ROD	IRON ROD
COR.	CORNER
RCP	REINFORCED CONCRETE PIPE
CMP	CORRUGATED METAL PIPE
CU	CONNECTION UNKNOWN
VGC	VERTICAL GRANITE CURB
SGC	SLOPED GRANITE CURB
BB	BITUMINOUS BERM
BIT. CONC.	BITUMINOUS CONCRETE
MTL. THRESH	METAL THRESHOLD
D.Y.L	DOUBLE YELLOW LINE
S.W.L	SINGLE WHITE LINE
C.L.F	CHAIN LINK FENCE
T1-P1	TRANSECT # - PLOT # (SEE NOTE 8)
N.F.O.	NOT FIELD OBSERVED
VGC	VERTICAL GRANITE CURB
SGC	SLOPED GRANITE CURB
(R)	RECORD
(C)	CALCULATED
(R/H)	RECORD & HELD

MASSACHUSETTS STATE PLANE COORDINATES (NAD83 - GEOID 12A)



ASSESSORS: MAP 50, LOT 6
MAP 50, LOT 42
MAP 50, LOT 16

ZONING: OSC – OPEN SPACE CONSERVANCY
R20 – RESIDENTIAL 20,000 S.F.
WATERSHED PROTECTION ZONE C

REFERENCES: DEED BOOK 5833, PAGE 124
DEED BOOK 5843, PAGE 244
PLAN BOOK 121, PLAN 52
PLAN 454 OF 1965

RECORD OWNER: THE INHABITANTS OF THE TOWN OF AMESBURY

NOTES:

1) ELEVATIONS SHOWN HEREON REFER TO THE NORTH AMERICAN VERTICAL DATUM ON 1988 (NAVD88).
2) UNDERGROUND UTILITIES SHOWN HEREON ARE COMPILED FROM FIELD LOCATIONS OF STRUCTURES AND FROM AVAILABLE RECORD INFORMATION ON FILE AT THE TOWN ENGINEERING OFFICES, TOWN D.P.W., AND UTILITY COMPANIES. OTHER UNDERGROUND UTILITIES MAY EXIST. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE LOCATION, SIZE & ELEVATION OF ALL UTILITIES WITHIN THE AREA OF PROPOSED WORK AND TO CONTACT "DIG-SAFE" AT 811 AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION, DEMOLITION OR CONSTRUCTION.
3) SIDELINE OF 1827 COUNTY LAYOUT OF LIONS MOUTH ROAD IS INDETERMINABLE. SIDELINES SHOWN HEREON COMPILED FROM MORE RECENT PLANS OF RECORD.
4) BORDERING VEGETATED WETLANDS SHOWN ON THE NORTHEAST PORTION OF THE LOT WERE DELINEATED BY DGT ASSOCIATES ON 7/19/18 AND LOCATED BY INSTRUMENT SURVEY ON 7/24/18 AND 7/25/18 BY HANCOCK ASSOCIATES.
BORDERING VEGETATED WETLANDS TO THE NORTH OF DGT FLAGS WERE SCALED FROM A PLAN ENTITLED "WETLAND DELINEATION PLAN" DATED 11/6/19 BY GM2 ASSOCIATES. BORDERING WETLANDS SHOWN TO THE WEST (WF-AA##) WERE DELINEATED BY SEEKAMP ENVIRONMENTAL CONSULTING, INC. IN OCTOBER OF 2019 AND LOCATED BY INSTRUMENT SURVEY ON 11/18/19 BY HANCOCK ASSOCIATES.
5) FEMA FLOOD ZONE X SHOWN HEREON SCALED FROM FLOOD INSURANCE RATE MAP 25009C0101F BEARING AN EFFECTIVE DATE OF 7/3/2012. NO ELEVATION ASSOCIATED WITH SAID FLOOD ZONE.
6) ENVIRONMENTAL TRANSECT AND PLOT NUMBERS SHOWN HEREON PROVIDED BY DGT ASSOCIATES.
7) EVIDENCE OF UNDERGROUND ELECTRIC AND IRRIGATION LINES OBSERVED IN SURROUNDING ATHLETIC FIELDS AND PLAYGROUNDS. LOCATION OF SAID LINES ARE UNKNOWN AND NOT SHOWN HEREON. SEE NOTE 2.
8) UNDERGROUND ELECTRIC AND CABLE LINES SHOWN HEREON FROM MARKINGS ON SITE AND PLANS PROVIDED BY UTILITY COMPANIES. SAID PLANS ARE SCHEMATIC IN NATURE. LOCATION OF ELECTRIC AND CABLE LINES SHOULD BE CONSIDERED APPROXIMATE. SEE NOTE 2.
9) UNDERGROUND TELEPHONE INFORMATION WAS NOT PROVIDED BY VERIZON AT THE TIME OF THE SURVEY AND IS NOT SHOWN HEREON. SEE NOTE 2.
10) BEARING SYSTEM SHOWN HEREON REFERS TO THE NORTH AMERICAN AMERICAN DATUM OF 1983 (NAD83 – GEOID12A).
11) TREES OF 8" DIAMETER OR GREATER WITHIN THE LIMITS OF SURVEY ARE SHOWN HEREON.
12) LIMITS LOT A, SECTIONS I, II, & III SHOWN HEREON WERE SCALED FROM PLAN SKETCH ENTITLED "WOODSOM FARM PLAN" (NOT DATED) AND SHOULD BE CONSIDERED APPROXIMATE. SAID PLAN, PROVIDED BY DINISCO DESIGN, IS REFERENCED IN CITY OF AMESBURY "ORDER TO CREATE WOODSOM FARM PARK" (BILL No. 2018-086).

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Figure 5

KEY PLAN

N

NORTH ARROW

COMMONWEALTH OF MASSACHUSETTS
WAYNE C. JALBERT
No. 34118
REGISTERED PROFESSIONAL ENGINEER

STAMP

Date: 15 MAY 2020

Drawn By: EME

Scale: 0 80 160

Revisions

Number	Date	Description

60% COST ESTIMATE SET

EXISTING CONDITIONS KEY PLAN

0.0.00

VGA JOB #21288 (21288ec.dwg)
PATH: F:\Civil 3D Projects\21288 - DiNisco - Cashman Elementary - Amesbury\DWG\

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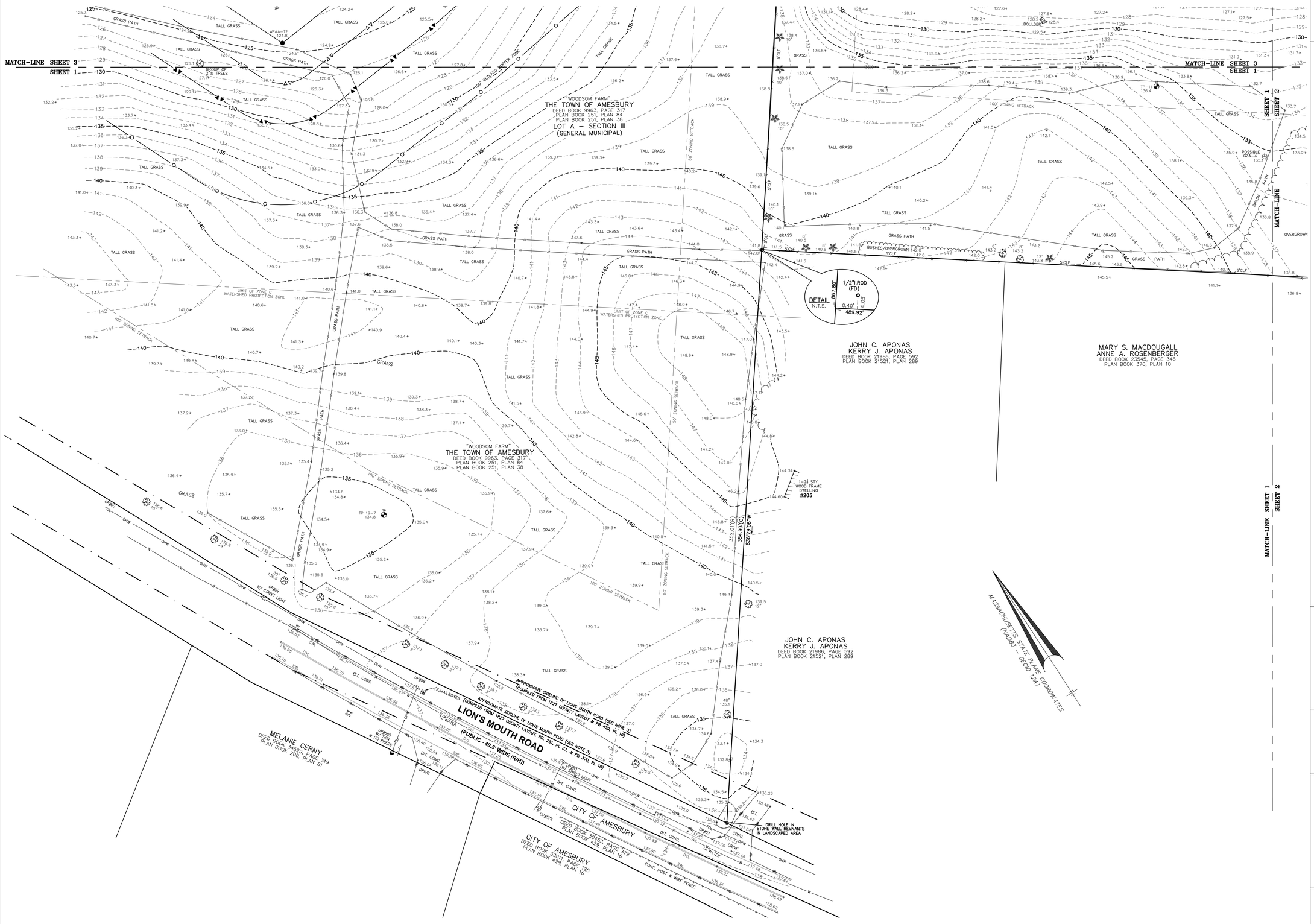

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Figure 5 (A)

KEY PLAN

NORTH ARROW

STAMP

Date: 15 MAY 2020

Drawn By: EME

Scale: 0 20 40

Revisions

Number	Date	Description

60% COST ESTIMATE SET

EXISTING CONDITIONS PLAN

0.0.01

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Figure 5 (D)

KEY PLAN

N

NORTH ARROW

STAMP

Date: 15 MAY 2020

Drawn By: EME

Scale: 0 20 40

Revisions

Number	Date	Description

60% COST ESTIMATE SET

EXISTING CONDITIONS PLAN

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NOTES:
1) SEE SHEET 0.0.00 FOR NOTES, REFERENCES, AND LEGEND.

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Figure 5 (C)

KEY PLAN

NORTH ARROW

STAMP

Date: 15 MAY 2020

Drawn By: EME

Scale: 0 20 40

Revisions

Number	Date	Description

60% COST ESTIMATE SET

EXISTING CONDITIONS PLAN

0.0.04

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MASSACHUSETTS STATE PLANE COORDINATES (NAD83 MAINLAND ZONE 2001)

Figure 5 (E)

KEY PLAN

NORTH ARROW

WAYNE A. JALBERT No. 36118 REGISTERED PROFESSIONAL ENGINEER — STAMP

Date: 15 MAY 2020

Drawn By: EME

Scale: 0 20 40

Revisions

Number	Date	Description

60% COST ESTIMATE SET

EXISTING CONDITIONS PLAN

0.0.05

HSA JOB #21288 (21288ec.dwg)
PATH: F:\21st 3D Projects\21288 – DiNisco – Cashman Elementary – Amesbury\DWG\

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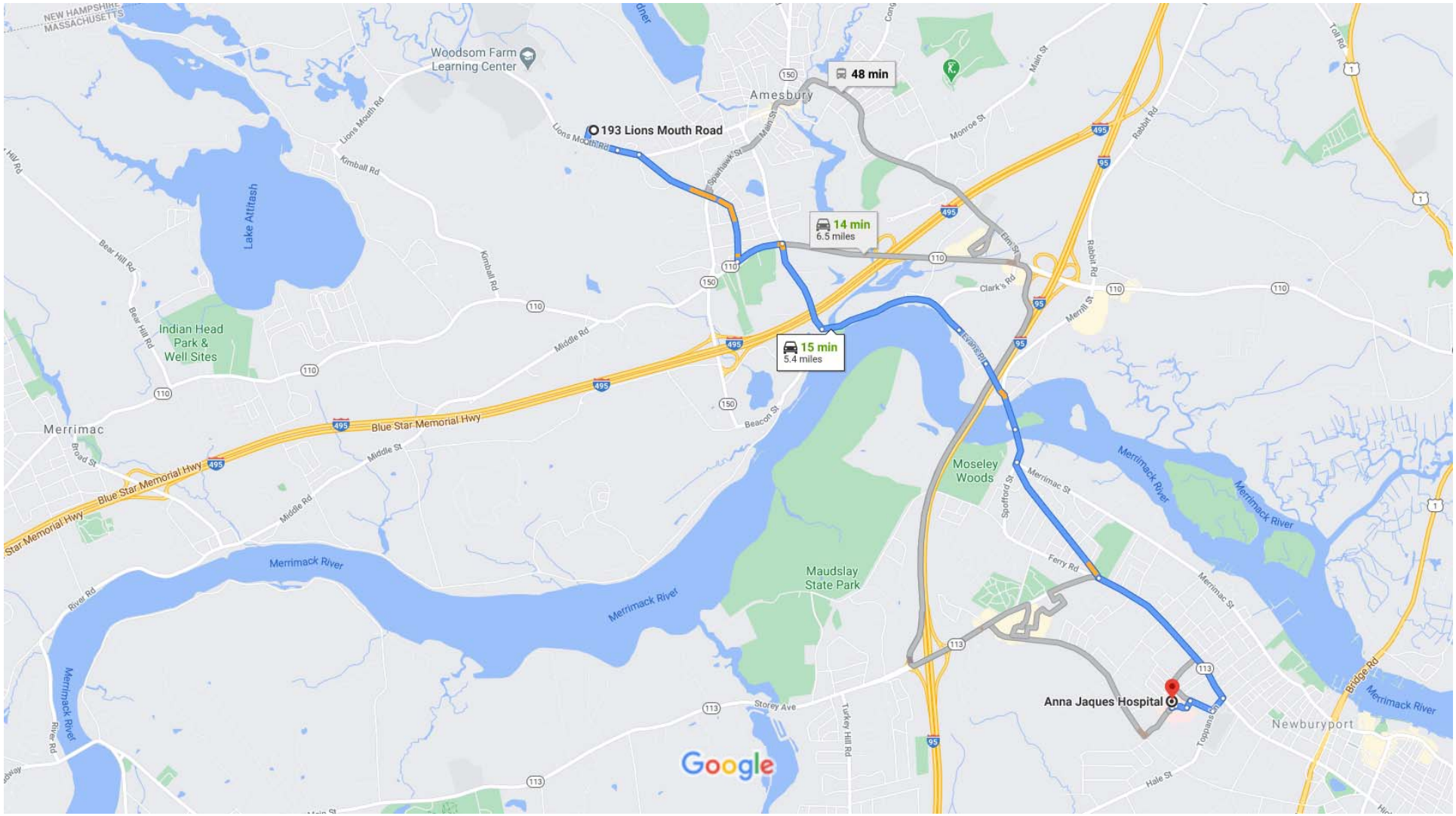
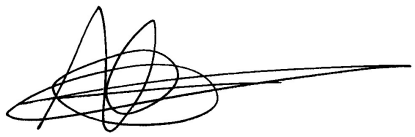
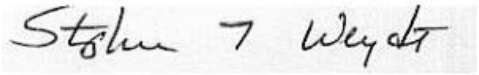
Google Maps 193 Lions Mouth Road, Amesbury, MA to Anna Jaques Hospital Drive 5.4 miles, 15 min



APPENDIX A

HASP ACKNOWLEDGEMENT/SIGNATURE LOG

ACKNOWLEDGEMENTS

Plan Prepared by: Kevin J. Kavanaugh, LSP, CHMM	**Signature:** **Date: 11/23/20** 
Plan Approved by: Stephen W. Weydt	**Signature:** **Date: 11/23/20** 

All on-site personnel are required to read and be familiar with the contents of this plan. Acknowledgement is indicated by signature below.

Printed Name	Company	Signature

Attach continuation sheet(s) as necessary.

APPENDIX B

SITE SUMMARY DATA

TABLE 1

SUMMARY OF TOPSOIL/LOAM/SUBSOIL SAMPLES FOR pH, REACTIVITY, IGNITABILITY, MASSDEP 14 METALS, POLCHLORINATED BIPHENYLS (PCBs) & TOTAL PETROLEUM HYDROCARBONS (TPH)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		**SS-1**	**SS-2**	**SSS-3**	**SSS-4**	**SSS-5**	**SSS-6**	**SSS-7**	**SSS-8**	**SSS-9**	**MassDEP**	**MassDEP**
Laboratory ID		**SC58794-01**	**SC58794-02**	**SC58794-10**	**SC58794-11**	**SC58794-12**	**SC58794-13**	**SC58794-14**	**SC58794-15**	**SC58794-16**	**Reportable**	**Imminent**
Sample Date		**7/9/2020**	**7/9/2020**	**7/9/2020**	**7/9/2020**	**7/9/2020**	**7/9/2020**	**7/9/2020**	**7/9/2020**	**7/9/2020**	**Concentrations**	**Hazard**
Sample Depth		**24"**	**22"**	**2-6"**	**2-6"**	**2-6"**	**2-6"**	**2-6"**	**2-6"**	**2-6"**	**RCS-1**	
SM2540 G (11) Mod. (%)												
solids	% Solids	89.3	88.8	82.7	88.9	85.8	92.6	83.4	86.1	78.7	NA	
SW846 9045D (pH Units)												
pH		5.99	6.08	6.13	5.58	5.57	5.74	5.71	5.56	5.41	NA	
SW846 Ch. 7.3 (mg/kg dry)												
Reactivity		Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative		
Reactive Cyanide		<6	<7	<7	<6	<6	<6	<7	<6	<7	30	
Reactive Sulfide		< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20		
SW846 1030 (N/A)												
NA	Ignitability by Definition	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	NA	
MassDEP 14 Metals - SW846 6010C (mg/kg)												
7440-36-0	Antimony	<5.59	<5.58	<5.98	<5.41	<6.27	<5.63	<6.01	<6.24	<6.28	20	
7440-38-2	Arsenic	**39.9**	**55.9**	**36.6**	**20.5**	**53.4**	**29.6**	**48.6**	**48.7**	**82.3**	**20**	**40**
7440-41-7	Beryllium	<0.559	<0.558	<0.598	<0.541	<0.627	<0.563	<0.601	<0.624	<0.628	90	
7440-43-9	Cadmium	<0.559	<0.558	<0.598	<0.541	<0.627	<0.563	<0.601	<0.624	<0.628	70	
7440-47-3	Chromium	22.6	19.4	21.8	18.8	25.0	30.0	65.9	31.6	24.7	100	
7439-92-1	Lead	8.42	19.3	17.0	18.6	17.0	15.8	28.6	21.0	22.9	200	
7440-02-0	Nickel	39.7	71.4	33.2	20.3	46.2	25.6	44.8	47.7	76.0	600	
7782-49-2	Selenium	<1.68	<1.67	<1.80	<1.62	<1.88	<1.69	<1.80	<1.87	<1.88	400	
7440-22-4	Silver	<3.35	<3.35	<3.59	<3.25	<3.76	<3.38	<3.60	<3.75	<3.77	100	
7440-28-0	Thallium	<3.35	<3.35	<3.59	<3.25	<3.76	<3.38	<3.60	<3.75	<3.77	8	
7440-62-2	Vanadium	22.7	24.5	30.1	24.5	33.9	35.8	46.7	36.0	39.4	400	
7440-66-6	Zinc	36.3	58.5	107	36.0	52.1	43.2	56.2	52.3	64.7	1000	
7440-39-3	Barium	18.4	22.5	30.0	29.5	30.3	28.6	34.6	33.0	29.1	1000	
RCRA Metals - SW846 7471B (mg/kg)												
7439-97-6	Mercury	<0.115	<0.127	<0.110	<0.116	<0.103	<0.120	<0.128	<0.115	<0.120	20	
Polychlorinated biphenyls (PCBs) - SW846 8082A (µg/kg)												
12674-11-2	Aroclor-1016	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
11104-28-2	Aroclor-1221	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
11141-16-5	Aroclor-1232	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
53469-21-9	Aroclor-1242	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
12672-29-6	Aroclor-1248	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
11097-69-1	Aroclor-1254	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
11096-82-5	Aroclor-1260	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
37324-23-5	Aroclor-1262	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	-	
11100-14-4	Aroclor-1268	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	-	
Total Petroleum Hydrocarbons (TPH) 8100 by GC (mg/kg)												
PH(TOT)	Total Petroleum Hydrocarbons	24.9	38.7	113	118	106	134	170	111	129	1000	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazrdous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 1

SUMMARY OF TOPSOIL/LOAM/SUBSOIL SAMPLES FOR pH, REACTIVITY, IGNITABILITY, MASSDEP 14 METALS, POLCHLORINATED BIPHENYLS (PCBs) & TOTAL PETROLEUM HYDROCARBONS (TPH)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location Laboratory ID Sample Date Sample Depth		SSS-10 SC58794-03 7/9/2020 2-6"	SSS-11 SC58794-04 7/9/2020 2-6"	SSS-12 SC58794-05 7/9/2020 2-6"	SSS-13 SC58794-06 7/9/2020 2-6"	SSS-14 SC58794-07 7/9/2020 2-6"	SSS-15 SC58794-17 7/9/2020 2-6"	SSS-16 SC58794-08 7/9/2020 2-6"	SSS-17 SC58794-09 7/9/2020 2-6"	MassDEP Reportable Concentrations RCS-1	MassDEP Imminent Hazard
SM2540 G (11) Mod. (%)											
solids	% Solids	80.1	80.6	83.3	79.0	86.9	79.8	90.3	89.6	NA	
SW846 9045D (pH Units)											
pH		6.17	5.47	5.71	6.35	6.03	5.69	6.08	6.11		
SW846 Ch. 7.3 (mg/kg dry)											
Reactivity		Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative		
Reactive Cyanide		<7	<9	<6	<7	<6	<7	<6	<6	30	
Reactive Sulfide		< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20		
SW846 1030 (N/A)											
NA	Ignitability by Definition	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	NA	
MassDEP 14 Metals - SW846 6010C (mg/kg)											
7440-36-0	Antimony	<5.89	<6.24	<5.56	<6.11	<5.63	<6.33	<5.58	<5.33	20	
7440-38-2	Arsenic	**25.4**	**33.6**	**39.2**	**49.1**	**23.7**	**37.8**	**36.6**	**21.9**	**20**	**40**
7440-41-7	Beryllium	<0.589	<0.624	<0.556	<0.611	<0.563	<0.633	<0.558	<0.533	90	
7440-43-9	Cadmium	<0.589	<0.624	<0.556	<0.611	<0.563	<0.633	<0.558	<0.533	70	
7440-47-3	Chromium	22.9	23.2	17.4	23.3	36.0	31.5	21.7	19.4	100	
7439-92-1	Lead	13.7	18.9	19.6	22.7	13.7	25.9	17.5	12.1	200	
7440-02-0	Nickel	28.2	30.4	26.9	37.2	26.1	37.7	30.6	27.9	600	
7782-49-2	Selenium	<1.77	<1.87	<1.67	<1.83	<1.69	<1.90	<1.67	<1.60	400	
7440-22-4	Silver	<3.53	<3.74	<3.34	<3.67	<3.38	<3.80	<3.35	<3.20	100	
7440-28-0	Thallium	<3.53	<3.74	<3.34	<3.67	<3.38	<3.80	<3.35	<3.20	8	
7440-62-2	Vanadium	29.6	38.3	33.5	34.6	41.9	36.3	30.6	8.48	400	
7440-66-6	Zinc	60.8	43.2	37.9	49.2	44.6	60.7	44.3	61.8	1000	
7440-39-3	Barium	26.5	24.8	21.7	28.9	44.1	46.3	24.0	113	1000	
RCRA Metals - SW846 7471B (mg/kg)											
7439-97-6	Mercury	<0.117	<0.126	<0.129	<0.133	<0.118	<0.123	<0.119	<0.116	20	
Polychlorinated biphenyls (PCBs) - SW846 8082A (µg/kg)											
12674-11-2	Aroclor-1016	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
11104-28-2	Aroclor-1221	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
11141-16-5	Aroclor-1232	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
53469-21-9	Aroclor-1242	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
12672-29-6	Aroclor-1248	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
11097-69-1	Aroclor-1254	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
11096-82-5	Aroclor-1260	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
37324-23-5	Aroclor-1262	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	-	
11100-14-4	Aroclor-1268	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	-	
Total Petroleum Hydrocarbons (TPH) 8100 by GC (mg/kg)											
PH(TOT)	Total Petroleum Hydrocarbons	109	184	180	93.0	116	168	93.6	49.7	1000	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazrdous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 2

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR VOLATILE ORGANIC COMPOUNDS (VOCs)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SS-1	SS-2	SSS-3	SSS-4	SSS-5	SSS-6	SSS-7	SSS-8	SSS-9	MassDEP Reportable Concentrations
Laboratory ID		SC58794-01	SC58794-02	SC58794-10	SC58794-11	SC58794-12	SC58794-13	SC58794-14	SC58794-15	SC58794-16	
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	
Sample Depth		24"	22"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Volatile Organic Compounds (VOCs) - SW846 8260B (µg/kg)											
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
67-64-1	Acetone	<532	<573	<711	<643	<662	<521	<594	<605	<760	6000
107-13-1	Acrylonitrile	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
71-43-2	Benzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	2000
108-86-1	Bromobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
74-97-5	Bromochloromethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
75-27-4	Bromodichloromethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
75-25-2	Bromoform	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
74-83-9	Bromomethane	<106	<115	<142	<129	<132	<104	<119	<121	<152	500
78-93-3	2-Butanone (MEK)	<106	<115	<142	<129	<132	<104	<119	<121	<152	4000
104-51-8	n-Butylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
135-98-8	sec-Butylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
98-06-6	tert-Butylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
75-15-0	Carbon disulfide	<106	<115	<142	<129	<132	<104	<119	<121	<152	100000
56-23-5	Carbon tetrachloride	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	5000
108-90-7	Chlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000
75-00-3	Chloroethane	<106	<115	<142	<129	<132	<104	<119	<121	<152	100000
67-66-3	Chloroform	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	200
74-87-3	Chloromethane	<106	<115	<142	<129	<132	<104	<119	<121	<152	100000
95-49-8	2-Chlorotoluene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
106-43-4	4-Chlorotoluene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
96-12-8	1,2-Dibromo-3-chloropropane	<106	<115	<142	<129	<132	<104	<119	<121	<152	10000
124-48-1	Dibromochloromethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	5
106-93-4	1,2-Dibromoethane (EDB)	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
74-95-3	Dibromomethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	500000
95-50-1	1,2-Dichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	9000
541-73-1	1,3-Dichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	3000
106-46-7	1,4-Dichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	700
75-71-8	Dichlorodifluoromethane (Freon12)	<106	<115	<142	<129	<132	<104	<119	<121	<152	1000000
75-34-3	1,1-Dichloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	400
107-06-2	1,2-Dichloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
75-35-4	1,1-Dichloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	3000
156-59-2	cis-1,2-Dichloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	300
156-60-5	trans-1,2-Dichloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000
78-87-5	1,2-Dichloropropane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
142-28-9	1,3-Dichloropropane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	500000
594-20-7	2,2-Dichloropropane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
563-58-6	1,1-Dichloropropene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
10061-01-5	cis-1,3-Dichloropropene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	10
10061-02-6	trans-1,3-Dichloropropene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	10
100-41-4	Ethylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	40000
87-68-3	Hexachlorobutadiene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	30000
591-78-6	2-Hexanone (MBK)	<106	<115	<142	<129	<132	<104	<119	<121	<152	100000
98-82-8	Isopropylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000000
99-87-6	4-Isopropyltoluene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
1634-04-4	Methyl tert-butyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
108-10-1	4-Methyl-2-pentanone (MIBK)	<106	<115	<142	<129	<132	<104	<119	<121	<152	400
75-09-2	Methylene chloride	<106	<115	<142	<129	<132	<104	<119	<121	<152	100
91-20-3	Naphthalene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	4000
103-65-1	n-Propylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
100-42-5	Styrene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	3000
630-20-6	1,1,1,2-Tetrachloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
79-34-5	1,1,2,2-Tetrachloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	5
127-18-4	Tetrachloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000
108-88-3	Toluene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	30000
87-61-6	1,2,3-Trichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
120-82-1	1,2,4-Trichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	2000
108-70-3	1,3,5-Trichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	30000
71-55-6	1,1,1-Trichloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
79-00-5	1,1,2-Trichloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
79-01-6	Trichloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	300
75-69-4	Trichlorofluoromethane (Freon 11)	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000000
96-18-4	1,2,3-Trichloropropane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
95-63-6	1,2,4-Trimethylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000000
108-67-8	1,3,5-Trimethylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	10000
75-01-4	Vinyl chloride	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	700
179601-23-1	m,p-Xylene	<106	<115	<142	<129	<132	<104	<119	<121	<152	300000
95-47-6	o-Xylene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	500000
109-99-9	Tetrahydrofuran	<106	<115	<142	<129	<132	<104	<119	<121	<152	500000
60-29-7	Ethyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
994-05-8	Tert-amyl methyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
637-92-3	Ethyl tert-butyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
108-20-3	Di-isopropyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
75-65-0	Tert-Butanol / butyl alcohol	<1060	<1150	<1420	<1290	<1320	<1040	<1190	<1210	<1520	100000
123-91-1	1,4-Dioxane	<1060	<1150	<1420	<1290	<1320	<1040	<1190	<1210	<1520	10000
110-57-6	trans-1,4-Dichloro-2-butene	<266	<286	<356	<321	<331	<261	<297	<302	<380	200
64-17-5	Ethanol	<10600	<11500	<14200	<12900	<13200	<10400	<11900	<12100	<15200	100000

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazrdous Materials List (MOHML) revised (effective) February 14, 2008

Environmental & Construction Management Services, Inc.

TABLE 2

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR VOLATILE ORGANIC COMPOUNDS (VOCs)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SSS-10	SSS-11	SSS-12	SSS-13	SSS-14	SSS-15	SSS-16	SSS-17	MassDEP Reportable Concentrations
Laboratory ID		SC58794-03	SC58794-04	SC58794-05	SC58794-06	SC58794-07	SC58794-17	SC58794-08	SC58794-09	
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	
Sample Depth		2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Volatile Organic Compounds (VOCs) - SW846 8260B (µg/kg)										
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
67-64-1	Acetone	<686	<693	<637	<695	<585	<695	<540	<529	6000
107-13-1	Acrylonitrile	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
71-43-2	Benzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	2000
108-86-1	Bromobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
74-97-5	Bromochloromethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
75-27-4	Bromodichloromethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
75-25-2	Bromoform	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
74-83-9	Bromomethane	<137	<139	<127	<139	<117	<139	<108	<106	500
78-93-3	2-Butanone (MEK)	<137	<139	<127	<139	<117	<139	<108	<106	4000
104-51-8	n-Butylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
135-98-8	sec-Butylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
98-06-6	tert-Butylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
75-15-0	Carbon disulfide	<137	<139	<127	<139	<117	<139	<108	<106	100000
56-23-5	Carbon tetrachloride	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	5000
108-90-7	Chlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000
75-00-3	Chloroethane	<137	<139	<127	<139	<117	<139	<108	<106	100000
67-66-3	Chloroform	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	200
74-87-3	Chloromethane	<137	<139	<127	<139	<117	<139	<108	<106	100000
95-49-8	2-Chlorotoluene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
106-43-4	4-Chlorotoluene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
96-12-8	1,2-Dibromo-3-chloropropane	<137	<139	<127	<139	<117	<139	<108	<106	10000
124-48-1	Dibromochloromethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	5
106-93-4	1,2-Dibromoethane (EDB)	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
74-95-3	Dibromomethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	500000
95-50-1	1,2-Dichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	9000
541-73-1	1,3-Dichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	3000
106-46-7	1,4-Dichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	700
75-71-8	Dichlorodifluoromethane (Freon12)	<137	<139	<127	<139	<117	<139	<108	<106	1000000
75-34-3	1,1-Dichloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	400
107-06-2	1,2-Dichloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
75-35-4	1,1-Dichloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	3000
156-59-2	cis-1,2-Dichloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	300
156-60-5	trans-1,2-Dichloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000
78-87-5	1,2-Dichloropropane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
142-28-9	1,3-Dichloropropane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	500000
594-20-7	2,2-Dichloropropane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
563-58-6	1,1-Dichloropropene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
10061-01-5	cis-1,3-Dichloropropene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	10
10061-02-6	trans-1,3-Dichloropropene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	10
100-41-4	Ethylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	40000
87-68-3	Hexachlorobutadiene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	30000
591-78-6	2-Hexanone (MBK)	<137	<139	<127	<139	<117	<139	<108	<106	100000
98-82-8	Isopropylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000000
99-87-6	4-Isopropyltoluene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
1634-04-4	Methyl tert-butyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
108-10-1	4-Methyl-2-pentanone (MIBK)	<137	<139	<127	<139	<117	<139	<108	<106	400
75-09-2	Methylene chloride	<137	<139	<127	<139	<117	<139	<108	<106	100
91-20-3	Naphthalene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	4000
103-65-1	n-Propylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
100-42-5	Styrene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	3000
630-20-6	1,1,1,2-Tetrachloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
79-34-5	1,1,2,2-Tetrachloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	5
127-18-4	Tetrachloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000
108-88-3	Toluene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	30000
87-61-6	1,2,3-Trichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
120-82-1	1,2,4-Trichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	2000
108-70-3	1,3,5-Trichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	30000
71-55-6	1,1,1-Trichloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
79-00-5	1,1,2-Trichloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
79-01-6	Trichloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	300
75-69-4	Trichlorofluoromethane (Freon 11)	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000000
96-18-4	1,2,3-Trichloropropane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
95-63-6	1,2,4-Trimethylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000000
108-67-8	1,3,5-Trimethylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	10000
75-01-4	Vinyl chloride	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	700
179601-23-1	m,p-Xylene	<137	<139	<127	<139	<117	<139	<108	<106	300000
95-47-6	o-Xylene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	500000
109-99-9	Tetrahydrofuran	<137	<139	<127	<139	<117	<139	<108	<106	500000
60-29-7	Ethyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
994-05-8	Tert-amyl methyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
637-92-3	Ethyl tert-butyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
108-20-3	Di-isopropyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
75-65-0	Tert-Butanol / butyl alcohol	<1370	<1390	<1270	<1390	<1170	<1390	<1080	<1060	100000
123-91-1	1,4-Dioxane	<1370	<1390	<1270	<1390	<1170	<1390	<1080	<1060	10000
110-57-6	trans-1,4-Dichloro-2-butene	<343	<347	<318	<348	<292	<347	<270	<264	200
64-17-5	Ethanol	<13700	<13900	<12700	<13900	<11700	<13900	<10800	<10600	100000

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazrdous Materials List (MOHML) revised (effective) February 14, 2008

Environmental & Construction Management Services, Inc.

TABLE 3

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SS-1	SS-2	SSS-3	SSS-4	SSS-5	SSS-6	SSS-7	SSS-8	SSS-9	MassDEP Reportable Concentrations
Laboratory ID		SC58794-01	SC58794-02	SC58794-10	SC58794-11	SC58794-12	SC58794-13	SC58794-14	SC58794-15	SC58794-16	
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	
Sample Depth		24"	22"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Semi-Volatile Organic Compounds (SVOCs) - SW846 8270D (µg/kg)											
83-32-9	Acenaphthene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	4000
208-96-8	Acenaphthylene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000
62-53-3	Aniline	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
120-12-7	Anthracene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
103-33-3	Azobenzene/Diphenyldiazene	<368	<369	<396	<367	<379	<352	<394	<379	<415	50000
92-87-5	Benzidine	<736	<738	<792	<735	<759	<704	<787	<757	<829	10000
56-55-3	Benzo (a) anthracene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	7000
50-32-8	Benzo (a) pyrene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	2000
205-99-2	Benzo (b) fluoranthene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	7000
191-24-2	Benzo (g,h,i) perylene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
207-08-9	Benzo (k) fluoranthene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
65-85-0	Benzoic acid	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
100-51-6	Benzyl alcohol	<368	<369	<396	<367	<379	<352	<394	<379	<415	-
111-91-1	Bis(2-chloroethoxy)methane	<368	<369	<396	<367	<379	<352	<394	<379	<415	500000
111-44-4	Bis(2-chloroethyl)ether	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
108-60-1	Bis(2-chloroisopropyl)ether	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
117-81-7	Bis(2-ethylhexyl)phthalate	<186	<187	<201	<186	<192	<178	<199	<192	<210	200000
101-55-3	4-Bromophenyl phenyl ether	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
85-68-7	Butyl benzyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
86-74-8	Carbazole	<186	<187	<201	<186	<192	<178	<199	<192	<210	-
59-50-7	4-Chloro-3-methylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
106-47-8	4-Chloroaniline	<186	<187	<201	<186	<192	<178	<199	<192	<210	1000
91-58-7	2-Chloronaphthalene	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
95-57-8	2-Chlorophenol	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
7005-72-3	4-Chlorophenyl phenyl ether	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
218-01-9	Chrysene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	70000
53-70-3	Dibenzo (a,h) anthracene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	700
132-64-9	Dibenzofuran	<186	<187	<201	<186	<192	<178	<199	<192	<210	100000
95-50-1	1,2-Dichlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	9000
541-73-1	1,3-Dichlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000
106-46-7	1,4-Dichlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	700
91-94-1	3,3´-Dichlorobenzidine	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000
120-83-2	2,4-Dichlorophenol	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
84-66-2	Diethyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	10000
131-11-3	Dimethyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	30000
105-67-9	2,4-Dimethylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	700
84-74-2	Di-n-butyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	50000
534-52-1	4,6-Dinitro-2-methylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	50000
51-28-5	2,4-Dinitrophenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	3000
121-14-2	2,4-Dinitrotoluene	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
606-20-2	2,6-Dinitrotoluene	<186	<187	<201	<186	<192	<178	<199	<192	<210	100000
117-84-0	Di-n-octyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
206-44-0	Fluoranthene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
86-73-7	Fluorene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
118-74-1	Hexachlorobenzene	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
87-68-3	Hexachlorobutadiene	<186	<187	<201	<186	<192	<178	<199	<192	<210	6000
77-47-4	Hexachlorocyclopentadiene	<186	<187	<201	<186	<192	<178	<199	<192	<210	50000
67-72-1	Hexachloroethane	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
193-39-5	Indeno (1,2,3-cd) pyrene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	7000
78-59-1	Isophorone	<186	<187	<201	<186	<192	<178	<199	<192	<210	100000
91-57-6	2-Methylnaphthalene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	700
95-48-7	2-Methylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	500000
108-39-4, 106-44-5	3 & 4-Methylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	500000
91-20-3	Naphthalene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	4000
88-74-4	2-Nitroaniline	<368	<369	<396	<367	<379	<352	<394	<379	<415	-
99-09-2	3-Nitroaniline	<368	<369	<396	<367	<379	<352	<394	<379	<415	-
100-01-6	4-Nitroaniline	<186	<187	<201	<186	<192	<178	<199	<192	<210	1000000
98-95-3	Nitrobenzene	<186	<187	<201	<186	<192	<178	<199	<192	<210	500000
88-75-5	2-Nitrophenol	<186	<187	<201	<186	<192	<178	<199	<192	<210	100000
100-02-7	4-Nitrophenol	<1470	<1480	<1580	<1470	<1520	<1410	<1570	<1510	<1660	100000
62-75-9	N-Nitrosodimethylamine	<186	<187	<201	<186	<192	<178	<199	<192	<210	50000
621-64-7	N-Nitrosodi-n-propylamine	<186	<187	<201	<186	<192	<178	<199	<192	<210	50000
86-30-6	N-Nitrosodiphenylamine	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
87-86-5	Pentachlorophenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	3000
85-01-8	Phenanthrene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	10000
108-95-2	Phenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000
129-00-0	Pyrene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
110-86-1	Pyridine	<368	<369	<396	<367	<379	<352	<394	<379	<415	500000
120-82-1	1,2,4-Trichlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	2000
90-12-0	1-Methylnaphthalene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	-
95-95-4	2,4,5-Trichlorophenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	3000
88-06-2	2,4,6-Trichlorophenol	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
82-68-8	Pentachloronitrobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
95-94-3	1,2,4,5-Tetrachlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Boldfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 3

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SSS-10	SSS-11	SSS-12	SSS-13	SSS-14	SSS-15	SSS-16	SSS-17	MassDEP Reportable Concentrations
Laboratory ID		SC58794-03	SC58794-04	SC58794-05	SC58794-06	SC58794-07	SC58794-17	SC58794-08	SC58794-09	
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	
Sample Depth		2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Semi-Volatile Organic Compounds (SVOCs) - SW846 8270D (µg/kg)										
83-32-9	Acenaphthene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	4000
208-96-8	Acenaphthylene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000
62-53-3	Aniline	<407	<405	<385	<414	<375	<407	<361	<356	100000
120-12-7	Anthracene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
103-33-3	Azobenzene/Diphenyldiazene	<407	<405	<385	<414	<375	<407	<361	<356	50000
92-87-5	Benzidine	<815	<809	<771	<828	<750	<814	<722	<713	10000
56-55-3	Benzo (a) anthracene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	7000
50-32-8	Benzo (a) pyrene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	2000
205-99-2	Benzo (b) fluoranthene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	7000
191-24-2	Benzo (g,h,i) perylene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
207-08-9	Benzo (k) fluoranthene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
65-85-0	Benzoic acid	<407	<405	<385	<414	<375	<407	<361	<356	1000000
100-51-6	Benzyl alcohol	<407	<405	<385	<414	<375	<407	<361	<356	-
111-91-1	Bis(2-chloroethoxy)methane	<407	<405	<385	<414	<375	<407	<361	<356	500000
111-44-4	Bis(2-chloroethyl)ether	<206	<205	<195	<210	<190	<206	<183	<180	700
108-60-1	Bis(2-chloroisopropyl)ether	<206	<205	<195	<210	<190	<206	<183	<180	700
117-81-7	Bis(2-ethylhexyl)phthalate	305	<205	<195	<210	<190	<206	<183	<180	200000
101-55-3	4-Bromophenyl phenyl ether	<407	<405	<385	<414	<375	<407	<361	<356	100000
85-68-7	Butyl benzyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	100000
86-74-8	Carbazole	<206	<205	<195	<210	<190	<206	<183	<180	-
59-50-7	4-Chloro-3-methylphenol	<407	<405	<385	<414	<375	<407	<361	<356	1000000
106-47-8	4-Chloroaniline	<206	<205	<195	<210	<190	<206	<183	<180	1000
91-58-7	2-Chloronaphthalene	<407	<405	<385	<414	<375	<407	<361	<356	1000000
95-57-8	2-Chlorophenol	<206	<205	<195	<210	<190	<206	<183	<180	700
7005-72-3	4-Chlorophenyl phenyl ether	<407	<405	<385	<414	<375	<407	<361	<356	1000000
218-01-9	Chrysene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	70000
53-70-3	Dibenzo (a,h) anthracene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	700
132-64-9	Dibenzofuran	<206	<205	<195	<210	<190	<206	<183	<180	100000
95-50-1	1,2-Dichlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	9000
541-73-1	1,3-Dichlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	1000
106-46-7	1,4-Dichlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	700
91-94-1	3,3'-Dichlorobenzidine	<407	<405	<385	<414	<375	<407	<361	<356	1000
120-83-2	2,4-Dichlorophenol	<206	<205	<195	<210	<190	<206	<183	<180	700
84-66-2	Diethyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	10000
131-11-3	Dimethyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	30000
105-67-9	2,4-Dimethylphenol	<407	<405	<385	<414	<375	<407	<361	<356	700
84-74-2	Di-n-butyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	50000
534-52-1	4,6-Dinitro-2-methylphenol	<407	<405	<385	<414	<375	<407	<361	<356	50000
51-28-5	2,4-Dinitrophenol	<407	<405	<385	<414	<375	<407	<361	<356	3000
121-14-2	2,4-Dinitrotoluene	<206	<205	<195	<210	<190	<206	<183	<180	700
606-20-2	2,6-Dinitrotoluene	<206	<205	<195	<210	<190	<206	<183	<180	100000
117-84-0	Di-n-octyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	1000000
206-44-0	Fluoranthene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
86-73-7	Fluorene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
118-74-1	Hexachlorobenzene	<206	<205	<195	<210	<190	<206	<183	<180	700
87-68-3	Hexachlorobutadiene	<206	<205	<195	<210	<190	<206	<183	<180	6000
77-47-4	Hexachlorocyclopentadiene	<206	<205	<195	<210	<190	<206	<183	<180	50000
67-72-1	Hexachloroethane	<206	<205	<195	<210	<190	<206	<183	<180	700
193-39-5	Indeno (1,2,3-cd) pyrene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	7000
78-59-1	Isophorone	<206	<205	<195	<210	<190	<206	<183	<180	100000
91-57-6	2-Methylnaphthalene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	700
95-48-7	2-Methylphenol	<407	<405	<385	<414	<375	<407	<361	<356	500000
108-39-4, 106-44-5	3 & 4-Methylphenol	<407	<405	<385	<414	<375	<407	<361	<356	500000
91-20-3	Naphthalene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	4000
88-74-4	2-Nitroaniline	<407	<405	<385	<414	<375	<407	<361	<356	-
99-09-2	3-Nitroaniline	<407	<405	<385	<414	<375	<407	<361	<356	-
100-01-6	4-Nitroaniline	<206	<205	<195	<210	<190	<206	<183	<180	1000000
98-95-3	Nitrobenzene	<206	<205	<195	<210	<190	<206	<183	<180	500000
88-75-5	2-Nitrophenol	<206	<205	<195	<210	<190	<206	<183	<180	100000
100-02-7	4-Nitrophenol	<1630	<1620	<1540	<1660	<1500	<1630	<1440	<1430	100000
62-75-9	N-Nitrosodimethylamine	<206	<205	<195	<210	<190	<206	<183	<180	50000
621-64-7	N-Nitrosodi-n-propylamine	<206	<205	<195	<210	<190	<206	<183	<180	50000
86-30-6	N-Nitrosodiphenylamine	<407	<405	<385	<414	<375	<407	<361	<356	100000
87-86-5	Pentachlorophenol	<407	<405	<385	<414	<375	<407	<361	<356	3000
85-01-8	Phenanthrene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	10000
108-95-2	Phenol	<407	<405	<385	<414	<375	<407	<361	<356	1000
129-00-0	Pyrene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
110-86-1	Pyridine	<407	<405	<385	<414	<375	<407	<361	<356	500000
120-82-1	1,2,4-Trichlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	2000
90-12-0	1-Methylnaphthalene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	-
95-95-4	2,4,5-Trichlorophenol	<407	<405	<385	<414	<375	<407	<361	<356	3000
88-06-2	2,4,6-Trichlorophenol	<206	<205	<195	<210	<190	<206	<183	<180	700
82-68-8	Pentachloronitrobenzene	<407	<405	<385	<414	<375	<407	<361	<356	100000
95-94-3	1,2,4,5-Tetrachlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	1000000

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Boldfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 4

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR PESTICIDES AND HERBICIDES

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SS-1	SS-2	SSS-3	SSS-4	SSS-5	SSS-6	SSS-7	SSS-8	SSS-9	MCP
Laboratory ID		SC58794-01	SC58794-02	SC58794-10	SC58794-11	SC58794-12	SC58794-13	SC58794-14	SC58794-15	SC58794-16	Reportable
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	Concentrations
Sample Depth		24"	22"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Pesticides - SW846 8081B (µg/kg)											
319-84-6	a-BHC	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	50000
319-85-7	b-BHC	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	10000
319-86-8	d-BHC	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	10000
58-89-9	g-BHC (Lindane)	<3.32	<3.34	<3.46	<3.23	<3.46	<3.22	<3.57	<3.45	<3.80	3000
76-44-8	Heptachlor	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	200
309-00-2	Aldrin	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	100000
1024-57-3	Heptachlor epoxide	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	90
959-98-8	Endosulfan I	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	500
60-57-1	Dieldrin	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	50
72-55-9	4,4' -DDE	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	3000
72-20-8	Endrin	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	8000
33213-65-9	Endosulfan II	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	500
72-54-8	4,4' -DDD	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	4000
1031-07-8	Endosulfan sulfate	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	-
50-29-3	4,4' -DDT	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	-
72-43-5	Methoxychlor	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	200000
53494-70-5	Endrin ketone	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	8000
7421-93-4	Endrin aldehyde	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	10000
5103-71-9	alpha-Chlordane	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	-
5103-74-2	gamma-Chlordane	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	-
8001-35-2	Toxaphene	<111	<111	<115	<108	<115	<107	<119	<115	<127	10000
57-74-9	Chlordane	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	700
15972-60-8	Alachlor	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	100
Herbicides - SW846 8151A (µg/kg)											
93-76-5	2,4,5-T	<80	<80	<80	<80	<80	<80	<80	<80	<80	100000
93-72-1	2,4,5-TP (Silvex)	<80	<80	<80	<80	<80	<80	<80	<80	<80	100000
94-75-7	2,4-D	<80	<80	<80	<80	<80	<80	<80	<80	<80	100000
94-82-6	2,4-DB	<80	<80	<80	<80	<80	<80	<80	<80	<80	100000
75-99-0	Dalapon	<80	<80	<80	<80	<80	<80	<80	<80	<80	1000000
1918-00-9	Dicamba	<80	<80	<80	<80	<80	<80	<80	<80	<80	500000
120-36-5	Dichloroprop	<80	<80	<80	<80	<80	<80	<80	<80	<80	-
88-85-7	Dinoseb	<80	<80	<80	<80	<80	<80	<80	<80	<80	500000
94-74-6	MCPA	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	100000
7085-19-0	MCPP	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	-

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Boldfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

TABLE 4

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR PESTICIDES AND HERBICIDES

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location Laboratory ID Sample Date Sample Depth		SSS-10 SC58794-03 7/9/2020 2-6"	SSS-11 SC58794-04 7/9/2020 2-6"	SSS-12 SC58794-05 7/9/2020 2-6"	SSS-13 SC58794-06 7/9/2020 2-6"	SSS-14 SC58794-07 7/9/2020 2-6"	SSS-15 SC58794-17 7/9/2020 2-6"	SSS-16 SC58794-08 7/9/2020 2-6"	SSS-17 SC58794-09 7/9/2020 2-6"	MCP Reportable Concentrations RCS-1
Pesticides - SW846 8081B (µg/kg)										
319-84-6	a-BHC	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	4000
319-85-7	b-BHC	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	3000
319-86-8	d-BHC	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	3000
58-89-9	g-BHC (Lindane)	<3.64	<3.69	<3.51	<3.78	<3.38	<3.73	<3.26	<3.34	50000
76-44-8	Heptachlor	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	100
309-00-2	Aldrin	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	100000
1024-57-3	Heptachlor epoxide	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	10000
959-98-8	Endosulfan I	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	700
60-57-1	Dieldrin	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	10000
72-55-9	4,4' -DDE	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	50
72-20-8	Endrin	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	500
33213-65-9	Endosulfan II	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	500
72-54-8	4,4' -DDD	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	-
1031-07-8	Endosulfan sulfate	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	8000
50-29-3	4,4' -DDT	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	10000
72-43-5	Methoxychlor	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	8000
53494-70-5	Endrin ketone	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	3000
7421-93-4	Endrin aldehyde	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	200
5103-71-9	alpha-Chlordane	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	90
5103-74-2	gamma-Chlordane	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	700
8001-35-2	Toxaphene	<121	<123	<117	<126	<113	<124	<109	<111	200000
57-74-9	Chlordane	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	10000
15972-60-8	Alachlor	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	-
Herbicides - SW846 8151A (µg/kg)										
93-76-5	2,4,5-T	<80	<80	<80	<80	<80	<80	<80	<80	100000
93-72-1	2,4,5-TP (Silvex)	<80	<80	<80	<80	<80	<80	<80	<80	100000
94-75-7	2,4-D	<80	<80	<80	<80	<80	<80	<80	<80	100000
94-82-6	2,4-DB	<80	<80	<80	<80	<80	<80	<80	<80	100000
75-99-0	Dalapon	<80	<80	<80	<80	<80	<80	<80	<80	1000000
1918-00-9	Dicamba	<80	<80	<80	<80	<80	<80	<80	<80	500000
120-36-5	Dichloroprop	<80	<80	<80	<80	<80	<80	<80	<80	-
88-85-7	Dinoseb	<80	<80	<80	<80	<80	<80	<80	<80	500000
94-74-6	MCPA	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	100000
7085-19-0	MCPP	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	-

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Boldfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

TABLE 5

SUMMARY OF BASEBALL INFIELD SOIL SAMPLES FOR MASSDEP 14 METALS

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SSS-18	SSS-19	SSS-20	SSS-21	SSS-22	SSS-23	SSS-24	SSS-25	MassDEP Reportable Concentrations	MassDEP Imminent Hazard
Laboratory ID		SC58954-01	SC58954-02	SC58954-03	SC58954-04	SC58954-05	SC58954-06	SC58954-07	SC58954-08		
Sample Date		7/31/2020	7/31/2020	7/31/2020	7/31/2020	7/31/2020	7/31/2020	7/31/2020	7/31/2020		
Sample Location		Randall Field - 1st Base	Randall Field - 2nd Base	Randall Field - 3rd Base	Randall Field - Home Plate	Packer Field - 1st Base	Packer Field - 2nd Base	Packer Field - 3rd Base	Packer Field - Home Plate	RCS-1	
Sample Depth		Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	(mg/kg)	
SM2540 G (11) Mod. (%)											
solids	% Solids	86.9	90.9	90.9	86.7	90.1	90.2	87.5	90.0	NA	
MassDEP 14 Metals - SW846 6010C (mg/kg)											
7440-36-0	Antimony	<5.90	<5.43	<5.43	<6.07	<5.13	<5.45	<5.68	<5.61	20	
7440-38-2	Arsenic	10.9	11.6	10.7	15.8	13.6	14.8	13.4	15.3	20	40
7440-41-7	Beryllium	<0.590	<0.543	<0.543	<0.607	<0.513	<0.545	<0.568	<0.561	90	
7440-43-9	Cadmium	<0.590	<0.543	<0.543	<0.607	<0.513	<0.545	<0.568	<0.561	70	
7440-47-3	Chromium	10.8	14.6	11.1	11.8	9.20	7.74	9.07	8.99	100	
7439-92-1	Lead	6.88	7.03	6.04	8.03	6.24	7.26	6.72	6.88	200	
7440-02-0	Nickel	5.65	6.67	6.73	6.81	5.25	5.20	4.90	5.42	600	
7782-49-2	Selenium	<1.77	<1.63	<1.63	<1.82	<1.54	<1.63	<1.70	<1.68	400	
7440-22-4	Silver	<3.54	<3.26	<3.26	<3.64	<3.08	<3.27	<3.41	<3.37	100	
7440-28-0	Thallium	<3.54	<3.26	<3.26	<3.64	<3.08	<3.27	<3.41	<3.37	8	
7440-62-2	Vanadium	13.6	14.4	14.6	17.2	15.6	15.8	16.2	15.5	400	
7440-66-6	Zinc	25.3	24.6	22.6	28.1	26.0	27.0	27.8	27.6	1000	
7440-39-3	Barium	31.4	33.2	27.0	45.7	29.4	25.4	31.5	29.2	1000	
RCRA Metals - SW846 7471B (mg/kg)											
7439-97-6	Mercury	<0.0323	<0.0363	<0.0310	<0.0305	<0.0388	<0.0321	<0.0319	<0.0330	20	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 6

SUMMARY OF BACKGROUND SOIL SAMPLES FOR MASSDEP 14 METALS

Cashman School & Woodsom Farm Property
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SSS-26**	SSS-27**	SSS-28	SSS-29	SSS-30	SSS-31	SSS-32	SSS-33	MassDEP Reportable Concentrations	MassDEP Imminent Hazard
Laboratory ID		SC59063-01	SC59063-02	SC59063-03	SC59063-04	SC59063-05	SC59063-06	SC59063-07	SC59063-08		
Sample Date		8/12/2020	8/12/2020	8/12/2020	8/12/2020	8/12/2020	8/12/2020	8/12/2020	8/12/2020		
Sample Location		Background-Woods	Background-Woods	Randall Field - Outfield	Background-Woodsom Farm	Background-Woodsom Farm	Background-Woodsom Farm	Background-Woodsom Farm	Packer Field - Outfield	RCS-1	
Sample Depth		0-6"	12"	18-24"	6"	18-22"	6"	18-22"	14-18"	(mg/kg)	
SM2540 G (11) Mod. (%)											
solids	% Solids	93.3	93.1	95.6	89.8	84.7	90.2	94.9	89.6	NA	
MassDEP 14 Metals - SW846 6010C (mg/kg)											
7440-36-0	Antimony	<5.34	<5.50	<4.92	<5.21	<5.68	<5.70	<5.25	<5.56	20	
7440-38-2	Arsenic	**56.1**	**65.5**	4.89	**27.7**	**31.2**	**74.8**	**89.6**	**62.3**	20	40
7440-41-7	Beryllium	<0.534	<0.550	<0.492	0.590	<0.568	<0.570	<0.525	<0.556	90	
7440-43-9	Cadmium	<0.534	<0.550	<0.492	<0.521	<0.568	<0.570	<0.525	<0.556	70	
7440-47-3	Chromium	32.0	32.8	7.71	35.6	32.3	60.3	50.5	24.7	100	
7439-92-1	Lead	40.0	35.4	2.80	29.6	25.9	32.3	30.7	13.7	200	
7440-02-0	Nickel	52.2	61.9	4.15	25.4	25.6	41.3	41.2	52.9	600	
7782-49-2	Selenium	<1.60	<1.65	<1.48	<1.56	<1.70	<1.71	<1.58	<1.67	400	
7440-22-4	Silver	<3.20	<3.30	<2.95	<3.13	<3.41	<3.42	<3.15	<3.33	100	
7440-28-0	Thallium	<3.20	<3.30	<2.95	<3.13	<3.41	<3.42	<3.15	<3.33	8	
7440-62-2	Vanadium	33.5	29.4	7.97	33.9	29.7	23.6	24.2	23.4	400	
7440-66-6	Zinc	56.6	57.7	7.36	44.5	38.6	66.2	62.2	64.5	1000	
7440-39-3	Barium	24.6	26.8	16.4	37.3	33.3	32.1	26.2	27.9	1000	
RCRA Metals - SW846 7471B (mg/kg)											
7439-97-6	Mercury	0.0764	0.0655	<0.0337	0.0650	0.0583	0.541	0.471	<0.0305	20	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014
** MassDEP also collectd soil samples for laboratory analysis

Environmental & Construction Management Services, Inc.

TABLE 7

SUMMARY OF MASSDEP COLLECTED BACKGROUND SOIL SAMPLES FOR ARSENIC AND LEAD

Cashman School & Woodsom Farm Property
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		DEP S-1 Little League Field	DEP S-2 Little League Field	DEP S-3 Background	DEP S-4 Background	MassDEP Reportable Concentrations	MassDEP Imminent Hazard
Laboratory ID		L2033028-01	L2033028-02	L2033028-03	L2033028-04		
Sample Date		8/12/2020	8/12/2020	8/12/2020	8/12/2020		
Sample Location		Little League Field	Background-Woods	Background	Background	RCS-1	
Sample Depth		0-6"	12"	18-24"	14-18"	(mg/kg)	
SM2540 G (11) Mod. (%)							
solids	% Solids	97	94	90	94	NA	
Metals - SW846 6010C (mg/kg)							
7440-38-2	Arsenic	**46.1**	**45.2**	**57.3**	**66.6**	20	40
7439-92-1	Lead	14.2	10.9	38.8	29.5	200	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014
** MassDEP collected and Alpha Analytical analyzed the above soil samples for laboratory analysis

Environmental & Construction Management Services, Inc.

TABLE 8

SUMMARY OF GZA GEOTECHNICAL SOIL BORING SAMPLE ANALYSIS FOR ARSENIC

Cashman School Property
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location Laboratory ID Sample Date Sample Location Sample Depth		GZA-10 S-1 SC59573-01 3-Jan-20 Packer Field 0-2'	GZA-10 S-3 SC59573-02 3-Jan-20 Packer Field 4-6'	GZA-10 S-4 SC59573-03 3-Jan-20 Packer Field 9-11'	GZA-6 S-1 SC59573-04 3-Jan-20 Packer Field 0-2'	GZA-6 S-3A SC59573-05 3-Jan-20 Packer Field 5' 9" - 6'	GZA-6 S-4 SC59573-06 3-Jan-20 Packer Field 9-11'	GZA-7 S-1 SC59573-07 14-Dec-19 Packer Field 0-2'	MassDEP Reportable Concentrations RCS-1 (mg/kg)	MassDEP Imminent Hazard
SM2540 G (11) Mod. (%)										
solids	% Solids	84.5	89.1	89.8	89.7	87.3	89.3	84.9	NA	
Metals - SW846 6010C (mg/kg)										
7440-38-2	**Arsenic**	**21.8**	**49.8**	**40**	**67.6**	**46.7**	**38.3**	**60.8**	**20**	**40**

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014
** Note these samples exceeded their holding times and are only meant for comparative purposes.

Environmental & Construction Management Services, Inc.

TABLE 8

SUMMARY OF GZA GEOTECHNICAL SOIL BORING SAMPLE ANALYSIS FOR ARSENIC

Cashman School Property
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		GZA-7 S-2	GZA-7 S-4	GZA-8 S-1	GZA-8 S-3	GZA-8 S-4	GZA-9 S-1B	GZA-9 S-3	MassDEP Reportable Concentrations RCS-1 (mg/kg)	MassDEP Imminent Hazard
Laboratory ID		**SC59573-08**	**SC59573-09**	**SC59573-10**	**SC59573-11**	**SC59573-12**	**SC59573-13**	**SC59573-14**		
Sample Date		**14-Dec-19**	**14-Dec-19**	**3-Jan-20**	**3-Jan-20**	**3-Jan-20**	**3-Jan-20**	**3-Jan-20**		
Sample Location		**Packer Field**	**Packer Field**	**Packer Field**	**Packer Field**	**Packer Field**	**Packer Field**	**Packer Field**		
Sample Depth		**2-4'**	**9-11'**	**0-2'**	**4-6'**	**9-11'**	**1' 3" - 2'**	**4-6'**		
SM2540 G (11) Mod. (%)										
solids	% Solids	85.8	85.6	76.3	87.5	90	88.1	86.9	NA	
Metals - SW846 6010C (mg/kg)										
7440-38-2	**Arsenic**	**34.9**	**86**	**45.2**	**65.7**	**30.6**	**77.2**	**77.5**	**20**	**40**

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014
** Note these samples exceeded their holding times and are only meant for comparative purposes.

Environmental & Construction Management Services, Inc.

APPENDIX C

SAFETY MEETING LOG

SAFETY MEETING LOG

Printed Name	Company	Date	Signature

APPENDIX D

MEDICAL DATA SHEET

ON SITE MEDICAL MONITORING

Site Safety Officer: _____ Date: _____

Outdoor Temperature: _____

Weather Conditions: _____

Outdoor Action Levels

Activity Level	Temperature
Light Activity	85º F WBGT
Moderate Activity	82º F WBGT
Heavy	79º F WBGT
Very Heavy	77º F WBGT
Impermeable Clothes	70º F WBGT

Summary of Heat Stress Measurement Guidelines

Vital Sign	Worker Removal Point	Return to Work Point
Pulse rate	> 85% of AAMHR, or > 110 beats per min. at rest	< 90 beats per min. and < 105% of baseline
Body Temp	> 100.4 ºF	Within 0.5 ºF of normal

Name	Company	Time	Pulse	Timpanic Temp.	AAMHR (220-Age)	Action Taken

APPENDIX E

AIR MONITORING LOG

AIR MONITORING LOG

Operator: _____ Date: _____

Photoionization Detector: _____

Calibration Std: _____

Multi-Gas Meter: _____

Calibration Std: _____

Dust Monitor: Meter: _____

Calibration Std: _____

Action Levels	
TOV	>1 ppmv for 15 minutes
O2	< 19.5 or > 22
LEL	NA
CO	NA
PM10	0.02 mg/m^3 in breathing zone 0.05 mg/m3 at fence line

Time	TOV (ppmv)	% O2	% LEL	CO ppm	HS ppm	Dust (PM10)	Action Taken

APPENDIX F

EXPOSURE/RISK CALCULATIONS

Calculation of Inhalable Soil Particle Action Levels

Cashman and New Amesbury Elementary School
Amesbury, Massachusetts

Construction Worker Exposure in Breathing Zone

Non-cancer Endpoint

Exposure pathway	Assumed Particulate Matter (PM_{10}) Air Concentration [1] $\mu g/m^3$	Calculated HI at Assumed PM_{10} Concentration [1] (unitless)	Percent of Total HI	Total Target HI	Pathway-Specific Target HI	Target PM_{10} [2] $\mu g/m^3$	Target PM_{10} mg/m^3
Inhalation of Entrained Soil Particles	60	0.57	96.7%	0.2	0.19	20	0.02
Ingestion of Inhaled, Entrained Soil Particles	60	0.02	3.3%	0.2	0.01	20	
Total Hazard Index		0.59					

Cancer Endpoint

Exposure pathway	Assumed Particulate Matter (PM_{10}) Air Concentration [1] $\mu g/m^3$	Calculated Risk at Assumed PM_{10} Concentration [1] (unitless)	Percent of Total Risk Level	Target Cancer Risk	Pathway-Specific Target Risk	Target PM_{10} [2] $\mu g/m^3$	Target PM_{10} mg/m^3
Inhalation of Entrained Soil Particles	60	2E-07	77%	1.0E-06	7.7E-07	191	0.2
Ingestion of Inhaled, Entrained Soil Particles	60	7E-08	23%	1.0E-06	2.3E-07	191	
Total Risk		3E-07					

Selected PM_{10} Action Level	**0.02**	**mg/m^3**

$\mu g/m^3$ Micrograms per cubic meter
mg/m^3 Milligrams per cubic meter
1. From the associated risk calculations.
2. [Pathway-specific Target HI or Risk x Assumed PM_{10}]/Calculated HI or Risk

Calculation of Inhalable Soil Particle Action Levels

Cashman and New Amesbury Elementary School
Amesbury, Massachusetts

Residential Exposure at Fence line

Non-cancer Endpoint

Exposure pathway	Assumed Particulate Matter (PM_{10}) Air Concentration [1] $\mu g/m^3$	Calculated HI at Assumed PM_{10} Concentration [1] (unitless)	Percent of Total HI	Total Target HI	Target PM_{10} [2] $\mu g/m^3$	Target PM_{10} mg/m^3
Inhalation of Entrained Soil Particles	60	0.26	100%	0.2	45	0.05

Cancer Endpoint

Exposure pathway	Assumed Particulate Matter (PM_{10}) Air Concentration [1] $\mu g/m^3$	Calculated Risk at Assumed PM_{10} Concentration [1] (unitless)	Percent of Total Risk Level	Target Cancer Risk	Target PM_{10} [2] $\mu g/m^3$	Target PM_{10} mg/m^3
Inhalation of Entrained Soil Particles	60	1E-07	100%	1.0E-06	537	0.54

Selected PM_{10} Action Level	**0.05**	**mg/m^3**

$\mu g/m^3$ Micrograms per cubic meter
mg/m^3 Milligrams per cubic meter

1. From the associated risk calculations.
2. [Total Target HI or Risk x Assumed PM_{10}]/Calculated HI or Risk

Calculation of Inhalable Soil Particle Action Levels
Cashman and New Amesbury Elementary School
Amesbury, Massachusetts

Construction Worker Inhalation of Entrained Soil Particles

$$ADE = \frac{C_{soil} \times FI \times PM_{10} \times IH_W \times RAFi \times EF \times ED \times EP \times CF1 \times CF2}{AP \times IH_A}$$

HQ = ADE(nc) / RfCs
HI = Sum [HQ]
Risk = ADE(ca) x UR

ADE = Average daily exposure (mg/m^3) (nc = noncarcinogen; ca = carcinogen)
C_{soil} = Constituent concentration in soil (mg/kg)
FI = Fraction inhaled that is retained in lungs (unitless)
PM_{10} = Particulate matter concentration in air (</= 10 microns) (µg/m^3)
IH_W = Worker inhalation rate (L/min)
RAFi = Inhalation Relative absorption fraction (unitless
EF = Exposure frequency (events/yr
ED = Exposure duration (hr/event)
EP = Exposure period (yr)

CF1 = Unit conversion factor [(min-kg-m^3)/(hr-ug-L)]
CF2 = Unit conversion factor (yr/dy)
IH_A = Assumed inhalation rate (m^3/dy)
AP = Averaging period (dy)
RfCs = Subchronic reference concentration (mg/m^3)
HQ = Non-carcinogenic Hazard Quotient (unitless)
HI = Total Hazard Index (unitless)
Risk = Excess lifetime cancer risk (unitless)
UR = Cancer inhalation unit risk [(mg/m^3)$^{-1}$]

Constituent	C_{soil} (mg/kg)	FI (unitless)	PM_{10} (µg/m^3)	IH_W (L/min)	RAFi (unitless)	EF (events/yr)	ED (hr/event)	EP (yr)	CF1 (min-kg-m^3)/(hr-ug-L)	CF2 (yr/dy)	IH_A (m^3/dy)	AP (nc) (yr)	ADE (nc) (mg/m^3)	RfCs (mg/m^3)	HQ (unitless)	AP (ca) (yr)	ADE (ca) (mg/m^3)	UR [(mg/m^3)$^{-1}$]	Risk (unitless)
Arsenic	165	0.5	60	60	1	130	8	1	6.00E-11	2.74E-03	20	0.5	1.10E-05	0.00002	0.6	70	7.89E-08	3	2E-07
Total												**HI =**			**0.6**				**2E-07**

Calculation of Inhalable Soil Particle Action Levels

Cashman and New Amesbury Elementary School
Amesbury, Massachusetts

Construction Worker Ingestion of Inhaled, Entrained Soil Particles

$$ADD = \frac{C_{soil} \times FI \times PM_{10} \times IH_W \times RAFo \times EF \times ED \times EP \times CF1 \times CF2}{BW \times AP}$$

HQ = ADD(nc)/RfDs
HI = Sum [HQ]
Risk = ADD (ca) x SF

ADD = Average daily dose (mg/kg-dy) (nc = non-carcinogens; ca = carcinogens)
C_{soil} = Constituent concentration in soil (mg/kg)
FI = Fraction inhaled that is ingested (unitless)
PM_{10} = Particulate matter concentration in air (</= 10 microns) (µg/m^3)
IH_W = Worker inhalation rate (L/min)
RAFo = Relative absorption fraction (unitless)
EF = Exposure frequency (events/yr)
ED = Exposure duration (hr/event)
EP = Exposure period (yr)
CF1 = Unit conversion factor [(min-kg-m^3)/(hr-ug-L)]
CF2 = Unit conversion factor (yr/dy)
BW = Body weight (kg)
AP = Averaging period (yr)
HQ = Non-carcinogenic Hazard Quotient (unitless)
RfDs = Subchronic Reference Dose (mg/kg-dy)
HI = Total Hazard Index (unitless)
Risk = Excess lifetime cancer risk (unitless)
SF = Oral cancer slope factor [(mg/kg-dy)$^{-1}$]

Constituent	C_{soil} (mg/kg)	FI (unitless)	PM_{10} (µg/m^3)	IH_W (L/min)	RAFo (unitless)	EF (events/yr)	ED (hr/event)	EP (yr)	CF1 [(min-kg-m^3)/(hr-ug-L)]	CF2 (yr/dy)	BW (kg)	AP (nc) (yr)	ADD (nc) (mg/kg-dy)	RfDs (mg/kg-dy)	HQ (unitless)	AP (ca) (yr)	ADD (ca) (mg/kg-dy)	SF [(mg/kg-dy)$^{-1}$]	Risk (unitless)
Arsenic	165	1.5	60	60	0.5	130	8	1	6.00E-11	2.74E-03	58.7	0.5	5.65E-06	0.0003	0.02	70	4.03E-08	1.8	7E-08
Total												**HI =**			**0.02**				**7E-08**

Calculation of Inhalable Soil Particle Action Levels
Penn Brook School, Georgetown, Massachusetts

Residential Inhalation of Entrained Soil Particles

$$C_{AIR} = C_{soil} \times PM_{10} \times CF1 \frac{C_{AIR}}{}$$

$$ADE = \frac{\underline{x\ EF \times ED \times EP \times CF2}}{AP}$$

HQ = ADE(nc) / RfCs
HI = Sum [HQ]
Risk = ADE(ca) x UR

ADE =	Average daily exposure (mg/m^3) (nc = noncarcinogen; ca = carcinogen	RfCs =	Subchronic reference concentration (mg/m^3)
C_{soil} =	Constituent concentration in soil (mg/kg	HQ =	Non-carcinogenic Hazard Quotient (unitless
PM_{10} =	Particulate matter concentration in air (</= 10 microns) ($\mu g/m^3$)	HI =	Total Hazard Index (unitless)
CF1 =	Unit conversion factor (µg/kg)	Risk =	Excess lifetime cancer risk (unitless
EF =	Exposure frequency (events/yr)	UR =	Cancer inhalation unit risk [$(mg/m^3)^{-1}$]
ED =	Exposure duration (hr/event)		
EP =	Exposure period (yr)		
CF2 =	Unit conversion factor (yr/dy)		
AP =	Averaging period (dy)		

Constituent	C_{soil} (mg/kg)	PM_{10} ($\mu g/m^3$)	CF1 (µg/kg)	C_{air} (mg/m^3)	EF (events/yr)	ED (hr/event)	EP (yr)	CF2 (yr/hr)	AP (nc) (yr)	ADE (nc) (mg/m^3)	RfCs (mg/m^3)	HQ (unitless)	AP (ca) (yr)	ADE (ca) (mg/m^3)	UR [$(mg/m^3)^{-1}$]	Risk (unitless)
Arsenic	165	60	1.00E-09	2.15E-05	130	8	1	1.14E-04	0.5	5.11E-06	0.00002	0.3	70	3.65E-08	3	1E-07
Total									**HI =**			**0.3**				**1E-07**

Calculation of Inhalable Soil Particle Action Levels

Cashman and New Amesbury Elementary School,
Amesbury, Massachusetts

Constituent Factors

Constituent	Soil Exposure Point Concentrations C_S	Carcinogenic Weight of Evidence Category [1]	Subchronic Oral Reference Dose (RfDs)	Subchronic Inhalation Reference Concentration (RfCs)	Oral Cancer Slope Factor (SF)	Inhalation Cancer Unit Risk (UR)	Soil Oral Relative Absorption Factor [2] (RAFo)
Arsenic	359	A	0.0003 [2]	0.00002 [2]	1.5 [2]	3 [2]	0.5

1. U.S. EPA's Weight of Evidence Category with respect to human carcinogenicity:
   A = known human carcinogen
   B1/B2 = probable human carcinogen
   C = possible human carcinogen
   D = not classifiable as to human carcinogenicity.
2. MassDEP (2013) Method 1 Numerical Standards and Supporting Documentation (proposed revision).

APPENDIX G

SIGN IN/SIGN OUT LOG

SIGN IN / SIGN OUT LOG

Printed Name	Date	Sign In Time	Sign Out Time

APPENDIX H

HEALTH & SAFETY FORMS

SAFETY INSPECTION CHECKLIST

Job Name		Date	
Location		Name of Inspector	
Job #		Supervisor	
		Project Manager	
		Director	

	O.K.	Need Attn.	N/A		O.K.	Need Attn.	N/A	NOTES
1. GENERAL SAFETY AND HEALTH				**11. CRANES, DERRICKS, HOISTS**				
Housekeeping	☐	☐	☐	Operator licensed	☐	☐	☐	
Medical Service / Sanitation	☐	☐	☐	Inspection Certificate	☐	☐	☐	
Gases, Fumes, Mists	☐	☐	☐	Other	☐	☐		
Standard Signs & Posters	☐	☐	☐	**12. MECHANICAL EQUIPMENT or VEHICLES**				
OSHA Book	☐	☐	☐	Back-up Alarms	☐	☐	☐	
Pike Manual	☐	☐	☐	Fire Extinguisher	☐	☐	☐	
MSCS Book	☐	☐	☐	Seat Belts in use	☐	☐	☐	
Other	☐	☐		Unobstructed Windshields and Vision	☐	☐	☐	
2. PERSONAL PROTECTIVE EQUIPMENT				Other	☐	☐		
Hard Hat / Safety Glasses	☐	☐	☐	**13. EXCAVATIONS (Competent Person)**				
Respirators/Hearing Protection as needed	☐	☐	☐	Daily Inspection	☐	☐	☐	
Gloves	☐	☐	☐	Shored / Sloped	☐	☐	☐	
Other	☐	☐		Access - Ladders, Ramps, Steps	☐	☐	☐	
3. FIRE PROTECTION				Other	☐	☐		
Extinguishers	☐	☐	☐	**14. CONCRETE AND MASONRY**				
Flammable Liquids / Gases	☐	☐	☐	Walls braced	☐	☐	☐	
Temporary Heating Devices	☐	☐	☐	Silica Dust / Respirators	☐	☐	☐	
Other	☐	☐		Ergonomic Set Up of Workstation	☐	☐	☐	
4. SIGNS, SIGNALS, BARRICADES				Other	☐	☐		
Caution / Danger Signs	☐	☐	☐	**15. STEEL ERECTION**				
Barricade Tape	☐	☐	☐	Fall Protection	☐	☐	☐	
Other	☐	☐		Erection Controlled Zones	☐	☐	☐	
5. MATERIAL HANDLING				Other	☐	☐		
Proper Lifting Techniques	☐	☐	☐	**16. DEMOLITION**				
Proper Storage	☐	☐	☐	Proper PPE	☐	☐	☐	
Material Handling Equipment	☐	☐	☐	Barricades	☐	☐	☐	
Other	☐	☐		Housekeeping	☐	☐	☐	
6. TOOLS - HAND AND POWER				Other	☐	☐		
Guards in place	☐	☐	☐	**17. ROLLOVER PROTECTION**				
Good Condition	☐	☐	☐	ROPS in Place	☐	☐	☐	
Other	☐	☐		Rollover Over Soil Conditions Controlled	☐	☐	☐	
7. WELDING AND CUTTING				Other	☐	☐		
Tank Storage	☐	☐	☐	**18. STAIRWAYS AND LADDERS**				
Welding Curtain	☐	☐	☐	Handrails on Stairs	☐	☐	☐	
Fire Prevention	☐	☐	☐	Ladder Tied Off	☐	☐	☐	
Other	☐	☐		Extends 36" Above Landing	☐	☐	☐	
8. Electrical				Other	☐	☐		
GFCI in use	☐	☐	☐	**19. JOB SITE SPECIFIC EXPOSURES**	☐	☐	☐	
Cords in good condition	☐	☐	☐	**20. JTA's**	☐	☐	☐	
Missing Ground Prongs	☐	☐	☐	**TOOL BOX TALKS**	☐	☐	☐	
Other	☐	☐		**WEEKLY INSPECTIONS**	☐	☐	☐	
9. SCAFFOLDS (competent person)				**21. EMERGENCY MANAGEMENT PLAN**				
Tied to Building	☐	☐	☐	AIR Accident Injury Report	☐	☐	☐	
Braces & Guardrails	☐	☐	☐	Dry Run to Medical Facility by Supertndnt.	☐	☐	☐	
Fully Planked	☐	☐	☐	**22. FIRE EMERGENCY PLAN**	☐	☐	☐	
Other	☐	☐		**23. EMPLOYEE ORIENTATION PACKET**	☐	☐	☐	
10. FALL PROTECTION								
Proper tie off point	☐	☐	☐					
Equipment in good condition	☐	☐	☐					
Guardrails	☐	☐	☐					
Other	☐	☐						

USE THE BACK OF THIS FORM TO IDENTIFY THOSE AREAS THAT NEED ATTENTION AND WHAT WAS DONE TO ABATE THE EXPOSURE.

SAFETY INSPECTION CHECKLIST

Job Name		Date	
Location		Name of Inspector	
Job #		Supervisor	
		Project Manager	
		Director	

	O.K.	Need Attn.	N/A		O.K.	Need Attn.	N/A	NOTES
1. GENERAL SAFETY AND HEALTH				**11. CRANES, DERRICKS, HOISTS**				
Housekeeping	☐	☐	☐	Operator licensed	☐	☐	☐	
Medical Service / Sanitation	☐	☐	☐	Inspection Certificate	☐	☐	☐	
Gases, Fumes, Mists	☐	☐	☐	Other	☐	☐		
Standard Signs & Posters	☐	☐	☐	**12. MECHANICAL EQUIPMENT or VEHICLES**				
OSHA Book	☐	☐	☐	Back-up Alarms	☐	☐	☐	
Pike Manual	☐	☐	☐	Fire Extinguisher	☐	☐	☐	
MSCS Book	☐	☐	☐	Seat Belts in use	☐	☐	☐	
Other	☐	☐		Unobstructed Windshields and Vision	☐	☐	☐	
2. PERSONAL PROTECTIVE EQUIPMENT				Other	☐	☐		
Hard Hat / Safety Glasses	☐	☐	☐	**13. EXCAVATIONS (Competent Person)**				
Respirators/Hearing Protection as needed	☐	☐	☐	Daily Inspection	☐	☐	☐	
Gloves	☐	☐	☐	Shored / Sloped	☐	☐	☐	
Other	☐	☐		Access - Ladders, Ramps, Steps	☐	☐	☐	
3. FIRE PROTECTION				Other	☐	☐		
Extinguishers	☐	☐	☐	**14. CONCRETE AND MASONRY**				
Flammable Liquids / Gases	☐	☐	☐	Walls braced	☐	☐	☐	
Temporary Heating Devices	☐	☐	☐	Silica Dust / Respirators	☐	☐	☐	
Other	☐	☐		Ergonomic Set Up of Workstation	☐	☐	☐	
4. SIGNS, SIGNALS, BARRICADES				Other	☐	☐		
Caution / Danger Signs	☐	☐	☐	**15. STEEL ERECTION**				
Barricade Tape	☐	☐	☐	Fall Protection	☐	☐	☐	
Other	☐	☐		Erection Controlled Zones	☐	☐	☐	
5. MATERIAL HANDLING				Other	☐	☐		
Proper Lifting Techniques	☐	☐	☐	**16. DEMOLITION**				
Proper Storage	☐	☐	☐	Proper PPE	☐	☐	☐	
Material Handling Equipment	☐	☐	☐	Barricades	☐	☐	☐	
Other	☐	☐		Housekeeping	☐	☐	☐	
6. TOOLS - HAND AND POWER				Other	☐	☐		
Guards in place	☐	☐	☐	**17. ROLLOVER PROTECTION**				
Good Condition	☐	☐	☐	ROPS in Place	☐	☐	☐	
Other	☐	☐		Rollover Over Soil Conditions Controlled	☐	☐	☐	
7. WELDING AND CUTTING				Other	☐	☐		
Tank Storage	☐	☐	☐	**18. STAIRWAYS AND LADDERS**				
Welding Curtain	☐	☐	☐	Handrails on Stairs	☐	☐	☐	
Fire Prevention	☐	☐	☐	Ladder Tied Off	☐	☐	☐	
Other	☐	☐		Extends 36" Above Landing	☐	☐	☐	
8. Electrical				Other	☐	☐		
GFCI in use	☐	☐	☐	**19. JOB SITE SPECIFIC EXPOSURES**	☐	☐	☐	
Cords in good condition	☐	☐	☐	**20. JTA's**	☐	☐	☐	
Missing Ground Prongs	☐	☐	☐	**TOOL BOX TALKS**	☐	☐	☐	
Other	☐	☐		**WEEKLY INSPECTIONS**	☐	☐	☐	
9. SCAFFOLDS (competent person)				**21. EMERGENCY MANAGEMENT PLAN**				
Tied to Building	☐	☐	☐	AIR Accident Injury Report	☐	☐	☐	
Braces & Guardrails	☐	☐	☐	Dry Run to Medical Facility by Supertndnt.	☐	☐	☐	
Fully Planked	☐	☐	☐	**22. FIRE EMERGENCY PLAN**	☐	☐	☐	
Other	☐	☐		**23. EMPLOYEE ORIENTATION PACKET**	☐	☐	☐	
10. FALL PROTECTION								
Proper tie off point	☐	☐	☐					
Equipment in good condition	☐	☐	☐					
Guardrails	☐	☐	☐					
Other	☐	☐						

USE THE BACK OF THIS FORM TO IDENTIFY THOSE AREAS THAT NEED ATTENTION AND WHAT WAS DONE TO ABATE THE EXPOSURE.

APPENDIX I

INCIDENT REPORT FORM

INCIDENT REPORT

Person reporting incident: _____ Date Incident Reported: _____

Was supervisor notified? Yes No Date of Incident: _____

Name of Supervisor: _____ Time of Incident: _____

Claimant Information: _____

Name of Person or Company

Address: _____

(address/job site) (city) (state) (zip code)

Phone: _____

(day) (evening) (other)

Location of Incident: _____

(address/job site) (city) (state) (zip code)

Describe fully how incident occurred: _____

Was there equipment or property involved? Yes _____ No _____

Describe property: _____

Describe other property: _____

(if other property is a vehicle, we will need the year, make, license number of that vehicle & any pertinent information)

Were there any injuries? Yes _____ No _____

If yes, name of injured person: _____

Describe Injuries: _____

Initial Treatment (check those that apply): No Medical Treatment _____

Care provided by person on site _____ Emergency Care _____ Hospitalized _____

Other (outpatient) _____ Clinic _____ Office Visit _____

If "other", please explain: _____

Name of Treating Physician: _____

Name of Treating Hospital: _____

Was injured an employee? Yes No (If yes, a First Report of Injury must be completed)

Name of Witness	**Address**	**Phone #**
None		

Other Information:

Person Completing Report: _____ Date: _____

Signature: _____

APPENDIX J

EMERGENCY CONTACT PERSONNEL LIST

EMERGENCY CONTACT LIST

POLICE, AMBULANCE, FIRE, HOSPITAL **911**

Amesbury Police Department .(Non-emergency)..... (978) 388-1212

Amesbury Fire Department . (Non-emergency)..... (978) 338-1333

Ambulance, Assist Inc. ..... (978) 685-8767

Occupational Health Provider (Occupation Health Associates, Inc.)..... (978) 388-3148

Hospital (Ana Jacques Hospital) ..... (978) 463-1000

Massachusetts Department of Environmental Protection (MassDEP) ..... (888) 304-1133

EPA National Response Center ..... (800) 424-8802

NIOSH Technical Information Line ..... (800) 232-4636

Centers for Disease Control PPE HotLine..... (888) 654-2294

Chemtrec..... (800) 262-8200

Poison Control Center..... (800) 222-1222

Massachusetts Office of Emergency Management ..... (508) 820-2000

RCRA Hotline..... (800) 424-9346

TSCA Hotline ..... (202) 554-1404

ATSDR (daytime)..... (800) 232-4636

ATF (explosives) ..... (800) 800-3855

DiNisco Design…(Project Architect)..... (617) 426-2858

NV5 Owner's Project Manager (OPM)..... (617) 744.3115

ECMS, Inc..... (617) 338-2121

Kevin Kavanaugh, LSP, CHMM ..... (617) 338-2121 (office)
(617) 212-9255 (cell)

General Contractor..... TBD

SECTION 312219

FINISH GRADING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Execute finish grades complete, as shown on the Drawings, and as specified herein.

1.03 RELATED WORK

A. The following related work is to be performed under the designated Sections.

1. Earthwork - Section 312000
2. Site Concrete - Section 321313
3. Bituminous Concrete Pedestrian – Section 321800
4. Playground Safety Surfacing – Section 321810
5. Miscellaneous Site Improvements - Section 323000
6. Fencing – Section 323100
7. Irrigation – Section 328400
8. Planting - Section 329000
9. Soil Preparation - Section 329113
10. Lawns and Grasses – Section 329200
11. Electrical – Section 260001

1.04 PROJECT/SITE CONDITIONS

A. Dust Nuisance: Assume full responsibility for alleviation or prevention of dust as a result of grading work.

1.05 SEQUENCING AND SCHEDULING

A. Regrade as required to finish grades and to the satisfaction of the Landscape Architect.

1.06 REFERENCES

A. The Commonwealth of Massachusetts, 521 CMR, Architectural Access Board, Current Addition.

B. 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010.

1.07 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 013300 – Submittals.

B. Quality Control: Review drawings and field conditions for conformance to current 521 CMR Architectural Access Board and ADA Standards for Accessible Design requirements and submit a plan drawing indicating areas that do not meet the current code.

1.08 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.09 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architects designated representative.

PART 2 PRODUCTS

2.01 EQUIPMENT: At Sub-Contractor's option.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that the following items have been completed prior to commencement of finish grading:

1. Installation of the topsoil and all soil preparation including debris removal.
2. Incorporation of soil amendments (as required by the Soil Testing Laboratory Report) and as otherwise specified.

3.02 INSTALLATION

A. Paved Area Finish Grading

1. Provide finish grading as shown on the Drawings and as specified.
2. Cross-slopes of all walkways, accessible routes, play areas, plazas, sidewalks and areas with multiple walking desire lines shall be graded at a maximum of 2%.
3. All sidewalks and walkways shall be installed at a maximum grade of 5%.
4. All ramps shall be installed at a maximum grade of 8.3% or 1:12.

B. Miscellaneous items and materials such as but not limited to area drains, site lighting, walks, walls, curbs, tree grate frames, fencing and gates, and trash receptacles shall relate to the adjacent finish grade surfaces as shown on the drawings and as specified.

C. Finish Landscape Grading

1. Provide all grading as shown on the Drawings and as specified.
2. Provide all grades for natural runoff of water without low spots or pockets. Accurately set flow line grades at 2% minimum gradient unless otherwise noted in Drawings.
3. Finish grade all mulch areas, plant beds, lawn and sod areas by hand raking. Finish grades shall be smooth, even and on a uniform plane with no abrupt changes of surface. Slope uniformly between given spot elevations, unless otherwise shown on drawings.
4. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given, or between points established by walks, paving, curbs or catch basins.
5. Tops and toes of all slopes shall be rounded to produce a gradual and natural appearing transition between relatively level areas and slopes.

D. Tolerances:

1. All planting areas, including lawn areas, shall be true to grade within (1) inch when tested with a (5) foot straightedge.

2. Hold finished grades of Amended topsoil and backfill mixes below top of adjacent pavement, headers, curbs, or walls as follows:

   a. Trees, Shrub, Annual, Perennial and Groundcover Areas: (1) inch.

   b. Seeded Lawn Areas: Flush.

   c. Sodded Lawn: (1) inch.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.01 GENERAL

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements (if any), apply to the work specified in this Section.

B. Provide facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section, and as shown on the Drawings.

C. Examine all Drawings and all Sections of the Specifications for requirements and provisions affecting the work of this Section.

D. Coordinate work with that of all other trades or Contracts affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK

A. This Section specifies the designing, furnishing, installing, maintaining, operating and removing of complete temporary dewatering systems of sumps, wells, well points or combinations thereof, as required to lower and control groundwater levels such that all work is performed in the dry and provide a stable subgrade during construction, and disposing of pumped water.

B. Pumped water may be discharged back into the ground on site provided the water does not overflow the pits and/or cause damage to adjacent utilities or structures, and the constraints described herein are followed. Alternatively, water may be discharged to dedicated storm drain lines provided water meets the acceptable permit discharge criteria and local permit requirements. Petroleum-impacted groundwater, if encountered, shall be treated prior to discharge back into the ground, or to the storm drain system.

C. Pumped water discharged to dedicated storm drain lines shall be discharged accordance with federal, state and/or local discharge permits, which may require period testing of the discharge. **The Contractor is responsible for all permits required for construction dewatering. The Contractor shall be responsible for treatment of water, if necessary, to meet minimum discharge criteria specified in the permit(s).**

D. Definitions:

1. Dewatering includes lowering the water table within the excavation and intercepting seepage which would otherwise emerge from the faces or bottom of the excavation.

1.03 RELATED WORK SPECIFIED ELSEWHERE

1. SECTION 312000 – Earthwork
2. SECTION 315000 – Excavation Support and Protection

1.04 DESIGN CRITERIA

A. The Contractor is responsible for the design and adequacy of the Dewatering systems. Dewatering systems shall be designed to:

1. Provide labor, materials and equipment necessary to lower and continuously maintain the groundwater level a minimum of 1 foot (1') below the base level of all excavations.
2. Enable all work to be conducted in the dry and to protect bearing surfaces from disturbance. Avoid standing water on subgrades as it could cause the subgrade to become softened/disturbed. Excavation and replacement of softened/disturbed subgrade because of inadequate dewatering shall be performed by the Contractor at no additional expense to the Owner.
3. Avoid damage to adjacent properties, buildings, structures, utilities, and other work.
4. Provide sedimentation basin(s), tank(s), or other filters as necessary to remove total suspended solids as prior to disposing of water into storm drain.
5. Prevent migration of soil particles into the dewatering system after thirty (30) minutes of initial pumping by use of filter fabric or graded filter material.

   The Contractor shall be required to limit Total Suspended Solids ("TSS") concentrations in effluent water to levels stated in state, federal and local permits and regulations, as determined by laboratory testing performed by the Owner. In absence of permit requirements or existing regulations, limit TSS concentration to 30 milligrams/liter (mg/L).
6. Provide emergency back-up power system and back-up dewatering equipment and components so as to maintain continuous and complete effectiveness of the dewatering system at all times as necessary to protect the work.
7. Discharge water from all dewatering operations shall be routed directly into sedimentation tank(s) prior to final discharge.

B. The Contractor shall obtain and maintain all required local, state and federal permits for the duration of dewatering activities. The Contractor shall be responsible for treatment of water, as necessary, to meet minimum discharge criteria specified in the permits.

1.05 SUBMITTALS

A. Prior to commencing dewatering, the Contractor shall submit the following for review by the Architect at least two (2) weeks prior to initiating dewatering.

1. The proposed type of dewatering system, shown on a site plan depicting the arrangement, location and depths of the proposed system components, with the excavation in a dewatered condition;
2. A description of the equipment and materials to be used, with installation, operation, maintenance and abandonment procedures;
3. Types and sizes of filters and sedimentation basins;
4. Location and size of pumps and discharge lines, including their relation to water disposal sites;
5. Method of controlling discharges to satisfy all construction and disposal permits;
6. Details of mitigating measures to be implemented in the event that specified water quality criteria of the discharge is exceeded, particularly with respect to Total Suspended Solids and contaminant concentrations.

B. Review of the dewatering system by the Architect or its representative will not relieve the Contractor from the responsibility for the adequacy of the dewatering system to achieve the required results and all permit requirements.

1.06 PROJECT CONDITIONS

A. Repair damage, disruption or interference to existing properties, buildings, structures, utilities and other work resulting directly or indirectly from operations conducted under this Contract, losses of ground due to incompletely drained soils, or removal of soil particles in the discharge from dewatering operations, at no cost to the Owner and to the satisfaction of the Geotechnical Engineer.

B. Prevent flow of surface water into the excavations by use of bituminous berms, dikes, ditches, pipes, sumps, or other means.

C. Refer to SECTION 312000 - EARTHWORK and available exploration logs, groundwater level data and laboratory data.

D. By submitting a Bid, the Contractor affirms that the site and all conditions affecting the work under this Section have been carefully examined. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation at the site.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide materials and equipment suitable for the intended purposes and adequate to reliably meet the specified performance requirements and permit requirements.

B. For utility connections, materials and equipment shall comply with the applicable construction standards of the affected utility.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor's attention is directed to the groundwater elevations indicated on the boring and test pit logs referenced in SECTION 312000- EARTHWORK. Groundwater levels will normally vary with precipitation and from season to season.

B. The Contractor shall provide, at his own expense, pumping and drainage facilities adequate to keep the excavated area sufficiently dry from groundwater and/or surface runoff and so as not to adversely affect construction procedures or cause excessive disturbance of underlying natural ground. Pumping from inside the excavation will be the only means allowed for removal of groundwater.

C. The groundwater levels shall be maintained a minimum of one foot (1') below the bottom of excavation. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed condition of the subgrade soils at proposed bottom of excavation.

D. When groundwater control is completed, and as directed by the Owner, the Contractor shall remove all parts of the dewatering systems, and shall backfill with clean Granular Fill or grout which results in no remaining voids to prevent loss of ground.

3.02 PROTECTION OF ADJACENT PROPERTY AND STRUCTURES

A. The Contractor shall be required to adequately maintain groundwater levels outside the property limits, as necessary to minimize damage to neighboring structures or utilities.

Lack of direction on the part of the Architect or the Owner's Representative shall not relieve the Contractor of his/her obligation to protect neighboring structures and utilities from damage which is a result of his/her construction activities.

3.03 PROTECTION OF NEW STRUCTURES

A. The Contractor shall provide an emergency back-up power system and back-up dewatering equipment and components so as to maintain continuous and complete effectiveness of the dewatering system as necessary to prevent damage to existing and newly constructed structures.

B. The disposal of all water resulting from pumping shall be arranged so as not to cause damage to adjacent property.

3.04 DISCHARGE QUALITY

A. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc., in order to prevent adverse effects on groundwater quality and discharge.

B. Discharge water from all dewatering operations shall be discharged directly into sedimentation basins prior to final discharge. A sedimentation basin shall be equipped with sorbent boom at the outflow end, with access in the sedimentation discharge line for sampling of dewatering system effluent.

The Contractor shall provide sedimentation basins at locations as necessary and approved by the Owner. The Contractor shall also provide all necessary piping for discharge from the sedimentation basins to the final discharge point as designated by the applicable permits.

If necessary, the Contractor shall provide additional tanks and/or mitigating measures at no cost to the Owner in order to meet discharge quality requirements. The Contractor shall satisfy requirements of all applicable state, federal and local permits and regulations regarding discharge of groundwater.

C. The Contractor is responsible for meeting applicable permit discharge criteria as provided in the authorized RGP.

3.06 DISCHARGE OF PUMPED WATER INTO GROUND

A. Water pumped from within the excavation shall not be discharged to the ground or groundwater outside of the property boundaries. Water shall not be discharged directly into the wetland adjacent to the site.

B. Water discharged to the ground or groundwater on site shall not result in water flowing over exposed subgrade soils or flow on, sidewalks, walkways and/or other property adjacent to site.

END OF SECTION

SECTION 312500

EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Furnish and install the following items required to complete the work of this SECTION as shown on the Contract Drawings and specified herein:

1. Prior to start of construction work, prepare a complete Stormwater Pollution Prevention Plan (SWPPP) per the EPA Guidelines and file a Notice of Intent with the EPA in accordance with the Federal Clean Water Act Requirements For Construction Sites under the NPDES Phase II. The SWPPP shall be submitted for review and approval by the Architect, Owners Project Manager, Amesbury City Engineer and Conservation Commission prior to start of site work. Copies of the Notice of Intent filed with the EPA and the EPA's confirmation response shall be submitted to the above listed entities.
2. Control measures to prevent all erosion, siltation and sedimentation of drainage ways, construction areas, adjacent areas and off-site areas and manage the site in compliance with the NPDES General Permit, the SWPPP and the Wetlands Order of Conditions.
3. Control measures shall be accomplished adjacent to and within all areas of the project site to maintain the project in compliance with all relative permits and approvals.
4. Additional means of protection shall be provided by the Contractor as necessary for continued or unforeseen erosion problems, at no additional cost to the project.
5. Periodic maintenance of all sediment control structures shall be provided to ensure intended purpose is accomplished. Sediment control measures shall be in working condition at the end of each day.
6. The Contractor shall provide a qualified professional civil engineer (PE) or a Certified Professional in Erosion and Sediment Control (CPESC) who shall be approved by the Amesbury Conservation Commission to act as erosion control monitor to oversee compliance with the Wetlands Order of Conditions and the NPDES Construction General Permit. See those permits for additional information.

7. Monitor and inspect the erosion controls on a continual basis and after any significant rainfall in accordance with the EPA Construction General Permit and the Order of Conditions. Inspections shall be for condition, integrity, and functionality. Damaged devices or those not adequate for the intended purposes shall be corrected immediately.

8. Provide permanent stabilization of slopes as specified herein.

1.03 SUBMITTALS

A. The SWPPP shall be submitted to the Architect, Owner's Project Manager, Amesbury City Engineer and Conservation Commission for approval prior to starting site work.

B. Copy of the Notice of Intent Filed with the EPA for coverage under the Construction General Permit shall be submitted to the Architect, Owners Project Manager, Amesbury City Engineer and Conservation Commission for record prior to starting site work.

C. Submittals for all sediment and erosion control products to be utilized on the site.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. The following related work is to be performed under the designated SECTIONS:

1. Soil materials, excavating, backfilling, and site grading and removal of site utilities: SECTION 312000 – EARTHWORK, SECTION 311000 – SITE PREPARATION, SECTION 312219 – FINISH GRADING, and SECTION 312319 – DEWATERING.

1.05 QUALITY ASSURANCE

A. Comply with the requirements of Stormwater Pollution Prevention Plan prepared for the NPDES permit, the Wetlands Order of Conditions, and all other applicable requirements of governing authorities having jurisdiction. The specifications and drawings are not represented as being comprehensive, but rather convey the intent to provide complete site protection and erosion control for both the Owner's and adjacent property.

1. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and wetlands resource areas, according to a sediment and erosion control plan specific to the site that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

B. Erosion control measures shall be established at the beginning of construction and maintained during the entire period of construction. On-site areas that are subject to severe erosion, and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation, are to be identified and receive special attention.

C. All land-disturbance activities are to be planned and conducted to minimize the size of the area to be exposed at any one time, and the length of time of exposure.

D. Surface water runoff originating upgrade of exposed areas should be controlled to reduce erosion and sediment loss during the period of exposure.

E. When the increase in the peak rates and velocity of storm water runoff resulting from a land-disturbing activity is sufficient to cause accelerated erosion of the receiving stream bed or wetlands, provide measures to control both the velocity and rate of release so as to minimize accelerated erosion and increased sedimentation of the stream and wetland resource areas.

F. All land-disturbing activities are to be planned and conducted so as to minimize off-site sedimentation damage.

G. The Contractor is responsible for cleaning out and disposing of all sediment once the storage capacity of any sediment facility is reduced by one-half.

H. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

I. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

J. Protect existing and proposed stormwater management structures from sediment. All proposed new stormwater management structures that recharge and/or infiltrate runoff are particularly sensitive to damage by sediment. Site runoff from unstabilized areas shall not be discharged into any of these facilities until the tributary drainage area is stable or the runoff is treated to be essentially free from sediment to the satisfaction of the Engineer. (Refer to Condition 19 of the Wetlands Order of Conditions).

PART 2 PRODUCTS

2.01 MATERIALS

A. Straw Bales: Wire or nylon bound bales of straw, oriented around sides, rather than over and under.

B. Stakes: Stakes for bales shall be one of the following materials: Wood stakes of sound hardwood 1.5 by 1.5 inches in size or steel reinforcing bars of at least No. 4 size. Lengths shall be approximately three feet.

C. Fiber Logs: Biodegradable fabric sock filled with compost or other material intended to filter stormwater runoff and to trap sediment meeting the City of Amesbury Public Works and Conservation Commission standards. The diameter of the fiber-logs shall be 12 inches minimum unless larger or multiple installations are necessary for the intended function and contributing watershed area.

D. Siltation Fence: Fabricated or prefabricated unit consisting of the following filter fabric properties:

1.	Grab Tensile Strength	90	ASTM D1682
2.	Elongation at Failure (%)	50	ASTM D1682
3.	Mullen Burst Strength (PSI)	190	ASTM D3786
4.	Puncture Strength (lbs)	70	ASTM D751 (modified)
5.	Slurry Flow Rate (gal/min/sf)	0.5	Virginia DOT VTM-51
6.	Equivalent Opening Size	40-80	US Std Sieve CW-02215
7.	Ultraviolet Radiation Stability (%)	90	ASTM G26

E. Protective Measures: As temporary short-term coverings on ground areas subject to erosion, provide one of the following protective measures:

1. Hay or straw temporary mulch, 100 pounds per 1,000 square feet.
2. Wood fiber cellulose temporary mulch, 35 pounds per 1,000 square feet.
3. Tackifier for anchoring mulch or straw shall be a non-petroleum based liquid bonding agent specifically made for anchoring hay or straw.
4. Provide natural (jute, wood excelsior) or man-made (glass fiber) covering with suitable staples or anchors to secure to ground surface. Note that wire stapes and non-biodegradable coverings shall not be used for any area that will be mown turf.
5. Temporary vegetative cover (Mulch) for graded areas shall be undamaged, air dry threshed straw or hay free of undesirable weed seed.
6. Others as shown on the Erosion and Sediment Control Plan and the SWPPP to manage site conditions in conformance with the NPDES General Construction permit.

F. Dewatering Activities: Any dewatering activities associated with the project where water will be released to a wetland resource area or storm drain shall require pre-treatment using a stilling basin, filter bag, straw bale, frac-tank, sediment basin or similar devise to remove sediment prior to release. Note that the method of pretreatment must be approved by the Project Engineer and the Conservation Commission (per the Wetlands Order of Conditions) prior to commencing any dewatering activity.

G. Seed Mix for steep slopes: Shall consist of a 50 – 50 percent mix of "New England Conservation / Wildlife Mix" and "New England Erosion Control / Restoration Mix For Dry Sites" or equivalent mix intended to stabilize steep slopes in conditions at the applicable locations.

H. Catch Basin Protection - Silt Sacks: Silt sacks are temporary catch basin insert filters that removes sediment, trash and debris from entering the catch basin. These are units specifically designed for this purpose. Installation of a piece of filter fabric under the catch basin rim is not an acceptable substitute. The unit must have a built-in overflow by-pass for high flows to minimize ponding.

I. Bio-degradable Erosion Control Blanket (ECB): to be used at the locations of sloped that are steeper than 2.5 ft. horizontal per 1 ft. vertical slope (40%) and at slopes that are experiencing chronic erosion. ESB shall be consist of a layer of coconut fiber stitched between layers of jute or coconut fiber netting intended to perform for at least 24 months. Manufacturers Bio-degradable erosion control blanket include, but are not limited to:

1. CONTECH Engineered Solutions, LLC
2. North American Green
3. American Excelsior Co.

The turf reinforcement selected must perform equal to or better than the product BioNet C125BN by North American Green.

PART 3 EXECUTION

3.01 STRAW BALE BARRIERS

A. Excavation shall be to the width of the bale and the length of the proposed barrier to a minimum depth of 4 inches.

B. Bales shall be placed in a single row, lengthwise on proposed line, with ends of adjacent bales tightly abutting one another. In swales and ditches the barrier shall extend to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale.

C. Staking shall be accomplished to securely anchor bales by driving at least two stakes or rebars through each bale to a minimum depth of 18 inches.

D. The gaps between bales shall be filled by wedging straw in the gaps to prevent water from escaping between the bales.

E. The excavated soil shall be backfilled against the barrier. Backfill shall conform to ground level on the downhill side and shall be built up to 4 inches on the uphill side. Loose straw shall then be scattered over the area immediately uphill from a straw barrier.

F. Inspection shall be frequent, and repair or replacement shall be made promptly as needed.

3.02 FIBER LOGS

A. Remove all rocks, clods, vegetation or other obstructions so that the installed fiber logs will have direct contact with the soil.

B. A small trench (2-3 inches) in depth should be excavated on the slope contour and perpendicular to water flow.

C. The fiber logs shall be secured to the ground using wooden stakes placed 6-inches from the end of the fiber log end and spaced every 4 feet.

D. The excavated soil shall be backfilled against the barrier.

E. Inspection shall be frequent, and repair or replacement shall be made promptly as needed.

3.03 STABILIZED CONSTRUCTION ENTRANCE AND STONE BERMS

A. Stone size: Use ASTM designation C-33, size No. 2 (1-1/2” to 2-1/2”). Use clean crushed stone.

B. Length: As effective, but not less than 50 feet.

C. Thickness: Not less than eight inches.

D. Width: Not less than full width of all points on ingress or egress, but not less than 20 feet.

E. Washing: When necessary, wheels shall be cleaned to remove sediment prior to entrance onto public right-of-way. When washing is required, it shall be done on an area stabilized with crushed stone which drains into a sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch, or watercourse through the use of sand bags, gravel boards, silt sacks or other standard methods.

F. Maintenance: The entrance shall be maintained in a condition that will prevent tracking or flowing of sediment onto public rights-or-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spoiled, dropped, washed or tracked onto public rights-of-way must be removed immediately.

G. Place crushed stone berms in locations required and as directed. Berms shall have side slopes of 1:3 or less. Stone size shall be ¾ to 1 ½ inch stone or as otherwise indicated on the drawings and shall be washed prior to installation to eliminate fines.

H. Inspect stone berms periodically and replace and/or regrade crushed stone as to maintain their condition and function.

3.04 SILT FENCING

A. Excavate a 6 inch trench along the upstream side of the desired fence location.

B. Drive fence posts a minimum of 1'-6" into the ground. Install fence, well-staked at maximum eight foot intervals in locations as shown on Drawings. Secure fabric to fence and bury fabric end within the six inch deep trench cut.

C. Lay lower 12 inches of silt fence into the trench, 6 inches deep and 6 inches wide. Backfill trench and compact.

D. Overlap joints in fabric at post to prevent leakage of silt at seam.

3.05 EROSION CONTROL GRASSING

A. Grassing shall be applied according to State of Massachusetts Department of Transportation Standard Specifications.

3.06 INLET PROTECTION

A. Install silt fence, compost fiber logs or straw bales around drain inlets inlet as specified herein.

B. At catch basin inlets, install manufactured silt sacks or other catch basin inlet protection intended for this function. Installation of a sheet of filter fabric under the rim of the catch basin will generally not be acceptable, except for very small watersheds with minimal chance of sediment laden runoff and approved by the Engineer. The silt sacks must include a built-in overflow.

3.07 DUST CONTROL

A. Throughout the construction period the Contractor shall carry on an active program for the control of fugitive dust within all site construction zones, or areas disturbed as a result of construction. Control methods include but are not limited to the following: Spray application of water on exposed surfaces; Application of calcium chloride; Application of temporary cover such as, but not limited to, hydro-mulch and tacifier, straw matting, jute netting, and tarps.

B. The frequency and methods of application for fugitive dust control shall be performed to maintain the site in compliance with the Constructional General Permit and local and state laws and regulations.

3.08 TEMPORARY PROTECTIVE COVERINGS (AFTER GROWING SEASON)

A. Place temporary covering for erosion and sedimentation control on all areas that have been graded and left exposed after October 30. Contractor shall have the choice to use either or both of the methods described herein.

B. Hay or straw shall be anchored in-place by one of the following methods: mechanical “crimping” with a tractor drawn device specifically devised to cut mulch into top two inches of soil surface or application of non-petroleum based liquid tackifier, applied at a rate and in accordance with manufacturer’s instructions for specific mulch material utilized.

C. Placement of mesh or blanket matting and anchoring in place shall be in accordance with manufacturer’s printed instructions.

D. Inspect protective coverings periodically and reset or replace materials to maintain compliance with the NPDES Construction General Permit.

3.09 BIODEGRADABLE EROSION CONTROL BLANKET FOR STEEP SLOPES

A. Install Erosion Controls in this SECTION 312500 and as shown on the Contract Drawings.

B. Excavate / Fill the side slopes to the proper grades as shown on the plans.

C. Finished Grading and Topsoil: For application of loam and finish grading of the side slopes, see related SECTION 312000 - EARTHWORK.

D. Install Topsoil (6 inch minimum) per the Landscape specifications.

E. Seeding: Seed the side slopes with the specified seed mix at the rates as recommended by the seed producer.

F. Install the Biodegradable Erosion Control Blanket matting in strict conformance with the manufacturer’s specifications.

G. Water and maintain the newly seeded areas as necessary until growth is fully established.

H. Final grading, loaming, seeding and turf installation shall be completed within the growing season and before September 1 to allow sufficient time to provide 100 percent vegetative cover before the end of the growing season.

I. Stormwater runoff from the site shall be controlled and directed during construction to prevent any runoff from up-gradient areas from flowing over the steep slope.

3.10. ALL EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (BMPs)

A. All sediment and erosion controls are to be installed per the latest EPA and the U.S.D.A Natural Resource Conservation Service guidelines and in accordance with the approved SWPPP.

END OF SECTION

SECTION 312600

MANAGEMENT AND DISPOSITION OF CONTAMINATED MATERIAL

PART 1 – GENERAL

1.01 GENERAL

A. PART A and Division 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project site and project-related areas prior to submitting a bid for the work of this SECTION.

1.02 WORK UNDER THIS SECTION

A. This Section specifies the requirements for handling, stockpiling, transporting, tracking and disposing of known arsenic contaminated soils (not subject to the Massachusetts Contingency Plan) and potentially contaminated material that may be encountered as part of construction activities. The Contractor shall transport and dispose of all contaminated soil to be removed from the site, including manifesting the loads and obtaining approval from RCRA landfills, non- RCRA out-of-state lined landfills, in-state or out-of-state recycling facilities, and in-state landfills, as necessary and as required by applicable laws.

B. Soils containing arsenic have previously been detected at the Cashman Elementary School and New Amesbury Elementary School site. In July and August 2020, ECMS collected pre-construction surface and subsurface soil samples for laboratory analysis in order to characterize the soils that may require off-site disposal. Soil sampling results indicated the presence of arsenic at concentrations above applicable standards in every location sampled across the proposed work site. Additional surface soil samples were subsequently collected on July 31, 2020 from the two baseball infields (Randall and Packer Little League Fields) at the site to verify that arsenic was not present in the imported red clay soils on either field. No arsenic was detected over any reportable concentration in any of the eight (8) surface infield samples analyzed. In addition, one (1) soil sample collected on August 12, 2020 from the outfield on Randall field at a depth of approximately 2 feet below grade did not have arsenic above its reportable concentration.

The assessment revealed elevated arsenic concentrations in 28 of 28 shallow soil samples (excluding the soil samples collected from both infields and one (1) sample from the outfield of Randall Field). The concentrations of generally exceeded reportable thresholds of 20 milligrams per gram (mg/kg), and in some cases exceeded Imminent Hazard (IH) Threshold of 40 mg/kg. No soil sample had a concentration of arsenic detected over its applicable Upper Concentration Limits (UCL) of 500 mg/kg.

Based on additional soil sampling for the presence of arsenic detected in the site' soils was found to be naturally occurring and outside of the MCP. While outside of the MCP, the presence of the arsenic in the soils presents a potential health and safety hazard for the school children in the Cashman Elementary School, workers and the general public as well as for the construction workers on the project.

C. It is the Owner's intent that soil excavated at the Site be reused on Site to the fullest extent practical. Refer to SECTION 312000-EARTHWORK for anticipated quantities. Off-site disposal will only be allowed upon written authorization of the Owner. The Contractor is responsible for sample collection and laboratory analysis of representative disposal characterization samples to obtain acceptance of all excavated materials from the site by off-site recycling/disposal facilities as specified herein.

D. The Contractor shall also be responsible for the management of miscellaneous materials accumulated from the Contractor's dewatering operations (See Section 31 23 19 Dewatering).

E. For arsenic impacted soils that are transported off the site, soils should be characterized as outlined in the MassDEP "Reuse and Disposal of Contaminated Soil at Massachusetts Landfills" MassDEP Policy # COMM-97-001 dated August 15, 1997 or in accordance with the receiving facility requirements.

F. Soil stockpile samples not already pre-characterized for off-site disposal will be collected as 9-point composites using clean, disposable sampling implement (e.g., plastic scoop) and placed into a clean container for mixing. The aliquots will then be well-homogenized in the field in groups of three to create three 8-ounce composite sub-samples. The three (3) sub-samples will be composited by the analytical laboratory into a single sample and submitted for laboratory analysis as specified in the MassDEP "Reuse and Disposal of Contaminated Soil at Massachusetts Landfills" MassDEP Policy # COMM-97-001 dated August 15, 1997 or in accordance with the receiving facility requirements. Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to this Section for additional Sampling and Testing requirements.

G. No fill may be transported off the site without prior testing by the Contractor's Environmental Consultant and approval by the Owner. Excess soil not re-used on site (if any) shall be stockpiled for testing by the Contractor's Environmental Consultant prior to being transported off site.

H. Excess excavated soil that is disposed off-site as approved by the Owner shall be transported under Hazardous Waste Manifests, Massachusetts Department of Environmental Protection (MassDEP) Bills of Lading (BOL), or Material Shipping Records. The Contractor's Environmental Consultant will prepare BOLs, Material Shipping Records, and Manifest packages based on information provided by the Contractor. The Owner will be the generator and the Owner's Project Manager (OPM) on behalf of the Owner will sign all Hazardous Waste Manifests, MSRs and BOLs.

I. The Contractor shall be familiar with, and shall fully understand, the relevant portions of the Massachusetts Department of Environmental Protection (MassDEP) Hazardous Waste Regulations 310 CMR 30.00, the Massachusetts Contingency Plan (MCP) 310 CMR 40.0000, and associated guidance documents when conducting earthwork operations. In particular, the Contractor shall be familiar with, and understand the requirements of, MassDEP's Policy #COMM-97-001, Reuse and Disposal of Contaminated Soil at Massachusetts Landfills.

J. The Contractor shall propose disposal facilities for approval by the Owner. While the Site has been deemed as not being subject to the MCP disposal, the presence of arsenic contaminated soils do require proper disposal at a landfill, or a site with similar site and contaminant conditions if the soil is contaminated in excess of the Reportable Concentrations (RCs) of one or more constituents. The MCP also establishes, pursuant to 310 CMR 40.0032, criteria for off-site disposal of soil with contamination below RCs.

K. The Contractor shall immediately halt soil movement activities and notify the Owner if visual, olfactory, or other evidence suggests that soils may be contaminated with oil or hazardous materials that has not been previously identified. Contractor shall provide reasonable assistance to Owner and to Owner's Environmental Consultant for access to potential contamination areas.

L. The Contractor shall engage an Environmental Consultant to sample and test earth materials suspected of containing chemical contaminants with the exception of the arsenic impacted topsoil which has already been detected on the site. The results shall be evaluated by the Environmental Consultant and compared with reporting thresholds found in the Massachusetts Contingency Plan (MCP) 310 CMR 40.0000. The Contractor shall inform the Owner of the laboratory test results and discuss the possible soil management, disposal, and recycling options available. Contaminated soils shall be managed and handled in compliance with the Massachusetts requirements referenced in Article 1.9.B, as well as any other state, federal, and local regulations, guidelines, and policies. The cost (time and expenses) associated with unanticipated contaminated soils shall be negotiated between the Contractor and the Owner prior to the start of the soil management, soil disposal, and/or recycling work. Owner reserves the right to negotiate and contract with other entities for remedial work and, in that event, the Contractor shall make reasonable accommodations for other entities to perform this work.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Carefully examine all of the Contract Documents for requirements which affect the work in this Section. Other specification sections which directly relate to the work of this Section include, but are not limited to, the following:

1. SECTION 312000-EARTHWORK
2. SOIL AND GROUNDWATER MANAGEMENT PLAN (SGMP), attachment to this SECTION 312600 MANAGEMENT AND DISPOSAL OF CONTAMINATED MATERIAL
3. ENVIRONMENTAL HEALTH AND SAFETY PLAN (HASP), attachment to Section 312000-EARTHWORK
4. SECTION 312319-DEWATERING

1.04 REFERENCED STANDARDS

A. References herein to any technical society, organization, group or body are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable:

ASTM: American Society for Testing and Materials OSHA: Occupational Safety and Health Administration

AASHTO: American Association of State Highway Transportation Officials

EPA: Environmental Protection Agency

1.05 LAWS AND REGULATIONS

A. Work shall be accomplished in accordance with regulations of local, county, state and federal agencies and utility company standards as they apply.

1.06 DEFINITIONS

A. Excavated Material: All soil, sediment, sewer grit, and miscellaneous materials and/or debris excavated from within the limit of work.

B. Contaminated Material: Soil containing Oil or Hazardous Material (OHM) at concentrations equal to or greater than the Limiting Soil Concentrations found in Table 2 of MassDEP Guidance WSC#-13-500, Similar Soils Provision Guidance, or containing OHM not listed in the Similar Soils Provision Guidance.

C. LSP / Contractor's Environmental Consultant: Licensed Site Professional, a hazardous waste site cleanup professional, as defined in M.G.L. c. 21A § 19, holding a valid license issued by the Board of Registration of Hazardous Waste Site Cleanup Professionals, pursuant to M.G.L. x. 21A, §§ 19 through 19J.

D. LSP-of-Record / Owner's Environmental Consultant: The LSP engaged by the Owner to perform LSP-of-Record Services and regulatory interaction / coordination of the Project. The Engineer will be the LSP-of-Record for the Project.

E. Suspected Contaminated Material: Excavated material with any of the following characteristics: significant petroleum and/or chemical odor; an oily sheen; and/or material with staining or significant change of color.

1.07 SUBMITTALS

A. The Contractor shall submit in writing the following to the Owner for review by their Environmental Consultant, an Excavated Materials Management Plan (EMMP) which includes at a minimum the information required by this Section, no more than 14 days after issuance of the Notice to Proceed.

B. The Contractor's EMMP shall include the following:

1. Description of Work:
2. Plans outlining the proposed procedures and sequence for the excavation of materials to be reused on-site and disposed/recycled off-site, procedures used to track excavated materials to be transported off-site and a proposed implementation schedule.
3. The name and contact information of the Contractor's Environmental Professional to oversee the implementation of the EMMP and ensure compliance with all references listed in Article 1.04 of this Section.

4. Documentation that the Contractor will utilize appropriately trained staff to excavate potentially contaminated materials when encountered on site and that the staff is informed of procedures to be followed to protect the Health and Safety of all on-site workers as it relates to possible contaminated materials to be removed. Documentation must show that workers involved in these activities have completed Health and Safety Training per Occupational Safety and Health Administration (OSHA) Regulation 29 CFR 1910.120, as appropriate.

   The Contractor is entirely responsible for the Health and Safety of its employees and subcontractors.

5. Locations and methods, including drainage and provisions for stockpile covering, for on-site stockpiling of excavated potentially contaminated soil as specified in this Section. Describe methods to keep different classifications of material segregated during processing operations.

6. Identification, via a Worker Health and Safety Plan prepared by a certified industrial hygienist, of a course of action to be taken when suspected contaminated materials are encountered during excavation

7. Procedure for decontamination of tools and equipment.

8. Methodology for soil tracking as specified in Article 3.3 of this Section, including methodology to ensure cross-contamination does not occur.

9. All pertinent information relating to the transport of excavated material, at a minimum, shall include:

   a. Name and address of all transporters

   b. Transporter identification number (USEPA or Massachusetts Department of Transportation Transporter) and expiration date.

   c. Proof of permit, license, or authorization to transport excavated material, when applicable, in all affected states.

   d. Dust control measures.

10. The Contractor shall submit proposed off-site disposal location(s) for Arsenic Impacted Soils, Organic Soils, MCP-Restricted Soil, MCP-Regulated Soil, Hazardous Material and Hazardous Waste (if testing indicates the presence) for review by the Owner; the Contractor shall also provide documentation certifying the suitability of proposed sites to receive soils. Proposed sites must meet the criteria specified herein and are subject to approval by the Owner. Disposal of all excavated soil must be in conformance with Federal, state, and local regulations governing soil disposition.

11. The Contractor shall submit a primary and secondary facility for each category of excavated materials, as identified in Article 3.06 of this Section. Disposal/recycling facilities listed in the EPA Superfund Program will not be accepted as disposal/recycling facilities for this Work. For each facility, the Contractor shall submit the following information:

    a. General Information:

       1) Facility Name

       2) Facility Address

3) Name of Contact Person

4) Title of Contract Person

5) Telephone Number of Contact Person

6) Permit Number

b. The facility shall specify the volume of material that can be accepted from the site on a weekly and a total basis.

c. The facility shall provide written confirmation that they are permitted to accept and will accept the excavated material and/or accumulated sediment of the general

d. The facility shall provide a listing of all current and valid permits, licenses, letters of approval, and other authorizations to operate that they hold, pertaining to the receipt and management of the soils or materials specified in this Contract.

e. The Contractor shall submit a complete list of the reuse sites and disposal/recycling facility's permitted allowable contaminant levels and physical characteristic requirements for contaminated material, and list any required regulatory approvals for individual waste streams.

f. After the Contractor obtains approval for off-site reuse and/or disposal/recycling of surplus excavated materials, the Contractor shall submit to the Owner's Environmental Consultant, approvals or letters of intent and facility information for each facility proposed, prior to transporting material off-site.

12. The Contractor shall include procedures for decontamination of vehicles and equipment in the EMMP.

13. The Contractor shall include procedures for the monitoring and control of dust in the EMMP during construction.

C. As part of the EMMP, the Contractor shall develop a Sampling and Analysis Plan (SAP) outlining the procedures for the characterization of all excavated materials to obtain off-site disposal/recycling facility acceptance. The SAP shall include, but is not limited to, the following:

1. The name and copies of all applicable certifications of the Contractor's proposed analytical laboratory to perform disposal characterization laboratory analysis.

2. Proposed off-site disposal/recycling facility sampling and material acceptance requirements.

3. Disposal characterization sampling procedures.

4. Laboratory analytical methods used to analyze disposal characterization samples.

5. Quality assurance and quality control procedures to be implemented during sampling collection and laboratory analysis.

D. Laboratory results for all samples collected and/or analyzed by the Contractor shall be submitted to the Architect within 2 days of receipt in tabulated spreadsheet form using Microsoft Excel version 2009 or later (.xls or .xlsx file), which summaries detections and exceedances of applicable criteria along with the raw laboratory data package. The results shall include all Chain-of-Custody forms, QA/QC summaries, and all documentation provided by the laboratory. Analytical data shall be kept confidential, distributed only to the Architect.

E. Contractor shall provide copies of all weight slips, both tare and gross, for every load transported off-site to an approved off-site reuse, recycling or disposal facility. The Owner will only allow progress payments after receipt of these weight slips.

F. The time period(s) specified for submittals are the minimum required to review, evaluate and respond to the Contractor. If, after review, resubmission is required for any reason, the specified time period(s) shall commence upon the date of receipt of the resubmittals. The Contractor is responsible for scheduling specified submittals and resubmittals so as to prevent delays in the work.

1.08 RESPONSIBILITIES OF THE CONTRACTOR

A. The Contractor is responsible for adhering to regulations and recognized standard practices related to the management of contaminated and potentially contaminated material during excavation and removal activities. The Owner and Owner's Environmental Consultant will not be responsible at any time for the Contractor's violation of pertinent State or Federal regulations or endangerment of laborers, passers-by or any others.

B. Minimum precautions noted in this Section shall in no way relieve the Contractor of his responsibility for implementing stricter health and safety precautions should they be warranted by the work.

C. The Owner and Owner's Environmental Consultant will not be held negligent or liable for any inadequacies or deficiencies in the Contractor's site-specific worker health and safety plan or for any oversight or inadequacies in the Contractor's implementation of the safety plan.

D. The Contractor shall provide the labor, materials and equipment necessary to complete the work shown on the drawings and as specified in this Section, which, without limiting the generality thereof, includes:

1. On-site transportation, stockpiling, and maintenance of excavated fill material.
2. Disposal off-site of all excess materials.
3. For soils exhibiting unanticipated contamination (if encountered), locate the materials in plan and elevation using survey techniques.

4. The Contractor is responsible for all construction, protection and maintenance of stockpiles of excavated soils, through possible chemical testing and on-site re-use or off-site disposal (if required). Under no circumstances will the lack of space to stockpile soil be deemed an excuse for construction delays and incur additional costs to the Owner. Contractor shall stockpile material only in areas designated by the Owner. Note that there is limited space to stockpile soils at the Site.

5. The Contractor is required to cooperate fully with the Environmental Consultant during the Contractor's efforts to segregate and stockpile excavated soils. If contaminated soils are excavated, the Contractor should anticipate delays to his operation as a result of the sampling and screening of in situ or excavated material by the Environmental Consultant.

6. The Contractor is responsible for providing all documentation to track potentially contaminated material from the time of excavation until it is disposed of at the disposal facility.

E. The Contractor shall coordinate its work with that of all other trades or contracts affecting or affected by work described in this Section, and shall cooperate with such trades to assure the steady progress of all work under the Contract.

1.09 RESPONSIBILITIES OF OTHERS

A. While the Site has been deemed as not being subject to the MCP, the OPM will be responsible for signing on behalf of the owner the BOLs, MSRs or manifests as necessary for the contractor to transport the soils to the designated disposal facility(s).

Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to this Section for additional requirements.

1.10 PERMITS, CODES, POLICIES, AND SAFETY REGULATIONS

A. All work shall conform to the Drawings and Specifications and shall comply with applicable codes, permits, and regulations.

B. The Contractor shall comply with all rules, regulations, laws, permits and ordinances of all authorities having jurisdiction including, but not limited to, MassDEP, the U.S. Environmental Protection Agency (EPA), City of Amesbury, and the Commonwealth of Massachusetts. In particular, the Contractor should be familiar with the following policies, guidance documents, and material tracking forms issued by MassDEP. Copies of the following documents are available for review at the office of the Owner.

- MassDEP - Bureau of Waste Site Cleanup, Policy No. WSC-94-400, "Interim Remediation Waste Management Policy for Petroleum Contaminated Soils", April 21, 1994.
- MassDEP - Bureau of Waste Prevention, Policy No. COMM-97-001, "Reuse and Disposal of Contaminated Soils at Massachusetts Landfills", August 15, 1997.

- MassDEP - Bureau of Waste Site Cleanup, "Policy No. WSC-00-425 Construction of Buildings in Contaminated Areas", January 26, 2000.
- MassDEP – Bureau of Waste Site Cleanup, "Similar Soils Provision Guidance", WSC #13-500, September 4, 2013.
- MassDEP - BWSC, Bill of Lading Package (BWSC-012).
- MassDEP - BWP, Material Shipping Record & Log.

All labor, materials, equipment, and services necessary to make the work comply with such requirements shall be provided by the Contractor without additional cost to the Owner.

C. The Contractor shall comply with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc., the Massachusetts Construction Industry Rules and Regulations (454 CMR 10.00), and the requirements of OSHA, United States Department of Labor.

D. Unless otherwise noted in the Supplementary Conditions, the Contractor shall procure and pay for all permits and licenses required for the complete work specified herein and shown on the Drawings.

1.11 SOIL CLASSIFICATION SYSTEM

The Contractor's Environmental Consultant will perform pre-characterization testing of some of the soils to be excavated at the Site. Based on this testing, excess excavated soil not reused on site (if any) will be given a designation for off-site disposal, reuse, or recycling based on chemical testing performed by the Environmental Consultant during construction on some of the soil, as described herein. These designations are defined as follows:

A. **MCP-Restricted Soil:** MCP-Restricted Soil consists of soil, fill and dredged material with measured levels of oil and/or hazardous materials (OHM) at concentrations above background levels but below applicable RCs presented in 310 CMR 40.1600 of the MCP. MCP Restricted Soil consists of material which may be used as fill, within the Commonwealth of Massachusetts, in a restricted manner, as described in 310 CMR 40.0032(3). The specific requirements of 310 CMR 40.0032(3) include:

- Soils cannot be disposed or reused at locations where OHM concentrations would exceed an applicable RC.
- Soils cannot be disposed or reused at locations where existing concentrations of OHM at the receiving site are significantly lower than those present in the soil being disposed.

Preferred off-site disposal is re-using MCP-Restricted Soil as daily cover at lined or unlined landfills or at MassDEP permitted "RCS-1" sites. If the Contractor proposes to re-use MCP Restricted Soil at another location, it is the Contractor's responsibility to provide documentation satisfactory to the Owner and Environmental Consultant that the receiving site has similar types and levels of contamination as those in the materials being disposed of.

B. **MCP-Regulated Soil:** MCP-Regulated Soil consists of material containing measurable levels of OHM that are equal to or above the applicable RCs for the site's Reporting Category ("RC") (i.e., RCS-1 or RCS-2) as defined in 310 CMR 40.0361, and which can be reused or disposed of at lined landfills within the Commonwealth of Massachusetts (in accordance with MassDEP Policy No. 97-001), at an unlined landfill that is approved by MassDEP for accepting such material, or at a similar out-of-state facility. These materials may also be recycled off site at a MassDEP- approved recycling facility possessing a Class A recycling permit, subject to acceptance by the facility and compliance with MassDEP Policy No. WSC-94-400. Criteria for material in this classification are contained in the above-referenced Policy documents.

For this project there are three (3) categories of MCP-Regulated Soil, depending on the suitability of the soil to be disposed of at one of the following disposal locations:

Type A acceptable for Soil re-use as cover at an in-state unlined landfill.

Type B acceptable for Soil re-use as cover at an in-state lined landfill.

Type C acceptable for Soil recycling at an in-state batching facility.

Hazardous Material: Hazardous Material is not a hazardous waste but contains sufficient contamination of OHM that it cannot be reused/recycled in an in-state landfill or in-state recycling facility because it exceeds the Allowable Contaminant Levels for Reuse at Lined Landfills (MassDEP Policy No. COMM-97-001) and Massachusetts Soil Recycling Facility Summary Levels (MassDEP Policy No. WSC-94-400). Hazardous Material must either be recycled/disposed of out-of-state in accordance with the policies and regulations of other state agencies or disposed of at a Massachusetts landfill with specific prior approval by the MassDEP Division of Solid Waste Management.

D. **Hazardous Waste:** Material in this category will meet one or more of the criteria for a characteristic Hazardous Waste as defined in 40 CFR 261. Excavated materials classified as Hazardous Waste will be disposed of off-site, in an out-of-state permitted facility which is operated in full compliance with 40 CFR 260-265 and 310 CMR 30.00, or the equivalent regulations of other states.

E. **Organic Soils:** Consists of undisturbed, original organic soils. There are two classifications of Organic Soils for this project:

1. **Uncontaminated Organic Soils** which contain no measured contamination (i.e., below minimum detection limits or below recognized “background” levels). There are no restrictions by the Massachusetts Contingency Plan on the disposal of these materials other than local ordinances. However, Uncontaminated Organic Soils shall not be disposed of/reused offsite in residential, school or recreational areas unless approved in writing by the Owner. Disposal of this material by the Contractor will still require written disposal tracking and approval of the potential location(s) by the Owner.
2. **Contaminated Organic Soils** which contain contaminant levels above “background levels.” Disposal of Contaminated Organic Soils shall be per the requirements for MCP Restricted Soil, MCP Regulated Soil, Hazardous Material, or Hazardous Waste, depending on contaminant levels.

F. **Arsenic Impacted Soil**: Soils in this category either: 1) contain arsenic concentrations exceeding 20 mg/kg based on laboratory testing, or 2) are assumed to contain arsenic since a testing has not been conducted. Arsenic impacted soil may not be reused on-site and shall be disposed of offsite at an appropriately licensed facility, except as noted on the SGMP, or unless otherwise approved by the Environmental Consultant and MassDEP.

1.12 ENVIRONMENTAL CONDITIONS

A. In July and August 2020, *ECMS* collected pre-construction surface and subsurface soil samples for laboratory analysis in order to characterize the soils that may require off-site disposal. Soil sampling results indicated the presence of arsenic at concentrations above applicable standards in every location sampled across the proposed work site. Additional surface soil samples were subsequently collected on July 31, 2020 from the two baseball infields (Randall and Packer Little League Fields) at the site to verify that arsenic was not present in the imported red clay soils on either field. No arsenic was detected over any reportable concentration in any of the eight (8) surface infield samples analyzed. In addition, one (1) soil sample collected on August 12, 2020 from the outfield on Randall field at a depth of approximately 2 feet below grade did not have arsenic above its reportable concentration. The assessment revealed elevated arsenic concentrations in 28 of 28 shallow soil samples (excluding the soil samples collected from both infields and one (1) sample from the outfield of Randall Field). The concentrations of generally exceeded reportable thresholds of 20 milligrams per gram (mg/kg), and in some cases exceeded Imminent Hazard (IH) Threshold of 40 mg/kg. No soil sample had a concentration of arsenic detected over its applicable Upper Concentration Limits (UCL) of 500 mg/kg.

B. Though arsenic detected in the site soils are background condition associated with known elevated arsenic concentrations in bedrock, their presence in soil poses a potential exposure risk to construction workers at the site.

C. There has been limited environmental testing of soil and groundwater samples at the site.

1.13 QUALITY CONTROL

A. The Contractor shall engage the services of an Environmental Consultant prior to and during the Work. The responsibilities and requirements of the Contractor's Environmental Consultant shall include, but not be limited to, the following:

1. Staff of the Contractor's Environmental Consultant shall have completed the 40-hour OSHA health and safety training course, with 8-hour OSHA refresher training, as needed to maintain continual certification.

2. Evaluate existing analytical data and perform any additional sampling, as required, for the removal of surplus excavated materials to meet all state and federal regulations and disposal facility acceptance requirements.

3. Prepare draft Material Shipping Records, hazardous waste manifests and/or Massachusetts Bills of Lading for off-site reuse/disposal/recycling of excavated materials.

4. Ensure compliance with all references listed in Article 1.04 of this Section.

5. Ensure the work conforms to local, state and federal regulatory agencies governing the handling of contaminated and hazardous materials.

6. Ensure that best management practices take place while performing the work described in this Section.

7. Develop and implement site-specific emergency response and health and safety protocols and procedures.

8. Coordinate handling, transport, and off-site disposal of excavated materials in accordance with the EMMP.

9. Keep records, including daily logs, of all waste streams, weights, stockpiles, and excavated materials for the purposes of tracking points of origin for excavated materials for submittal to the Owner and the Architect for review.

10. Develop and implement dust control measures, which will adequately protect workers and residents in the nearby community and prevent off-site migration of dust.

PART 2 – PRODUCTS

2.01 POLYETHYLENE STOCKPILE SHEETING

A. Polyethylene barrier for use in protecting stockpiles from spreading contamination or for protecting truck bodies shall be minimum 6-mil (0.006 inches) thick. For potentially contaminated soils, the first lift of stockpiled soil shall be placed on a minimum of two layers of six-mil-thick (0.006") or one layer of 20-mil-thick (0.020") polyethylene barrier over existing soils or pavement. At least one (1) layer of black, 6-mil polyethylene will be used to cover stockpiles of impacted material at all times except when modifying stockpiles.

2.02 PERSONAL PROTECTIVE EQUIPMENT

A. Personal protective equipment and protective clothing for use by all Contractors' employees shall be consistent with the levels of protection for this work as indicated in the ECMS Health and Safety Plan (HASP) or the Contractor's Hazardous Materials Health and Safety Plan.

1. All the Contractor's personnel and Sub-Contractors shall wear personal protective equipment and protective clothing consistent with the levels of protection for this Work. Coordinate health and safety and personal protective equipment with the ECMS Health and Safety Plan (attachment to 3120000 Earthwork Section).
2. The Contractor shall decontaminate vehicles, construction equipment, tools and appliances used during the Work as required in the ECMS Health and Safety Plan (attachment to 3120000 Earthwork Section).

2.03 CONTAINERS

A. Containers used by the Contractor for storing and/or hauling the excavated material shall be constructed of steel, in good condition and designed for the intended purpose of safe, secure storage of contaminated and hazardous materials during loading and transport. The containers shall have a secure cover that will prevent a release of material from trucks during transportation. The containers and covers shall be provided at no additional cost and shall be approved by the Architect prior to mobilization of any trucks/containers. The containers must be approved by and labeled in accordance with the U.S Department of Transportation (DOT). The containers shall be sift-proof and water resistant in accordance with the DOT.

PART 3 – EXECUTION

3.01 GENERAL

A. Based upon all analytical results, the Contractor shall transport, reuse, and/or dispose/recycle the surplus excavated material as specified in this Section.

B. The Contractor's excavation sequence and temporary excavation support system used shall allow for the Architect's visual inspection of the excavation limits from the surface to the bottom.

C. The Owner will be the generator of all excavated materials removed from the site and will sign all Material Shipping Records, hazardous waste manifests and Massachusetts Bills of Lading. The Contractor shall prepare draft Massachusetts Bills of Lading and Material Shipping Records, along with all supporting documents and submit to the Owner for approval prior to shipment. The OPM, on behalf of the Owner, shall sign all Massachusetts Bills of Lading and Material Shipping Records upon final review and approval.

D. The Contractor shall be the generator of material contaminated as a result of the Contractor or Sub-Contractors release of oil/hazardous materials on the site caused by them. The Contractor shall engage the services of a LSP to address releases caused by them.

E. The Owner shall have final approval over all reuse/disposal/recycling options based on the analytical data.

F. The Contractor shall immediately notify the Architect of suspected contaminated materials with visible stains or unnatural odor, or if other potentially contaminated and/or hazardous material is encountered. The Contractor shall excavate and manage areas of suspected contaminated and/or hazardous material as required by the Architect.

G. Before backfilling the Contractor shall assist the Architect to survey/measure the bottom of the excavation, as required.

3.02 SOIL CLASSIFICATION PROCESS

A. The Environmental Consultant will be responsible for classification of excess excavated fill material necessary to be removed from the site.

B. Soil classification will be based on precharacterization testing performed by the Environmental Consultant. Where not pre-classified (such as when unanticipated contamination is encountered during excavation), soil classification will be via characterization of representative samples from stockpiled soil. No material shall leave the site until completed testing results are reviewed by the Environmental Consultant and a disposal site agreed to by the Environmental Consultant, Contractor and Owner.

C. The Contractor shall be prepared to allow the Environmental Consultant access to the stockpile(s) from time to time and should be prepared for periodic interruptions to his operations during these activities. Within fourteen (14) calendar days after the Environmental Consultant samples a stockpile, the Environmental Consultant will provide the classification of the material to be disposed of by the Contractor, as necessary.

D. The Contractor is responsible for the construction, protection and maintenance of temporary stockpiles. After completion of classification, materials shall be removed from the Site by the Contractor. Stockpiles shall not contain solid waste material.

3.03 WEIGHT MEASUREMENT

A. The Contractor shall provide certified tare and gross weight slips for each load received at the accepted facility which shall be attached to a copy of each Manifest/Bill of Lading/Materials Shipping Record within 14 days of obtaining all final signatures from a representative of the reuse/disposal/recycling facility, the Contractor (transporter), LSP (if applicable), and the Owner.

3.04 SOIL TRACKING

A. For soils exhibiting olfactory or visual evidence of potential contamination, the Contractor will provide a soil tracking system to track all excavated soils between excavation and final disposition.

1. The soil tracking system shall include identification of the source of material (area, depth, date of excavation, etc.). The system shall be designed by the Contractor and shall be submitted to the Environmental Consultant for review and acceptance. The system should include daily log sheets for tracking all soils from excavation through final transport and disposal.
2. The Contractor shall provide to the Environmental Consultant, on a daily basis, copies of field records documenting the location of stockpiled material, and stockpile identification data. This documentation shall be provided on a daily basis when stockpiles are present on-site.
3. If requested by the Owner, the Contractor shall obtain a written receipt signed by the owner/operator of the receiving facility or disposal site, even if such documentation is not required by law.

3.05 STOCKPILE CRITERIA

A. The Contractor shall stockpile all excavated material that exhibits olfactory or visual evidence of potential contamination that has not been previously identified by precharacterization testing. Soils that exhibit evidence of potential contamination shall be stockpiled separately from other excavated soil.

B. The Contractor is responsible for the construction, protection and maintenance of temporary stockpiles during chemical testing and final soil category classification by the Environmental Consultant and through the final disposal or re-use of those stockpiles by the Contractor. Materials will be removed from the site by the Contractor.

1. Stockpile areas will be graded such that storm water runoff is diverted from stockpiled soils; berms (i.e., hay bales, silt fencing, gravel) will be placed around the perimeter of the area to prevent contact of runoff with contaminated soils.

2. The area will be blocked off to minimize worker and passerby contact with stockpiled soils. The area will be visibly marked with appropriate warning signs of potential hazards.

3. For potentially contaminated soils, the first lift of stockpiled soil will be placed on a minimum of two layers of six-mil-thick (0.006") or one layer of 20-mil-thick (0.020") polyethylene barrier over existing soils or pavement.

4. The size of the individual stockpiles (for soil to be tested) will be limited such that no individual stockpile is larger than 500 cubic yards (or 100 cubic yards if asbestos testing is required). Total dimensions and locations of the stockpile areas will be at the discretion and approval of the Owner.

C. The transfer of soil materials from the excavation to the stockpile areas will be conducted by the Contractor in such a manner as to prevent the spread of contaminated or potentially contaminated materials across the site and to minimize the mixing of soils from different areas of the excavation in different stockpiles.

D. The Contractor will place stockpiled soils within a designated stockpile area, graded to shed water, and shall cover the stockpiled soils prior to inclement weather and at the end of each work day with a minimum six-mil-thick (0.006") black polyethylene cover overlapped and weighted to form a continuous waterproof barrier over the soil. The cover will be maintained by the Contractor throughout the stockpile period to prevent water from entering the soils and to prevent blowing dust.

E. Excavation and soil handling will be performed in a manner which limits mixing of soils with different levels and types of contamination. Disposal of soil which is contaminated as a result of the Contractor's careless or unauthorized procedures for excavation or soil handling and stockpiling will be at his own expense. All stockpiles will be located within the Project limits.

F. Soil which is being stockpiled for further testing by the Contractor’s Environmental Consultant shall be placed at a height not exceeding six feet (6') above ground surface. The stockpile shall not be moved or rearranged without the approvals of the Contractor’s Environmental Consultant and Owner.

G. No re-handling of stockpiled soil will be carried out after chemical testing without the observation of the Contractor’s Environmental Consultant. No material will be removed from the site without classification by the Contractor’s Environmental Consultant.

H. Stockpiles for excavated soil classified as Hazardous Waste (if any) shall be stored on drip pads designed and operated under 40 CFR Subpart W. Drip pads shall be constructed of non- permeable, non-earthen materials, sloped for proper drainage, with bermed perimeters of sufficient structural strength and thickness. Drip pad construction shall include a synthetic liner below the pad, leakage detection, and a collection system above the liner.

I. Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to this Section for additional requirements.

3.06 DISPOSAL OF MATERIAL

A. Excavation of existing subsurface material may include the excavation of contaminated materials. Soils that exhibit evidence of potential contamination shall be stockpiled separately from other excavated soil.

B. The Contractor's Environmental Consultant shall classify material for disposal as MCP-Restricted, MCP- Regulated, Hazardous Material, Hazardous Waste, Uncontaminated Organic Soils, Contaminated Organic Soils, or Arsenic Impacted Soils, depending on laboratory results. The Contractor will recommend the proposed disposal or recycling location(s) for the Contractor's Environmental Consultant's review and Owner's approval prior to disposal.

C. All material designated for off-site disposal will be transported to an off-site location via a tracking form (for example, 21E BOL, Hazardous Waste Manifest, or Material Shipping Record) appropriate for the material classification in accordance with the laws of the appropriate local, state, and federal authorities.

D. No stockpiled soil will be removed for off-site disposal until the results of final classification chemical analyses have been received and the materials have been properly classified. It is expected that for stockpiled soils, the time required between sampling and classification of the soils by chemical criteria may be about 14 calendar days depending on the turnaround time achieved by the Contractor's Environmental Consultant's testing laboratory. No claim for delay damages will be allowed until the turnaround time for laboratory data exceeds four (4) weeks.

E. The Owner will be the designated generator for all soil transported off-site, in accordance with these Specifications and with all applicable local, state, and federal requirements.

F. All materials transported off-site shall be loaded under the direction of the Contractor into properly licensed and permitted vehicles and transported directly to the selected facility. As a minimum, trucks will be lined and covered with a minimum six (6) mil-thick polyethylene liner, which will be placed to form a continuous waterproof tarpaulin to protect the load from wind and rain.

G. Contingency Measures: There is a possibility of encountering unanticipated buried underground storage tanks containing hazardous materials or petroleum products during excavations. In that event, the Contractor will stop construction in that vicinity immediately and notify the Owner who will have contents of the tanks identified and will contract with a licensed waste hauler to remove and dispose of the tank(s) and contents, in accordance with State and Federal guidelines.

In addition, excavated material may contain various amounts of unsuitable material such as building debris, wood, concrete, etc. These materials will be stockpiled by the Contractor in areas at the construction site, as designated by the Owner. This material may not be stockpiled with potentially contaminated soils. The Contractor shall be prepared to mobilize labor and equipment necessary to remove this material from the soil (mechanical screening or manual picking). Refuse, coal ash, cinders, glass, wood and other "nonchemical" waste products as regulated by MassDEP Division of Solid Waste Management (DSWM) must be disposed of in accordance with MCP 310 CMR 19.00. Generally, these materials, if brought off site, must be disposed of at a sanitary landfill, or recycled in an approved manner. Roadway pavement, brick, and concrete rubble free of reinforcing steel may be exempt from the solid waste requirements if processed and reused in accordance with MassDEP regulation 310 CMR 16.05.

Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to this Section for additional requirements.

3.07 WASTE PROFILES AND MANIFESTS

A. The Contractor shall be responsible for preparing and submitting to the Owner's Environmental Consultant for review all waste profile applications and questionnaires and accompanying waste analysis, and coordination with disposal facilities and all federal and state environmental agencies.

B. The Contractor shall be responsible for providing the Contractor's Environmental Consultant information required for preparing all Hazardous Waste Manifests, BOL, and Material Shipping Record (MSR) forms with all applicable notification and control forms. The Contractor's Environmental Consultant will prepare the Manifests, BOLs, and MSRs with input from the Contractor. The Environmental Consultant will also be responsible for preparing LSP Opinion letters if required by facility.

C. The Contractor shall provide certified tare and gross weight slips for each load received at the designated facility which shall be attached to each returned manifest.

D. The Owner will be designated as generator and will sign all manifests and waste profile applications or questionnaires. The Contractor's Environmental Consultant or other qualified environmental personnel will prepare and sign Hazardous Waste Manifests, BOL, MSR forms.

E. The Contractor shall furnish all generator copies of the hazardous waste manifest to the Contractor's Environmental Consultant for submittal to the appropriate state environmental agencies and shall provide a copy to the Owner's Environmental Consultant to retain for the Owner's records.

F. Prior to receiving progress payment, the Contractor shall submit to the Owner, for review by the Owner's Environmental Consultant, documentation certifying that all materials were transported to, accepted, and disposed of at the selected disposal sites. The documentation shall include the following, as a minimum.

1. Documentation shall be provided for each load from the site to the disposal site, including all manifests and any other transfer documentation as applicable.

2. All documentation for each load shall be tracked by the original manifest document number that was assigned at the site. The documentation shall include a location designation, established by the Contractor's Environmental Consultant and Contractor prior to excavation, and original elevation of the material.

3. Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to this Section for additional requirements.

3.08 DECONTAMINATION OF EQUIPMENT

A. Contractor's tools and equipment which have been in contact with contaminated site soils, and which are to be taken from the areas with contamination, will be decontaminated on the site using methods approved by the Owner such as water steam cleaning. This will include all tools, heavy machinery, and excavating and hauling equipment used during excavations, stockpiling, and re-handling of contaminated material. The Contractor shall provide a clean pad for loading trucks and will minimize contamination of the trucks. If required to prevent trucks from tracking site-soils to the street, the Contractor shall provide a wheel wash facility for trucks leaving the site.

B. Refer to the Soil and Groundwater Management Plan (SGMP) that is attached to this Section for additional requirements.

PART 4 – COMPENSATION

4.01 MEASUREMENT AND PAYMENT

A. Measurement and payment for excavation of materials **regardless of classification;** for on-site handling and reuse of excavated soil regardless of classification; for the creation, operation, maintenance and final cleanup of all temporary soil stockpiles and for the decontamination of all of Contractor's equipment and tools used in handling contaminated materials will not be measured separately for payment but rather will be considered incidental to the Work and will be included in the Contractor's lump sum price for Earthwork.

B. Transferring excavated soil to an on-site stockpile as required for testing will be considered incidental to the Work and will not be measured separately for payment. Transferring of material from the stockpile to transporters for off-site disposal for material quantities identified in SECTION 312000-EARTHWORK will not be measured separately and will be considered incidental to the Work.

C. Measurement and payment for loading, transportation and disposal of **Uncontaminated Organic Soils, Contaminated Organic Soils, MCP-Restricted Soil, MCP-Regulated Soil, Arsenic Impacted Soils, Hazardous Material (if any), and Hazardous Waste (if any)** will be by the ton based on a calibrated scale as reported by the disposal facility and may be verified by the Owner by independent scale measurements. If measurement exceeds quantities identified in SECTION 312000 EARTHWORK, payment will be made for excess based on Unit Prices as identified in SECTION 012200 UNIT PRICES.

D. If hazardous materials and waste OTHER THAN arsenic impacted soils encountered, payment for Hazardous Material and Hazardous Waste shall be negotiated between the Owner and Contractor.

END OF SECTION

Attachment A

Soil & Groundwater Management Plan (SGMP)

NEW AMESBURY ELEMENTARY SCHOOL
MANAGEMENT AND DISPOSAL OF CONTAMINATED MATERIAL
312600

SOIL AND GROUNDWATER MANAGEMENT PLAN (SGMP)

For

Charles C. Cashman and New Amesbury Elementary School
193 Lions Mouth Road
Amesbury, Massachusetts 01913
MassDEP RTN 3-36397

Prepared for:

DiNisco Design, Inc.
99 Chauncy Street
Boston, Massachusetts 02111

Prepared by:

Environmental & Construction Management Services, Inc.
288 Grove Street #391
Braintree, Massachusetts 02184
(617) 338-2121

October 15, 2020

ECMS Project No. 1009.073

This report has been prepared for the exclusive use of DiNisco Design and their client the City of Amesbury, Massachusetts. Environmental & Construction Management Services, Inc. acknowledges that DiNisco Design and the City of Amesbury may rely on this report. Photocopying of this document by parties other than those designated by DiNisco Design and the City of Amesbury, or use of this document for purposes other than intended, is prohibited without the prior written consent of Environmental & Construction Management Services, Inc.

Environmental & Construction Management Services, Inc.

DRAFT

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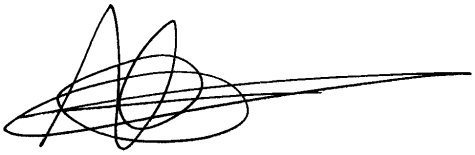
CERTIFICATION OF RESULTS

The evaluation was conducted on behalf of and for the exclusive use of *DiNisco Design* and their client, the *City of Amesbury* and all its successors and assigns, solely for use in an environmental evaluation of the Site. This report and the findings contained herein shall not, in whole or in part, be disseminated or conveyed to any other party, nor used by any other party, in whole or in part, other than *DiNisco Design* or the *City of Amesbury* and all its successors and assigns, without the prior written consent of *Environmental & Construction Management Services, Inc. (ECMS).*

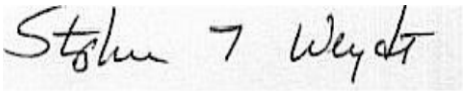
ECMS professional services have been performed, our findings obtained, and our recommendations prepared by an environmental professional and customary principles and practices in the fields of environmental science and engineering. This warranty is in lieu of all other warranties either expressed or implied. *ECMS* is not responsible for the independent conclusions, opinions or recommendations made by others based on the records review, site inspection, field exploration, and laboratory test data presented in this report.

Respectfully submitted this 15th day of October 2020.

For ***Environmental & Construction Management Services, Inc.*** by



Kevin J. Kavanaugh, L.S.P., CHMM
Principal Environmental Engineer



Stephen T. Weydt
Principal Environmental Scientist

1.0 INTRODUCTION

This document provides a plan for the management of arsenic-impacted soil and groundwater that may be encountered during construction of a new elementary school building on the Site of the existing Cashman Elementary School. *DiNisco Design, Inc.* (*DiNisco*) is the architect supporting the City of Amesbury for the project at 193 Lions Mouth Road in Amesbury, Massachusetts (subject property). Refer to Figure 1, Site Locus/Location Plan for the general location of the Site.

This Soil and Groundwater Management Plan (SGMP) was prepared by *Environmental & Construction Management Services, Inc. (ECMS)* at the request of *DiNisco* to support construction of a new elementary school for PreK through 2nd grade students. Scope of work will also include a new parking lot, driveways, playground and planted areas on a portion of the subject property that is currently occupied by the Packer Field and wooded area. Renovations to the existing Cashman Elementary School parking lot and driveways will also be included in the scope. Site work covered by this SGMP is anticipated to include the following:

- clearing and grubbing;
- cutting, filling, and grading;
- excavation for utility installation;
- excavation for foundations and footings;
- excavation and grading for access roads and bioretention areas;
- dewatering as necessary to support excavation; and
- construction of a new building.

Based on known environmental conditions at the property, these activities will require handling and management of arsenic-impacted soil. All excavated and/or disturbed soil will be managed as specified in this SGMP. Although limited existing data does not indicate such, groundwater may contain elevated concentrations of arsenic.

2.0 BACKGROUND

ECMS conducted a Phase I Environmental Site Assessment (Phase I ESA) in September 2018 to identify and evaluate actual and potential environmental liabilities associated with the subject property. The Phase I ESA identified did not reveal any recognized environmental conditions (RECs).

In July 2020, *ECMS* completed the collection of loam/topsoil and subsoils samples from representative areas proximate to the Cashman School and from the fields adjacent to the school for laboratory analysis for potential oil and/or hazardous material (OHM) prior to

proposed site construction activities. Soil sampling results indicated the presence of the metal arsenic, at concentrations above applicable standards in the shallow soil samples across the area of proposed construction. Based on the concentrations detected, the condition was reportable under the Massachusetts Contingency Plan (MCP) 310 CMR 40.0000.

Given the presence of school-aged children, an emergency assessment was performed to assess the presence of these arsenic in shallow soil in other areas of the site, including infield of Randall and Packer fields. As described in Section 2.4, *Environmental Site Characterization,* arsenic was not detected in the surface soil samples from the infield of Randall or Packer Fields at concentrations above applicable standards. Soil analytical results are presented in Tables 1 through 7 with initial arsenic analytical results presented in Table 1 – Summary of Topsoil/Loam/Subsoil Samples for pH, Reactivity, Ignitability, MassDEP 14 Metals, Polychlorinated Biphenyls (PCBs) & Total Petroleum Hydrocarbons (TPH) and additional soil sample analytical results for arsenic in Tables 5 – Summary of Baseball Infield Soil Samples for MassDEP 14 Metals, Table 6 – Summary of Background Soil Samples for MassDEP 14 Metals and Table 7 – Summary of MassDEP Collected Background Soil Samples for Arsenic and Lead. The soil sampling locations with surface arsenic concentrations are depicted on Figure 9 – Soil Sample Location Plan.

2.1 Location and Legal Description of the Site

The Site is an irregularly-shaped 35.32-acre parcel of land located at 193 Lions Mouth Road in Amesbury, Essex County, Massachusetts 01913. According to the City of Amesbury Assessor, the property is listed as parcel three (3) parcels including 50/6, 50/16 and 50/42. In addition, a portion of the adjacent Woodsom Farm (parcel 37/4) is part of the proposed project. The Site is occupied by the Charles C. Cashman Elementary School and associated athletic fields, playground, parking lots and landscaped areas. Refer to Figure 2 entitled Lot Location Plan.

The Site is depicted on the 7.5 x 15-minute U.S.G.S. topographic quadrangle for Newburyport, Massachusetts dated 1987. The Universal Transverse Mercator (UTM) coordinates of the Site within zone 19 are approximately 4,746,558 meters north latitude and 340,818.9 meters east longitude or 42° 51' 26.06'' north latitude and 70° 56' 54.07'' west longitude. Elevation at the site is approximately 105 feet above mean sea level (amsl). Figure 1 includes both a Site Locus Plan and a Street Location Map of the Site. The Site and surrounding properties are shown on Figure 2, Lot Location Plan attached to this report.

2.2 Site and Vicinity Characteristics

The Site is currently occupied by the City of Amesbury Cashman Elementary School housing grades Pre-kindergarten through 4th grade students (approximately 443 children). The Site is located within OSC – Open Space Conservancy. The school building is surrounded by a driveway and associated paved parking lots, a

playground area and grass athletic field. Woodsom Farm is located to the west, and is accessed from Lions Mouth Road to the South. The north edge of the site is steeply sloping forested hill with an intermittent steam at the base. The Site is surrounded with pockets of densely settled residential neighborhoods.

2.3 Descriptions of Structures, Roads, Other Improvements on the Site

The 2-story school building is 61,472 gross square feet (GSF). The building is constructed of masonry block with brick veneer on slab on grade construction.

Assessor Office records indicate that the main Site building construction was completed in 1975. The school building is currently heated by natural gas and heated through forced air ducts. The roof is asphalt and on the roof are several HVAC units. Records indicate, the building is and always has been heated by natural gas.

The nearest surface water bodies to the Site is Lake Gardner that is located approximately 2,500 feet to the north-northeast. According to the City of Amesbury Health Department, there are no know public or private potable water supply wells in the vicinity of the Site.

The City of Amesbury obtains its drinking water from its watershed area that encompasses about 55 square miles; most of which reside in New Hampshire. Tuxbury Pond feeds the Powow River, which the treatment plant draws from. Lake Attitash and Meadowbrook also supplement the water source seasonally and in times of drought. All of Amesbury's wastewater empties into their municipal sewer system. The wastewater treatment facility is located at 19 Merrimac Street.

The site is currently supplied with natural gas and serviced by the municipal water and sewer systems. The existing Cashman School building has a sewage ejector system that was observed along the entrance driveway area south of the school.

2.4 Environmental Site Characterization

In July and August 2020, *ECMS* collected pre-construction surface and subsurface soil samples for laboratory analysis in order to characterize the soils that may require off-site disposal. Soil sampling results indicated the presence of arsenic at concentrations above applicable standards in every location sampled across the proposed work site. Additional surface soil samples were subsequently collected on July 31, 2020 from the two baseball infields (Randall and Packer Little League Fields) at the site to verify that arsenic was not present in the imported red clay soils on either field. No arsenic was detected over any reportable concentration in any of the eight (8) surface infield samples analyzed. In addition, one (1) soil sample collected on August 12, 2020 from the outfield on Randall field at a depth of

approximately 2 feet below grade did not have arsenic above its reportable concentration.

The assessment revealed elevated arsenic concentrations in 28 of 28 shallow soil samples (excluding the soil samples collected from both infields and one (1) sample from the outfield of Randall Field). The concentrations of generally exceeded reportable thresholds of 20 milligrams per gram (mg/kg), and in some cases exceeded Imminent Hazard (IH) Threshold of 40 mg/kg. No soil sample had a concentration of arsenic detected over its applicable Upper Concentration Limits (UCL) of 500 mg/kg. Soil analytical results are presented in Tables 1 through 7 and soil sampling locations are depicted on Figure 3.

Though arsenic detected in the site soils are background condition associated with known elevated arsenic concentrations in bedrock, their presence in soil poses a potential risk to construction workers at the site. Based on estimated quantities of topsoil and subsoils that will be required to be disposed of off the site, additional soil sampling and laboratory analysis to characterize the soils are necessary to be completed prior to commencement of construction activities. This sampling can be best achieved during initial site preparation that includes the stripping and stockpiling of the topsoil/loam.

2.5 Release Notification Retraction

After extensive soil sampling, including sampling with the MassDEP, *ECMS* concluded that the presence of the arsenic detected on the site was from naturally occurring sources.

Consistent with the provisions of 310 CMR 40.0335(1)(c), this release notification was retracted on the basis that the subject "release" did not meet one or more of the sets of notification criteria specified in 310 CMR 40.0300. Specifically, releases of arsenic do not require notification pursuant to 310 CMR 40.0317(22) if they are in areas that are documented to have elevated arsenic measured in soil or groundwater that:

- is consistently present in the environment at and in the vicinity of the sampling location;
- is solely attributable to natural geologic or ecologic conditions; and
- has not been mobilized or transferred to another environmental medium or increased in concentration in an environmental medium as a result of anthropogenic activities.

The City of Amesbury lies within an area of Massachusetts that has been identified in studies by the United States Geological Survey (USGS) as being underlain by bedrock units, particularly the Merrimack and Nashoba formations, containing elevated arsenic concentrations (see *Arsenic and Uranium in Water from Private Well*

Completed in Bedrock of East-Central Massachusetts – Concentrations, Correlations with Bedrock Units, and Estimated Probability Maps, John A. Colman, USGS, Scientific Investigations Report 2011-5013).

Elevated concentrations of arsenic were detected in native soil across the site at all depths sampled, with the most elevated concentration detected just below the grass cover to a depth of 2 feet below grade. No field evidence was encountered that indicated soil had been disturbed or mobilized, or that an anthropogenic activity might have resulted in the elevated arsenic concentrations.

On September 17, 2020, *ECMS* submitted a Retraction of Release Notification dated September 17, 2020 in accordance MCP 310 MR 40.0335 to the MassDEP via eDEP.

In accordance with MCP 40.0335: Retracting a Notification "Submission of a notification retraction in conformance with the provisions of 310 CMR 40.0335 shall terminate all future response action requirements and submittals that would otherwise be necessitated by the reporting of said release or threat of release, unless written notice to the contrary is provided by the Department within 21 days of the Department's receipt of such retraction." Therefore, since of the writing of this SGMP has surpassed the 21 days, the *ECMS* Retraction of Release Notification dated September 17, 2020 has been conditionally accepted by MassDEP and RTN 3-36397 will be retracted and the site is not subject to the MCP at this time.

3.0 PURPOSE AND SCOPE

The objectives of this SGMP are to ensure that:

1. arsenic-impacted soil and groundwater, if encountered, are managed in accordance with applicable federal, state, and municipal laws and regulations;

2. although this site has been determined to be outside of the MCP, analytical testing and reporting are completed in accordance with Massachusetts MassDEP requirements stipulated under the MCP;

3. worker safety is preserved through awareness of potential exposure conditions;

4. the safety of the school children, workers and the general public is preserved throughout; and

5. access to excavated soil and excavation areas is limited to workers covered by an appropriate environmental Health and Safety Plan (HASP), and prevented for all others, including children, abutters, or accidental trespassers.

To achieve these objectives, this plan presents the procedures that will be followed during the management of soil and groundwater at the site. All soil and groundwater encountered within the work area will be subject to the provisions of this plan. In addition, the provisions of this plan can, and will be, extended to any other off-site areas where contaminants are detected via field screening, visual observation, or any other method.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

ECMS is the consultant responsible for the development of this Soil & Groundwater Management Plan (SGMP). Mr. Kevin J. Kavanaugh, LSP, CHMM is the primary point of contact for this project. All correspondence concerning the content or implementation of this plan should be directed to him [via email at kevin.kavanaugh@ecmsinc.com; or via telephone at (617) 338-2121 ext. 2].

This plan will be implemented by *ECMS*, the general contractor, and its subcontractors during earthwork in support of this project. The *ECMS* Project Manager, Mr. Kevin J. Kavanaugh, LSP, CHMM, is responsible for project team organization, supervision of all project tasks, and production of reports and deliverables.

An *ECMS* field scientist will be responsible for the execution of field activities, including monitoring, sampling, and stockpile management. *ECMS* field scientists have completed 40-hour OSHA Hazardous Waste Operations (HAZWOPER) training as well as 8-hour HAZWOPER Supervisor training and are experienced in excavation oversight and field screening techniques. Contact information for key contractors and individuals is as follows:

Client: *DiNisco Design, Inc.*
Site Name: Cashman and New Amesbury Elementary School
Site Location: 193 Lions Mouth Road, Amesbury, Massachusetts

General Contractor: To Be Determined

Site work contractor: To Be Determined

Field Safety Officer: *ECMS*
288 Grove Street #391, Braintree, Massachusetts 02184
Field Scientist: To Be Determined
Project Manager - LSP: Kevin J. Kavanaugh, LSP o: (617) 338-2121
c: (617) 212-9255

The general contractor's Superintendent will communicate with *ECMS* regarding this SGMP and be responsible for its implementation.

5.0 SITE MANAGEMENT

Soil will be excavated and/or disturbed for installation of subsurface features and to reach finished grades for the proposed construction project. Temporary construction fencing will be installed around construction areas to prevent access by unauthorized personnel. Stormwater and erosion control are not part of this plan, but will be implemented by the contractor in accordance with the approved construction drawings and specifications.

With the exception of the two Little League Fields (Randall and Packer), impacted soil has been found to be located from just below the grass surface to the maximum depths necessary for the proposed project. Based upon the historical use of the site, as well as site characterization data, arsenic appears to be present throughout the entire work area and the source is naturally occurring. The soil management provisions of this plan will be implemented during all soil intrusive work. The work includes handling and disposal of potentially-impacted soil for construction of new building, and appurtenant facilities, such as underground utilities. Dewatering may be required to facilitate utility and foundation installation.

During construction activities, workers will minimize contact with impacted soil (and groundwater) and practice appropriate work site hygiene. An environmental *Health and Safety Plan* (HASP) has been prepared separately and will be implemented for the project. Exclusion zones may be established based upon conditions observed during construction, and workers entering the exclusion zones during soil-intrusive activities will be required to have HAZWOPER training consistent with the requirements of 1910.120.

Materials that may be encountered during construction include, but are not limited to, the following:

- **Decontamination Water**: Water may be generated during decontamination of equipment and personal protective equipment (PPE) and, if generated, will require management.
- **Sediment:** Sediments removed from any erosion and sediment control devices (e.g., silt fence, inlet covers) or stormwater collection systems will be stockpiled in the primary stockpile area for assessment and potential off-site disposal/recycling.
- **Imported fill materials:** Clean fill materials will be brought to the site as needed. All imported materials will be inspected by the field scientist.
- **Arsenic-contaminated Soil**: The metal arsenic has been encountered in soil at concentrations exceeding applicable standards.

As only an estimated 25% of soil excavated during the project is expected to be reused on site; the project site will require additional material for cover and fill. However, excavated soil in excess or not suitable for reuse for geotechnical reasons will require off-site disposal. Soil that is suitable to be re-used on site will be placed beneath permanent structures such as

buildings, concrete or asphalt paving, rubberized playground surface landscaped areas with a minimal non-arsenic-impacted soil and beneath unpaved recreational areas (such as playing fields) unless it is demonstrated by analytical testing that arsenic concentrations meet applicable standards for unrestricted use.

6.0 ENVIRONMENTAL MONITORING

Environmental monitoring will be performed by a qualified *ECMS* field scientist, who will be on site during all soil intrusive work. The field scientist will confirm compliance with this SGMP and the HASP. The scientist will monitor for dust concentrations in ambient air and will be the primary observer for potential conditions indicating the presence of contaminants other than arsenic. Conditions that may indicate the presence of contaminants in soil or groundwater may include stressed vegetation, odors, staining, buried structures such as tanks or pipelines, and elevated organic vapor concentrations. Findings will be communicated to the Site Superintendent regularly throughout each day. In addition, findings will be communicated to the workers who are handling the materials, both in real time and during follow-up tailgate meetings.

6.1 Ambient Air Monitoring

The air monitoring program is designed to protect human health and the environment surrounding the site and provide contingencies to mitigate off-property airborne particulate arsenic levels exceeding project action levels.

Ambient air within the area of excavation or soil disturbance will be monitored for total dust using a handheld meter to ensure that excavation does not create airborne particulate arsenic concentrations that pose health risks to site workers. Worker exposure monitoring is detailed in the HASP. Air monitoring will also be implemented at fixed monitoring stations at the site perimeter to evaluate air quality at the limits of the work area. One fixed monitoring station will be placed between the active work zone and the Cashman School building. Another will be placed in a location near the nearest residence at 201 and a final one if necessary, will be placed in a downwind direction (determined during construction). The fixed stations will log readings continuously and will be checked at least hourly throughout the day.

For total dust, a work zone action level of 0.02 milligrams per cubic meter (mg/m^3) has been established, as detailed in the HASP. This level is designed to be protective of workers via the inhalation pathway using exposure factors provided by MassDEP. A "fence line" or work perimeter action level for total dust will be set at 0.05 mg/m^3. This level is designed to be protective of residents in the area and students at the school. An airborne dust concentration of 15 mg/m^3 results in a visible dust cloud; therefore, the presence of visible dust will also be considered an action level.

Upon exceedance of an action level, work practices will be altered to reduce the generation of vapors or total dust. Work practice alterations may include:

- Reducing the pace of, or halting, excavation or soil handling.
- Covering areas of excavation and stockpiled soil with poly sheeting.
- Applying water or another vapor/dust suppressant.

Monitoring results will be conveyed to the Site Superintendent if results affect the selection of personal protective equipment (PPE) or require modification of construction practices (*e.g.*, work stoppage, dust-suppression).

6.2 Soil Screening

The presence of arsenic in soil is being assumed using pre-characterization soil data, which will be supplemented by additional data as work progresses as necessary. Depending upon project objectives, field screening for metals (arsenic) may be performed using a handheld x-ray fluorescence (XRF) analyzer. The use of an XRF is limited to "screening" level data but could be useful once conditions during construction are identified. Attached as Appendix A is a Review of Applications and Guidance on the Measurement of Arsenic in Soil Using XRF by the University of Florida (UF) dated June 20, 2013.

While not anticipated, if visual or olfactory observations suggest the presence contaminants other than arsenic, representative soil samples will be screened for organic vapors with a photoionization detector (PID) using the jar headspace procedure. At the beginning of each work day, the PID will be calibrated per the manufacturer's recommendations. The appropriate photosensitivity will be set on the instrument to read as isobutylene. Periodically throughout the day, background air concentrations will be noted, and calibration checks (zero and span gas) will be made. If field screening data suggest areas of significant contamination other than arsenic, excavation may be extended beyond construction requirements to remove impacted material.

7.0 MATERIAL STORAGE

Although other waste materials will be generated during execution of the project (*e.g.*, demolition building materials), this plan is limited to the management of soil and groundwater.

7.1 Soil Stockpiling and Storage

The air monitoring program is designed to protect human health and the environment surrounding the site and provide contingencies to mitigate off-property airborne particulate arsenic levels exceeding project action levels.

All excavated soil will be stockpiled pending determination of geotechnical suitability for re-use. To the extent possible, soil will be segregated based on field screening data and for planning purposes, it is presumed that elevated arsenic concentrations are ubiquitous at the site. Approximate quantities are identified in the bid documents.

This presumption will prevail until laboratory analytical data indicate otherwise. Additional soil samples will be collected prior to the initiation of construction activities and will be used to guide segregation of soil.

Although not anticipated based on pre-characterization soil sampling, the presence of significant volatile organic compounds (VOCs) or petroleum hydrocarbons can generally be detected using a combination of visual, olfactory, and PID field screening data. Any soil exhibiting characteristics that indicate contamination will be stockpiled separately.

A primary stockpile and storage location will be selected by the contractor. Temporary stockpile locations adjacent to excavations may also be designated based upon field conditions, site logistics, and project sequencing, but will be located exclusively within the subject property boundary. Soil may be temporarily stockpiled adjacent to a working excavation for backfill into that same excavation.

Up to three distinct stockpile areas will be created as follows:

- **Stockpile 1 – Arsenic-Impacted Soil** - All soil excavated from the site for potential re-use beneath buildings, rubberized playground or pavement, at depths of greater than 1 foot below grade in landscaped areas, and at depths of greater than 2 feet below grade in other unpaved recreational areas (such as playing fields).
- **Stockpile 2 - Contaminated Soil (other than arsenic)** - Excavated soil exhibiting characteristics that indicate contamination (elevated field screening data) will be characterized and disposed off-site. Soil contaminated with other than arsenic, if encountered, will not be reused on site.
- **Stockpile 3 – Non-Arsenic-Impacted Soil** - Excavated topsoil/loam that has been analyzed and is not arsenic-contaminated and can be reused unrestricted on the site.

Laboratory characterization is not required for soil being re-used on site that does not exhibit visual, olfactory, or field screening evidence of contamination.

All soil stockpiles will be securely covered by 6-mil (minimum) polyethylene sheeting at the end of each day and whenever the pile is not in active use. Run-on and run-off controls (*e.g.,* silt fence and hay bales) will be provided as needed to minimize migration of sediments to or from the pile. At no time will the generation of visible dust from the stockpiles be permitted.

Saturated materials may not be placed in stockpiles, and may not be transported from the site if free liquids are present or may be generated. All such materials will be drained or dewatered in a location near the point of generation so that drainage water is returned to the excavation.

Whenever possible, and as necessary, dewatering will be performed so that saturated soil is not generated.

7.2 Groundwater and Decontamination Water Storage

If encountered, groundwater recovered during excavation dewatering will be contained onsite pending proper characterization. If groundwater is determined to contain elevated concentrations of arsenic or other contaminants, water will be contained pending treatment and discharge (see Section 7.3) or offsite disposal. If groundwater concentrations are determined to be below applicable standards, the water can be discharged in accordance with the construction specifications.

Decontamination of construction equipment will be required prior to the equipment leaving the site. Where decontamination is required, equipment will be dry brushed to remove the majority of solids. If necessary, high pressure water and scrubbing will be used to remove remaining visible material. All decontamination rinsate will be contained on site or collected and managed for off-site disposal.

7.3 Groundwater and Decontamination Water Treatment and Discharge

If decontamination rinsate is generated or groundwater is encountered and removed from excavations, then treatment of the water under either a Construction General Permit (CGP) or a Remediation General Permit (RGP) will be required prior to on-Site discharge. Groundwater discharge must comply with construction specifications in addition to issued permits. Alternatively, if a small volume of water is generated, the water may be shipped off-site for proper treatment and disposal.

8.0 MATERIAL REUSE

Soil suitable for reuse (Stockpile 1 as defined in Section 7.1) will be backfilled into the excavation from which it was removed, to the maximum extent practicable, at the depth from which it was removed. Material that cannot be replaced into the initial excavation location will be backfilled in areas of similar characteristics and arsenic concentrations, and at appropriate depths, to the extent feasible.

Topsoil/loam suitable for reuse (Stockpile 3 as defined in Section 7.1) may be used unrestricted.

9.0 FINISHED GRADES

Due to the presence of the elevated concentrations of arsenic in the soil and the planned (and current) use of the site as an elementary school, final surface grade materials must be selected to minimize contact with arsenic impacted soil following completion of the project. In general, suitable barriers to contact included the following:

- Pavement;
- Buildings;
- Clean fill material approximately two (2) feet in thickness placed over arsenic impacted soils in recreational areas that will see more contact potential (such as a plying field);
- Clean fill material approximately one (1) foot in thickness placed over arsenic impacted soils in landscaped areas; and/or
- Gravel approximately 6 inches in thickness placed over a persistent demarcating layer within the utility corridors that have been backfilled with any arsenic containing soils.

As a result, cuts in areas that will be accessible will need to be adjusted to allow for the placement of clean base course, clean fill, and/or clean topsoil to attain finish grades.

10.0 MATERIAL CHARACTERIZATION

10.1 Soil Sampling and Analysis for Site Materials

Based upon discussions with *DiNisco*, approximately 25% of the excavated soil is anticipated to be re-used on site without laboratory analysis. However, the additional cut necessary to accommodate clean fill at finish grade may alter the cut/fill balance. For purposes of this plan, it is assumed that soil not suitable for re-use will be transported to an off-site disposal facility, or if approved by the City of Amesbury, to a City owned property that has similar arsenic concentrations under the Similar Soils Provision Guidance "Guidance for Identifying When Soil

Concentrations at a Receiving Location Are "Not Significantly Lower Than" Managed Soil Concentrations Pursuant to 310 CMR 40.0032(3) WSC#-13-500 dated September 4, 2014. The location of city owned property with similar arsenic concentrations has not been identified as of the writing of the plan. Based on the concentrations of naturally occurring arsenic found, disposal of this material is likely to be out of state. A copy of the Similar Soils Provision Guidance MassDEP Policy WSC#13-500 dated September 4, 2014 is attached as Appendix B.

Any soil transported off site should be transported under either a MassDEP Bill of Lading (BOL) or Material Shipping Record (MSR) and it is recommended that this be under the supervision of a Massachusetts Licensed Site Professional (LSP).

Currently 17 representative soil samples have been collected in-situ and analyzed for all necessary parameters for off-site disposal of excess soils generated during proposed construction. Based on a one sample per 500 cubic yards as specified in the MassDEP "Reuse and Disposal of Contaminated Soil at Massachusetts Landfills" MassDEP Policy # COMM-97-001 dated August 15, 1997. This would already cover approximately 8,500 cubic yards of soil that could be excavated and transported off-site to a disposal facility. Any additional representative samples of stockpiled soil requiring off-site recycling or disposal should be collected in accordance with the receiving facility requirements. For the purposes of this plan, the soil pre characterization requirements *ECMS* recommends that analysis be completed in accordance with the MassDEP "Reuse and Disposal of Contaminated Soil at Massachusetts Landfills" MassDEP Policy # COMM-97-001 dated August 15, 1997 unless a disposal facility is selected and requires a different list of laboratory analysis.

Stockpile samples for waste characterization will be collected as 9-point composites using clean, disposable sampling implement (*e.g.*, plastic scoop) and placed into a clean container for mixing. The aliquots will then be well-homogenized in the field in groups of three to create three 8-ounce composite sub-samples. The three (3) sub-samples will be composited by the analytical laboratory into a single sample. Each of the initial characterization samples will be submitted for analysis of polychlorinated biphenyls (EPA Method 8082), total RCRA 8 metals, VOCs (EPA Method 8260), semi-VOCs (EPA Method 8270), pH, and flashpoint. Samples will be analyzed for toxicity characteristic leaching procedure (TCLP) RCRA 8 metals as needed. Once initial characterization is complete, one soil samples is required to be analyzed for RCRA 8 metals per 500 tons of soil to be disposed. All samples will be placed on ice immediately after collection and transported to *Eurofins Spectrum Analytical Laboratory (Eurofins Spectrum)* in Rhode Island for analysis.

10.2 Soil Sampling and Analysis for Imported Materials

Clean fill that is brought into the site must be from a clean borrow site and certified to be free of contaminants. Clean fill will be characterized to confirm soil quality.

Initial loads of fill material will be fully characterized based on the origin of the material. Subsequently, samples will be collected at a minimum of one per 500 cubic yards and submitted for analysis of total arsenic.

10.3 Water Sampling and Analysis

If dewatering and water treatment are required, then water sampling and analysis requirements will be established to comply with the MCP and/or appropriate permits.

10.4 Quality Control

Given the intended re-use on site of the some of excavated soil, the assumed ubiquity and consistency of arsenic concentrations across the work area, and the lack of a need for site characterization analysis during excavation, field duplicates and equipment rinsate samples will not be prepared or submitted for this project. If contamination is discovered that triggers site characterization during this project, then the quality control requirements will be revised to reflect modified data quality objectives.

A trip blank will accompany all sample shipments that contain water samples for volatiles analysis. The trip blank will be prepared and supplied by the laboratory and will accompany the sample containers on the roundtrip from the laboratory to the site and back.

11.0 MATERIAL DISPOSAL/RECYCLING

11.1 Soil Transport and Disposal/Recycling

Whereas previously mentioned, only an estimated 25% of excavated soils will be re-used on the site. Excess soil and soil that is determined to be unsuitable for reuse (due to field screening indicating the likely presence of contaminants, geotechnical limitations, or excess volume) will be managed via off-site disposal or recycling. The soil will be transported to the receiving facility under an MCP Bill of Lading, or Uniform Hazardous Waste Manifest (if necessary), consistent with the facility permit requirements. A log of all loads shipped off site and copies of all disposal documents (including receiving facility weight slips) will be maintained by the field scientist.

The truck loading area and access road(s) will be kept free of soil. Prior to departing the site, all vehicles used to transport soil will be inspected by the field scientist to ensure that:

- The truck is licensed for hauling contaminated soil;
- A tarp has been placed over the load;

- The truck tires are free of potentially-contaminated soil; and
- The driver has the appropriate paperwork to transport the material.

If truck tires are observed to be coated with soil, decontamination will be required, as set forth in Section 12.0.

11.2 Groundwater Disposal/Recycling

If required, groundwater can be disposed off-site at a suitable facility based upon characterization data. Groundwater transported from the site must be transported under an MCP Bill of Lading or Uniform Hazardous Waste Manifest.

12.0 MATERIAL DISPOSAL/RECYCLING

Measures will be put in place to eliminate the potential for equipment to track soil off the site. A tracking pad will be installed at the site entrance/exit. All soil must be removed from equipment and vehicles prior to leaving the site.

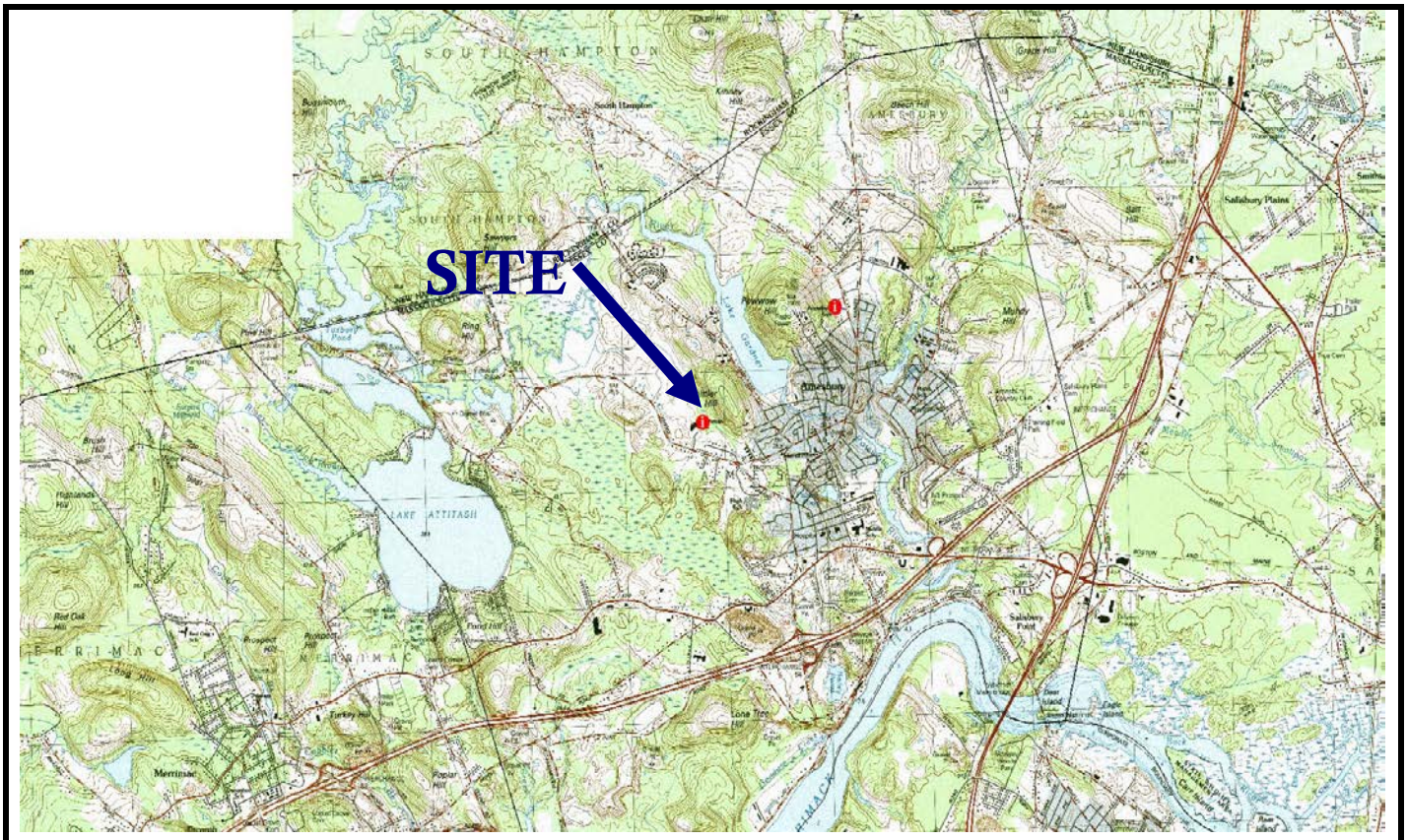
Decontamination of the equipment will be required prior to leaving the active work area. A decontamination area will be designated and constructed by the contractor in such a way as to contain decontamination liquids and/or solids to prevent them from leaving the site.

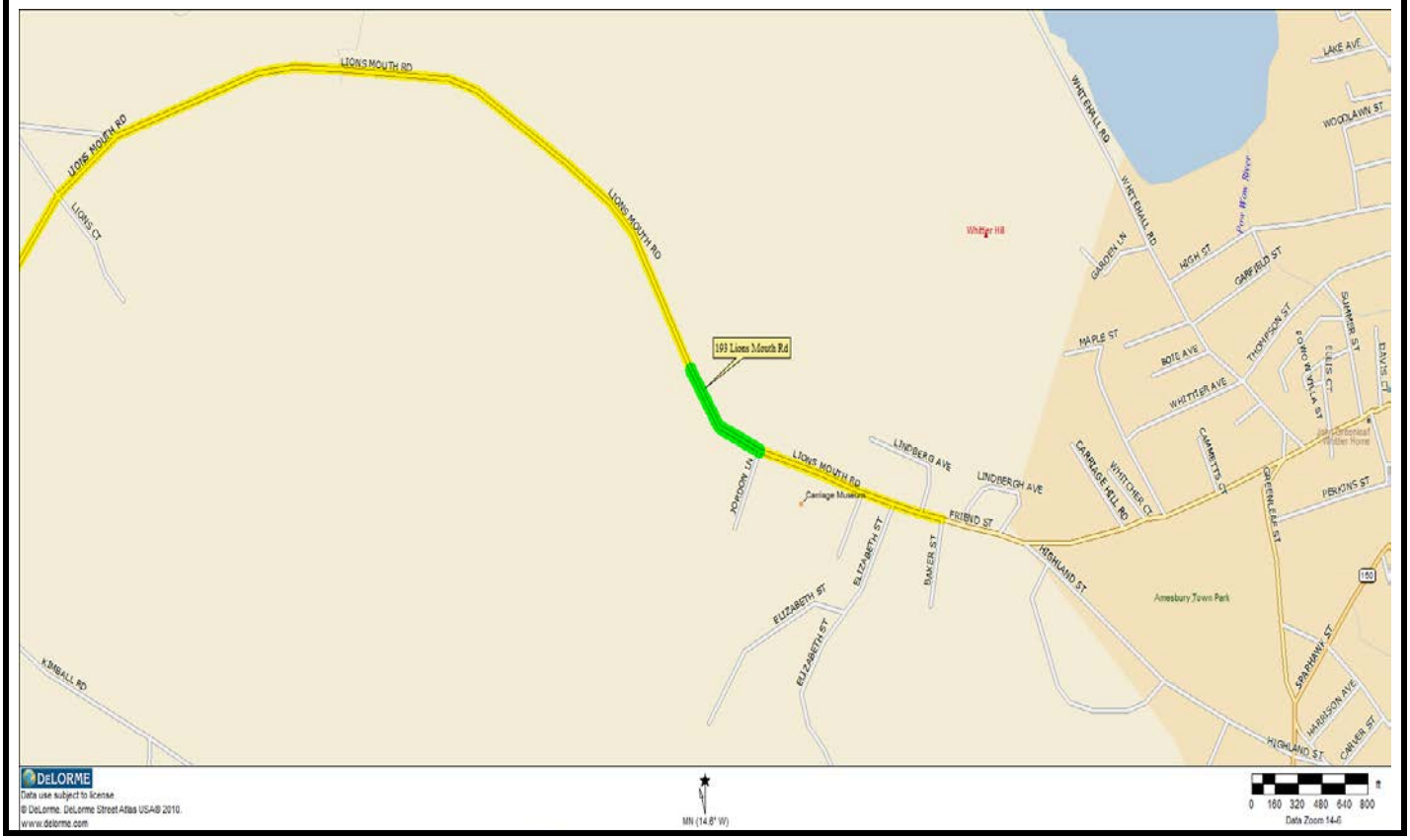
Equipment requiring decontamination will be brushed to remove adhered soil. If brushing cannot remove all visible soil, the equipment will be power washed or scrubbed and rinsed with fresh water to remove adhered soil and visible material. All decontamination rinsate will either be contained on site or be collected and managed consistent with the management of groundwater. Solids generated during decontamination must be field screened for contaminants prior to be being added to Stockpile 1.

13.0 HEALTH & SAFETY

All work under this plan will be performed in accordance with the applicable health and safety provisions for general construction established in 29 CFR 1926 and for uncontrolled hazardous waste sites as established in 29 CFR 1926.65 and 29 CFR 1910 when appropriate. A site-specific HASP has been prepared and will be implemented at the site. Health and safety monitoring of on-site operations will be performed by qualified personnel. At the onset of the project, and during weekly tailgate safety meetings, workers will be reminded of the potential for encountering contaminated soil. More frequent meetings will be held initially, with the frequency adjusted based on the variability of site conditions.

FIGURES





Cashman Elementary School **193 Lions Mouth Road** **Amesbury, Massachusetts** **01913**	**Environmental & Construction Management Services, Inc.**	**Project No.** 1009.073	**Figure 1**
		Site Locus / Street Location Plan	**N**
		Drawn By: KJK	**Date:** 8/24/18

CITY OF AMESBURY, MASS.

Assessor Maps



LEGEND

- Parcel Line
- Building Footprints
- Prior Parcel Line with Common Ownership
- 5 Condo Unit Number
- Right of Way
- Map Index
- Town Boundaries
- Easements
- Hydrographic Features
- Streams
- Wetlands

Exempt Lands

- Federal
- State
- Municipal
- Private

N

SCALE: 1" = 100'

100 0 100 200 300 400

NOTE:
THE AREAS, BOUNDARIES, AND DIMENSIONS SHOWN ON THIS TAX MAP ARE DERIVED FROM AERIAL PHOTOGRAPHS, GROUND SURVEYS, AND RECORDED PLANS, MAPS, DEEDS, AND WILLS, AND ARE INTENDED TO BE USED FOR PROPERTY ASSESSMENT PURPOSES ONLY AND NOT FOR CONVEYANCE.

MAP REVISION DATE		
As of January 1, 2018		

Data Sources: The data for this map was supplied by the Merrimack Valley Planning Commission, the Town of Amesbury and the Executive Office of Environmental Affairs/MassGIS.

Merrimack Valley Planning Commission
plan • develop • promote

J:\ArcGIS\Amesbury\AmesburyAssessorMap_24x36.mxd

INDEX

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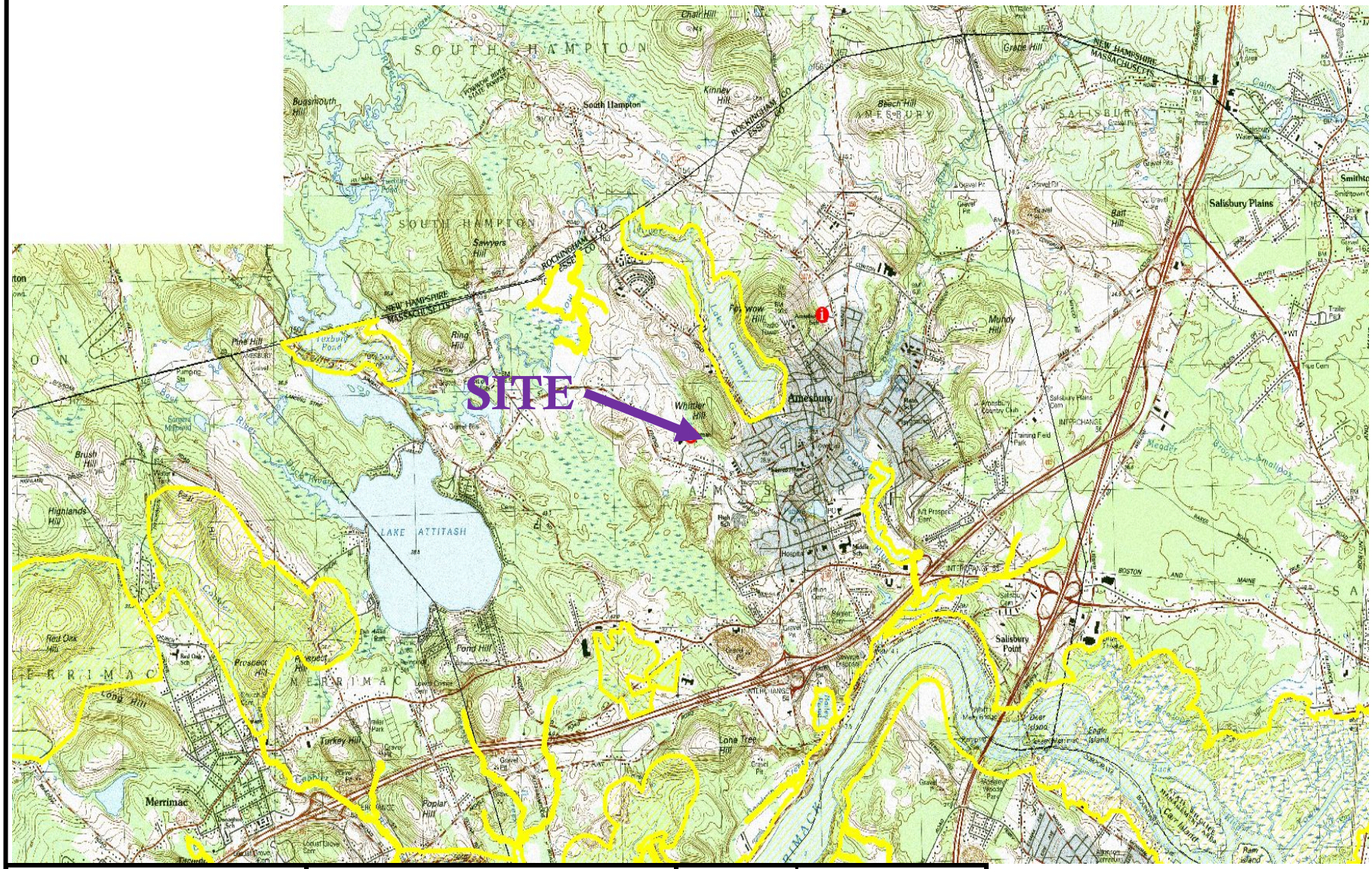
30	31	32	33	34	35	36	37	38	39	40	41	42	43	
	44	45	46	47	48	49	50	51	52	53	54	55	56	
	57	58	59	60	61	62	63	64	65	66	67	68	69	
	70	71	72	73	74	75	76	77	78	79	80	81		
	82	83	84	85	86	87	88	89	90	91	92			
	93	94	95	96	97	98	99		100	101				
	102	103	104	105	106	107								
		108	109	110	111									

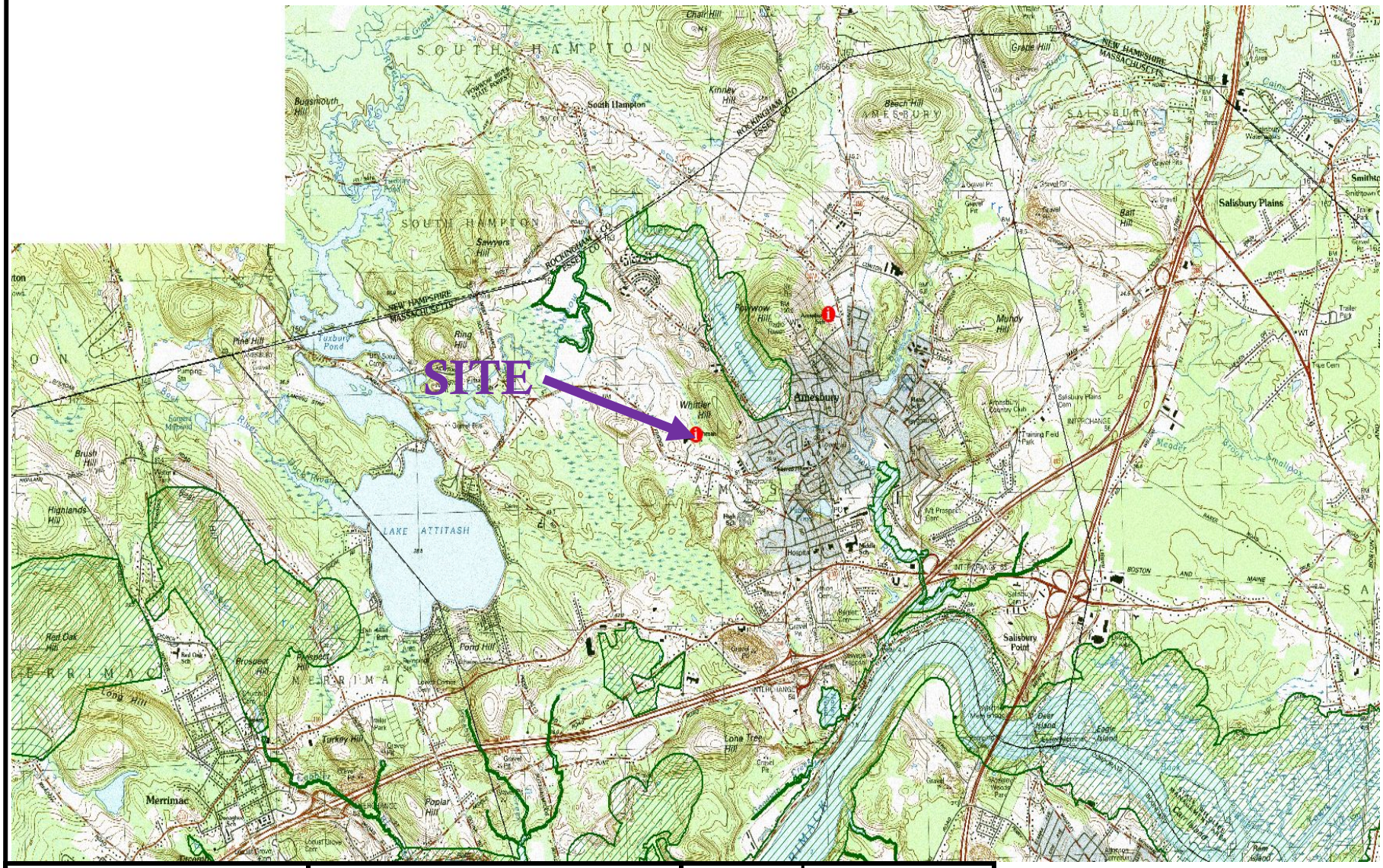
Map 50



Cashman Elementary School
193 Lions Mouth Road
Amesbury, Massachusetts
01913

Environmental & Construction Management Services, Inc.

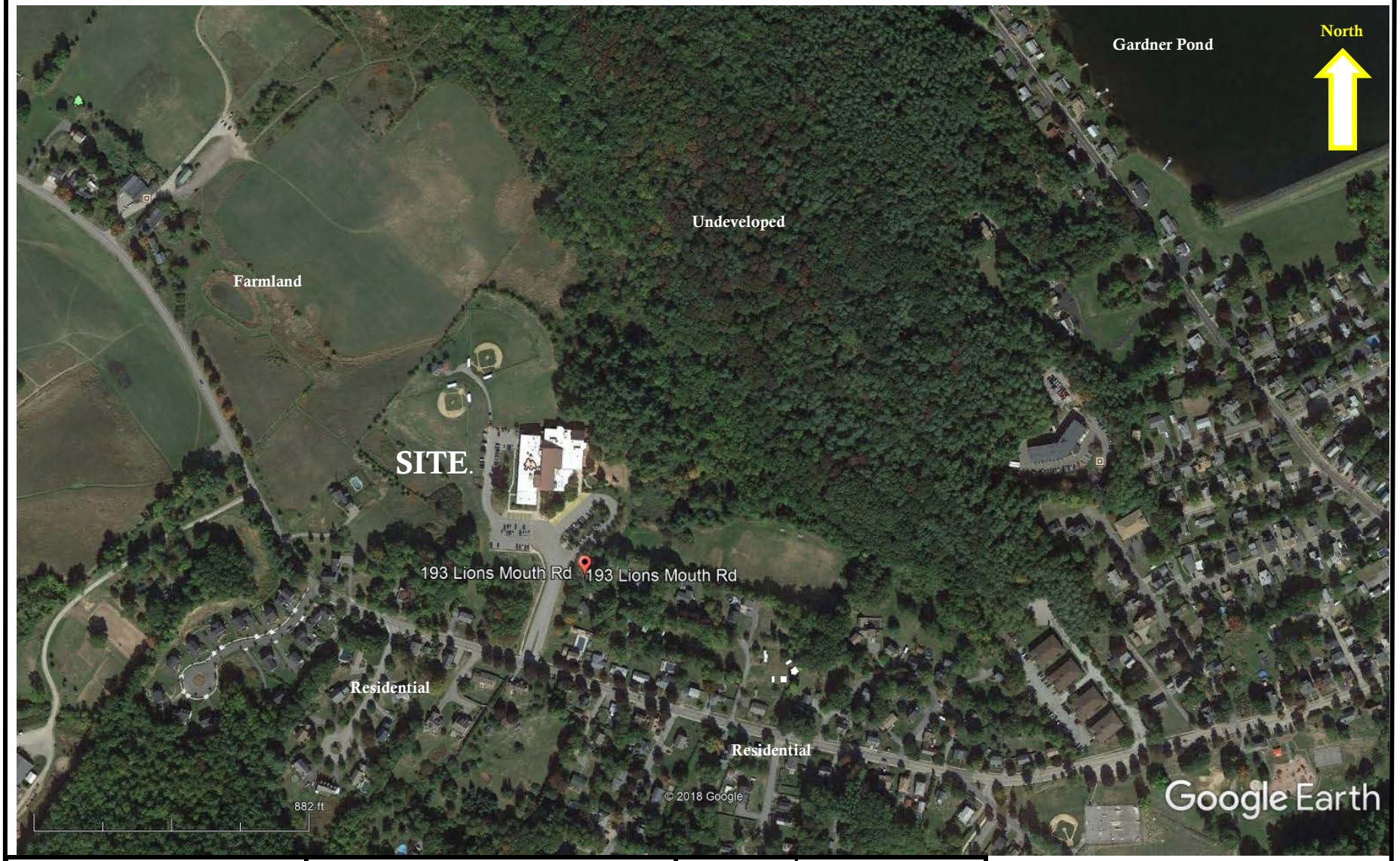
Project No. 1009.073	**Figure 3**
Priority Habitats of Rare Species Plan	
Drawn By: KJK	**Date:** 8/23/18



Cashman Elementary School
193 Lions Mouth Road
Amesbury, Massachusetts
01913

Environmental & Construction Management Services, Inc.

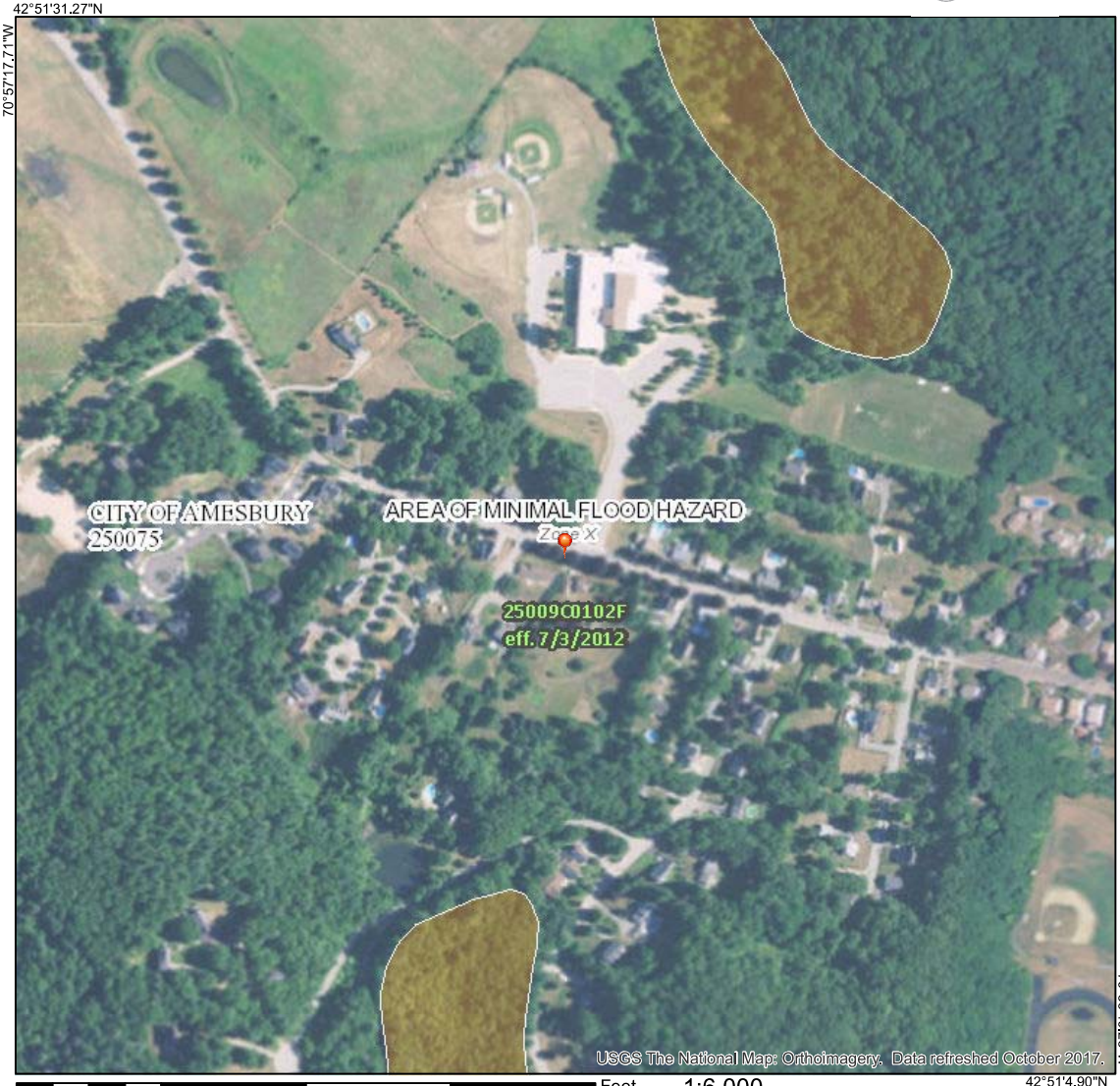
Project No. 1009.073	**Figure 4**
Map of Estimated Habitats of Rare Wildlife and Certified Vernal Pools	
Drawn By: KJK	**Date:** 8/23/18



Cashman Elementary School **193 Lions Mouth Road** **Amesbury, Massachusetts** **01913**	**Environmental & Construction Management Services, Inc.**	**Project No.** 1009.073	**Figure 5**
		Aerial Photograph Site Location Plan	
		Drawn By: KJK	**Date:** 8/24/2018

National Flood Hazard Layer FIRMette

FEMA



0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

FIGURE 7

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/13/2018 at 3:39:51 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



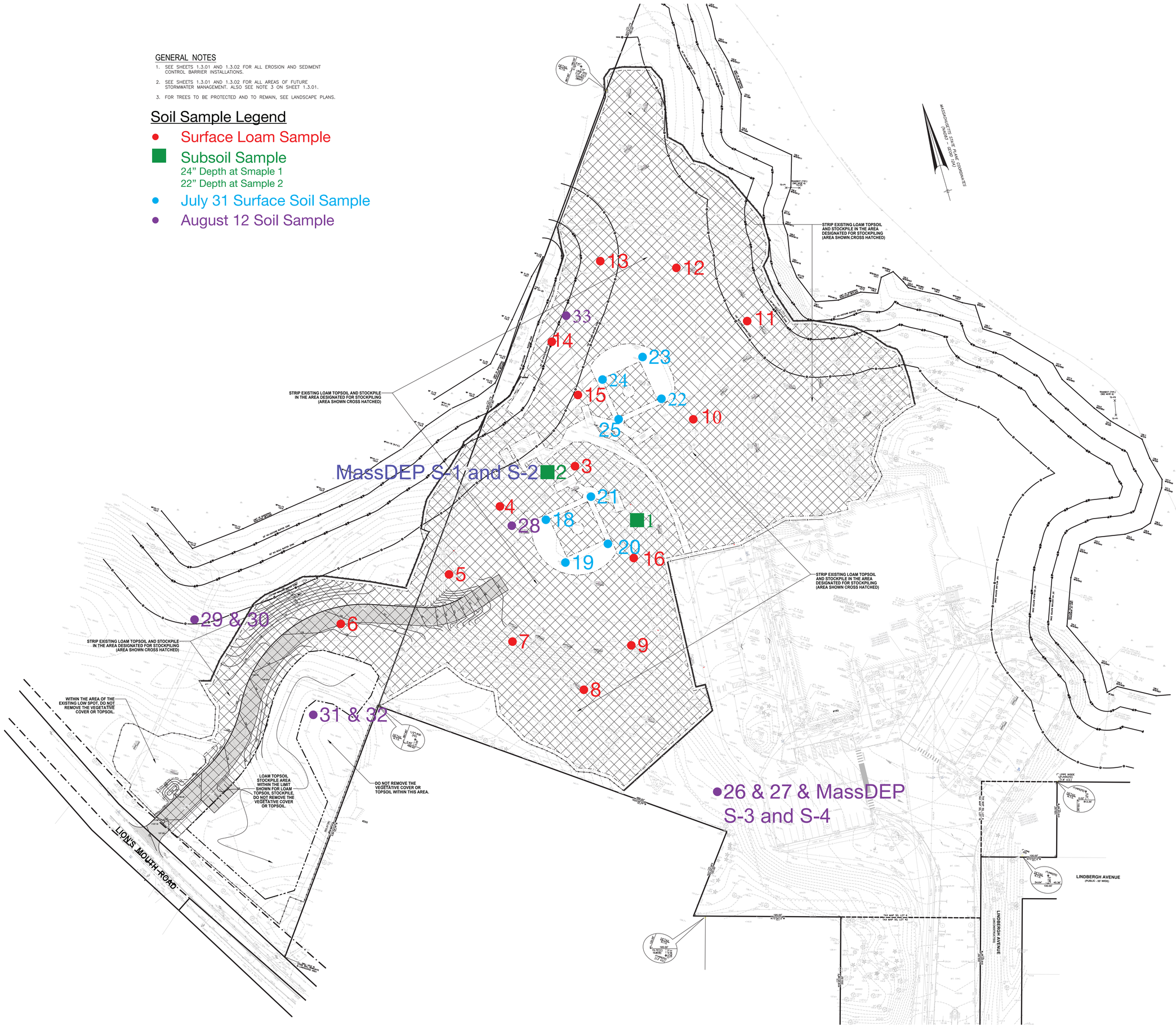
Cashman Elementary School **193 Lions Mouth Road** **Amesbury, Massachusetts** **01913**	**Environmental & Construction Management Services, Inc.**	**Project No.** 1009.073	**Figure 8**
		Site Plan	
		Drawn By: KJK	**Date:** 8/23/18

GENERAL NOTES

1. SEE SHEETS 1.3.01 AND 1.3.02 FOR ALL EROSION AND SEDIMENT CONTROL BARRIER INSTALLATIONS.
2. SEE SHEETS 1.3.01 AND 1.3.02 FOR ALL AREAS OF FUTURE STORMWATER MANAGEMENT. ALSO SEE NOTE 3 ON SHEET 1.3.01.
3. FOR TREES TO BE PROTECTED AND TO REMAIN, SEE LANDSCAPE PLANS.

Soil Sample Legend

- Surface Loam Sample
- Subsoil Sample
  - 24" Depth at Smaple 1
  - 22" Depth at Sample 2
- July 31 Surface Soil Sample
- August 12 Soil Sample



AMESBURY ELEMENTARY SCHOOL

EARLY SITE PREPARATION

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Hancock Associates
Surveyor
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Danvers, MA 09123
(978) 777-3050

KEY PLAN

NORTH ARROW (Called North) STAMP

Date: 6 JULY 2020

Drawn By: KMR

Scale: 0 40 80

Revisions

Number	Date	Description

Figure 8 - Soil Sample Location Plan

G:\Contract Jobs\12526\Dwg\12526_Fig 8.dwg

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TABLES

TABLE 1

SUMMARY OF TOPSOIL/LOAM/SUBSOIL SAMPLES FOR pH, REACTIVITY, IGNITABILITY, MASSDEP 14 METALS, POLCHLORINATED BIPHENYLS (PCBs) & TOTAL PETROLEUM HYDROCARBONS (TPH)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SS-1	SS-2	SSS-3	SSS-4	SSS-5	SSS-6	SSS-7	SSS-8	SSS-9	MassDEP	MassDEP
Laboratory ID		SC58794-01	SC58794-02	SC58794-10	SC58794-11	SC58794-12	SC58794-13	SC58794-14	SC58794-15	SC58794-16	Reportable	Imminent
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	Concentrations	Hazard
Sample Depth		24"	22"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1	
SM2540 G (11) Mod. (%)												
solids	% Solids	89.3	88.8	82.7	88.9	85.8	92.6	83.4	86.1	78.7	NA	
SW846 9045D (pH Units)												
pH		5.99	6.08	6.13	5.58	5.57	5.74	5.71	5.56	5.41	NA	
SW846 Ch. 7.3 (mg/kg dry)												
Reactivity		Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative		
Reactive Cyanide		<6	<7	<7	<6	<6	<6	<7	<6	<7	30	
Reactive Sulfide		< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20		
SW846 1030 (N/A)												
NA	Ignitability by Definition	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	NA	
MassDEP 14 Metals - SW846 6010C (mg/kg)												
7440-36-0	Antimony	<5.59	<5.58	<5.98	<5.41	<6.27	<5.63	<6.01	<6.24	<6.28	20	
7440-38-2	Arsenic	**39.9**	**55.9**	**36.6**	**20.5**	**53.4**	**29.6**	**48.6**	**48.7**	**82.3**	**20**	**40**
7440-41-7	Beryllium	<0.559	<0.558	<0.598	<0.541	<0.627	<0.563	<0.601	<0.624	<0.628	90	
7440-43-9	Cadmium	<0.559	<0.558	<0.598	<0.541	<0.627	<0.563	<0.601	<0.624	<0.628	70	
7440-47-3	Chromium	22.6	19.4	21.8	18.8	25.0	30.0	65.9	31.6	24.7	100	
7439-92-1	Lead	8.42	19.3	17.0	18.6	17.0	15.8	28.6	21.0	22.9	200	
7440-02-0	Nickel	39.7	71.4	33.2	20.3	46.2	25.6	44.8	47.7	76.0	600	
7782-49-2	Selenium	<1.68	<1.67	<1.80	<1.62	<1.88	<1.69	<1.80	<1.87	<1.88	400	
7440-22-4	Silver	<3.35	<3.35	<3.59	<3.25	<3.76	<3.38	<3.60	<3.75	<3.77	100	
7440-28-0	Thallium	<3.35	<3.35	<3.59	<3.25	<3.76	<3.38	<3.60	<3.75	<3.77	8	
7440-62-2	Vanadium	22.7	24.5	30.1	24.5	33.9	35.8	46.7	36.0	39.4	400	
7440-66-6	Zinc	36.3	58.5	107	36.0	52.1	43.2	56.2	52.3	64.7	1000	
7440-39-3	Barium	18.4	22.5	30.0	29.5	30.3	28.6	34.6	33.0	29.1	1000	
RCRA Metals - SW846 7471B (mg/kg)												
7439-97-6	Mercury	<0.115	<0.127	<0.110	<0.116	<0.103	<0.120	<0.128	<0.115	<0.120	20	
Polychlorinated biphenyls (PCBs) - SW846 8082A (µg/kg)												
12674-11-2	Aroclor-1016	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
11104-28-2	Aroclor-1221	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
11141-16-5	Aroclor-1232	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
53469-21-9	Aroclor-1242	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
12672-29-6	Aroclor-1248	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
11097-69-1	Aroclor-1254	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
11096-82-5	Aroclor-1260	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	1000	
37324-23-5	Aroclor-1262	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	-	
11100-14-4	Aroclor-1268	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	-	
Total Petroleum Hydrocarbons (TPH) 8100 by GC (mg/kg)												
PH(TOT)	Total Petroleum Hydrocarbons	24.9	38.7	113	118	106	134	170	111	129	1000	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazrdous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 1

SUMMARY OF TOPSOIL/LOAM/SUBSOIL SAMPLES FOR pH, REACTIVITY, IGNITABILITY, MASSDEP 14 METALS, POLCHLORINATED BIPHENYLS (PCBs) & TOTAL PETROLEUM HYDROCARBONS (TPH)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location Laboratory ID Sample Date Sample Depth		SSS-10 SC58794-03 7/9/2020 2-6"	SSS-11 SC58794-04 7/9/2020 2-6"	SSS-12 SC58794-05 7/9/2020 2-6"	SSS-13 SC58794-06 7/9/2020 2-6"	SSS-14 SC58794-07 7/9/2020 2-6"	SSS-15 SC58794-17 7/9/2020 2-6"	SSS-16 SC58794-08 7/9/2020 2-6"	SSS-17 SC58794-09 7/9/2020 2-6"	MassDEP Reportable Concentrations RCS-1	MassDEP Imminent Hazard
SM2540 G (11) Mod. (%)											
solids	% Solids	80.1	80.6	83.3	79.0	86.9	79.8	90.3	89.6	NA	
SW846 9045D (pH Units)											
pH		6.17	5.47	5.71	6.35	6.03	5.69	6.08	6.11		
SW846 Ch. 7.3 (mg/kg dry)											
Reactivity		Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative		
Reactive Cyanide		<7	<9	<6	<7	<6	<7	<6	<6	30	
Reactive Sulfide		< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20		
SW846 1030 (N/A)											
NA	Ignitability by Definition	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	NA	
MassDEP 14 Metals - SW846 6010C (mg/kg)											
7440-36-0	Antimony	<5.89	<6.24	<5.56	<6.11	<5.63	<6.33	<5.58	<5.33	20	
7440-38-2	Arsenic	**25.4**	**33.6**	**39.2**	**49.1**	**23.7**	**37.8**	**36.6**	**21.9**	**20**	**40**
7440-41-7	Beryllium	<0.589	<0.624	<0.556	<0.611	<0.563	<0.633	<0.558	<0.533	90	
7440-43-9	Cadmium	<0.589	<0.624	<0.556	<0.611	<0.563	<0.633	<0.558	<0.533	70	
7440-47-3	Chromium	22.9	23.2	17.4	23.3	36.0	31.5	21.7	19.4	100	
7439-92-1	Lead	13.7	18.9	19.6	22.7	13.7	25.9	17.5	12.1	200	
7440-02-0	Nickel	28.2	30.4	26.9	37.2	26.1	37.7	30.6	27.9	600	
7782-49-2	Selenium	<1.77	<1.87	<1.67	<1.83	<1.69	<1.90	<1.67	<1.60	400	
7440-22-4	Silver	<3.53	<3.74	<3.34	<3.67	<3.38	<3.80	<3.35	<3.20	100	
7440-28-0	Thallium	<3.53	<3.74	<3.34	<3.67	<3.38	<3.80	<3.35	<3.20	8	
7440-62-2	Vanadium	29.6	38.3	33.5	34.6	41.9	36.3	30.6	8.48	400	
7440-66-6	Zinc	60.8	43.2	37.9	49.2	44.6	60.7	44.3	61.8	1000	
7440-39-3	Barium	26.5	24.8	21.7	28.9	44.1	46.3	24.0	113	1000	
RCRA Metals - SW846 7471B (mg/kg)											
7439-97-6	Mercury	<0.117	<0.126	<0.129	<0.133	<0.118	<0.123	<0.119	<0.116	20	
Polychlorinated biphenyls (PCBs) - SW846 8082A (µg/kg)											
12674-11-2	Aroclor-1016	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
11104-28-2	Aroclor-1221	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
11141-16-5	Aroclor-1232	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
53469-21-9	Aroclor-1242	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
12672-29-6	Aroclor-1248	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
11097-69-1	Aroclor-1254	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
11096-82-5	Aroclor-1260	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	1000	
37324-23-5	Aroclor-1262	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	-	
11100-14-4	Aroclor-1268	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	-	
Total Petroleum Hydrocarbons (TPH) 8100 by GC (mg/kg)											
PH(TOT)	Total Petroleum Hydrocarbons	109	184	180	93.0	116	168	93.6	49.7	1000	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazrdous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 2

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR VOLATILE ORGANIC COMPOUNDS (VOCs)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SS-1	SS-2	SSS-3	SSS-4	SSS-5	SSS-6	SSS-7	SSS-8	SSS-9	MassDEP Reportable Concentrations
Laboratory ID		SC58794-01	SC58794-02	SC58794-10	SC58794-11	SC58794-12	SC58794-13	SC58794-14	SC58794-15	SC58794-16	
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	
Sample Depth		24"	22"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Volatile Organic Compounds (VOCs) - SW846 8260B (µg/kg)											
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
67-64-1	Acetone	<532	<573	<711	<643	<662	<521	<594	<605	<760	6000
107-13-1	Acrylonitrile	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
71-43-2	Benzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	2000
108-86-1	Bromobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
74-97-5	Bromochloromethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
75-27-4	Bromodichloromethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
75-25-2	Bromoform	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
74-83-9	Bromomethane	<106	<115	<142	<129	<132	<104	<119	<121	<152	500
78-93-3	2-Butanone (MEK)	<106	<115	<142	<129	<132	<104	<119	<121	<152	4000
104-51-8	n-Butylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
135-98-8	sec-Butylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
98-06-6	tert-Butylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
75-15-0	Carbon disulfide	<106	<115	<142	<129	<132	<104	<119	<121	<152	100000
56-23-5	Carbon tetrachloride	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	5000
108-90-7	Chlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000
75-00-3	Chloroethane	<106	<115	<142	<129	<132	<104	<119	<121	<152	100000
67-66-3	Chloroform	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	200
74-87-3	Chloromethane	<106	<115	<142	<129	<132	<104	<119	<121	<152	100000
95-49-8	2-Chlorotoluene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
106-43-4	4-Chlorotoluene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
96-12-8	1,2-Dibromo-3-chloropropane	<106	<115	<142	<129	<132	<104	<119	<121	<152	10000
124-48-1	Dibromochloromethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	5
106-93-4	1,2-Dibromoethane (EDB)	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
74-95-3	Dibromomethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	500000
95-50-1	1,2-Dichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	9000
541-73-1	1,3-Dichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	3000
106-46-7	1,4-Dichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	700
75-71-8	Dichlorodifluoromethane (Freon12)	<106	<115	<142	<129	<132	<104	<119	<121	<152	1000000
75-34-3	1,1-Dichloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	400
107-06-2	1,2-Dichloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
75-35-4	1,1-Dichloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	3000
156-59-2	cis-1,2-Dichloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	300
156-60-5	trans-1,2-Dichloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000
78-87-5	1,2-Dichloropropane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
142-28-9	1,3-Dichloropropane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	500000
594-20-7	2,2-Dichloropropane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
563-58-6	1,1-Dichloropropene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
10061-01-5	cis-1,3-Dichloropropene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	10
10061-02-6	trans-1,3-Dichloropropene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	10
100-41-4	Ethylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	40000
87-68-3	Hexachlorobutadiene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	30000
591-78-6	2-Hexanone (MBK)	<106	<115	<142	<129	<132	<104	<119	<121	<152	100000
98-82-8	Isopropylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000000
99-87-6	4-Isopropyltoluene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
1634-04-4	Methyl tert-butyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
108-10-1	4-Methyl-2-pentanone (MIBK)	<106	<115	<142	<129	<132	<104	<119	<121	<152	400
75-09-2	Methylene chloride	<106	<115	<142	<129	<132	<104	<119	<121	<152	100
91-20-3	Naphthalene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	4000
103-65-1	n-Propylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
100-42-5	Styrene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	3000
630-20-6	1,1,1,2-Tetrachloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
79-34-5	1,1,2,2-Tetrachloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	5
127-18-4	Tetrachloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000
108-88-3	Toluene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	30000
87-61-6	1,2,3-Trichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
120-82-1	1,2,4-Trichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	2000
108-70-3	1,3,5-Trichlorobenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	30000
71-55-6	1,1,1-Trichloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
79-00-5	1,1,2-Trichloroethane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100
79-01-6	Trichloroethene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	300
75-69-4	Trichlorofluoromethane (Freon 11)	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000000
96-18-4	1,2,3-Trichloropropane	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
95-63-6	1,2,4-Trimethylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	1000000
108-67-8	1,3,5-Trimethylbenzene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	10000
75-01-4	Vinyl chloride	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	700
179601-23-1	m,p-Xylene	<106	<115	<142	<129	<132	<104	<119	<121	<152	300000
95-47-6	o-Xylene	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	500000
109-99-9	Tetrahydrofuran	<106	<115	<142	<129	<132	<104	<119	<121	<152	500000
60-29-7	Ethyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
994-05-8	Tert-amyl methyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
637-92-3	Ethyl tert-butyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	
108-20-3	Di-isopropyl ether	<53.2	<57.3	<71.1	<64.3	<66.2	<52.1	<59.4	<60.5	<76.0	100000
75-65-0	Tert-Butanol / butyl alcohol	<1060	<1150	<1420	<1290	<1320	<1040	<1190	<1210	<1520	100000
123-91-1	1,4-Dioxane	<1060	<1150	<1420	<1290	<1320	<1040	<1190	<1210	<1520	10000
110-57-6	trans-1,4-Dichloro-2-butene	<266	<286	<356	<321	<331	<261	<297	<302	<380	200
64-17-5	Ethanol	<10600	<11500	<14200	<12900	<13200	<10400	<11900	<12100	<15200	100000

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazrdous Materials List (MOHML) revised (effective) February 14, 2008

Environmental & Construction Management Services, Inc.

TABLE 2

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR VOLATILE ORGANIC COMPOUNDS (VOCs)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SSS-10	SSS-11	SSS-12	SSS-13	SSS-14	SSS-15	SSS-16	SSS-17	MassDEP Reportable Concentrations
Laboratory ID		SC58794-03	SC58794-04	SC58794-05	SC58794-06	SC58794-07	SC58794-17	SC58794-08	SC58794-09	
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	
Sample Depth		2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Volatile Organic Compounds (VOCs) - SW846 8260B (µg/kg)										
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
67-64-1	Acetone	<686	<693	<637	<695	<585	<695	<540	<529	6000
107-13-1	Acrylonitrile	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
71-43-2	Benzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	2000
108-86-1	Bromobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
74-97-5	Bromochloromethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
75-27-4	Bromodichloromethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
75-25-2	Bromoform	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
74-83-9	Bromomethane	<137	<139	<127	<139	<117	<139	<108	<106	500
78-93-3	2-Butanone (MEK)	<137	<139	<127	<139	<117	<139	<108	<106	4000
104-51-8	n-Butylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
135-98-8	sec-Butylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
98-06-6	tert-Butylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
75-15-0	Carbon disulfide	<137	<139	<127	<139	<117	<139	<108	<106	100000
56-23-5	Carbon tetrachloride	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	5000
108-90-7	Chlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000
75-00-3	Chloroethane	<137	<139	<127	<139	<117	<139	<108	<106	100000
67-66-3	Chloroform	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	200
74-87-3	Chloromethane	<137	<139	<127	<139	<117	<139	<108	<106	100000
95-49-8	2-Chlorotoluene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
106-43-4	4-Chlorotoluene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
96-12-8	1,2-Dibromo-3-chloropropane	<137	<139	<127	<139	<117	<139	<108	<106	10000
124-48-1	Dibromochloromethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	5
106-93-4	1,2-Dibromoethane (EDB)	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
74-95-3	Dibromomethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	500000
95-50-1	1,2-Dichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	9000
541-73-1	1,3-Dichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	3000
106-46-7	1,4-Dichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	700
75-71-8	Dichlorodifluoromethane (Freon12)	<137	<139	<127	<139	<117	<139	<108	<106	1000000
75-34-3	1,1-Dichloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	400
107-06-2	1,2-Dichloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
75-35-4	1,1-Dichloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	3000
156-59-2	cis-1,2-Dichloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	300
156-60-5	trans-1,2-Dichloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000
78-87-5	1,2-Dichloropropane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
142-28-9	1,3-Dichloropropane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	500000
594-20-7	2,2-Dichloropropane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
563-58-6	1,1-Dichloropropene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
10061-01-5	cis-1,3-Dichloropropene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	10
10061-02-6	trans-1,3-Dichloropropene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	10
100-41-4	Ethylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	40000
87-68-3	Hexachlorobutadiene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	30000
591-78-6	2-Hexanone (MBK)	<137	<139	<127	<139	<117	<139	<108	<106	100000
98-82-8	Isopropylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000000
99-87-6	4-Isopropyltoluene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
1634-04-4	Methyl tert-butyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
108-10-1	4-Methyl-2-pentanone (MIBK)	<137	<139	<127	<139	<117	<139	<108	<106	400
75-09-2	Methylene chloride	<137	<139	<127	<139	<117	<139	<108	<106	100
91-20-3	Naphthalene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	4000
103-65-1	n-Propylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
100-42-5	Styrene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	3000
630-20-6	1,1,1,2-Tetrachloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
79-34-5	1,1,2,2-Tetrachloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	5
127-18-4	Tetrachloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000
108-88-3	Toluene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	30000
87-61-6	1,2,3-Trichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
120-82-1	1,2,4-Trichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	2000
108-70-3	1,3,5-Trichlorobenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	30000
71-55-6	1,1,1-Trichloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
79-00-5	1,1,2-Trichloroethane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100
79-01-6	Trichloroethene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	300
75-69-4	Trichlorofluoromethane (Freon 11)	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000000
96-18-4	1,2,3-Trichloropropane	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
95-63-6	1,2,4-Trimethylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	1000000
108-67-8	1,3,5-Trimethylbenzene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	10000
75-01-4	Vinyl chloride	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	700
179601-23-1	m,p-Xylene	<137	<139	<127	<139	<117	<139	<108	<106	300000
95-47-6	o-Xylene	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	500000
109-99-9	Tetrahydrofuran	<137	<139	<127	<139	<117	<139	<108	<106	500000
60-29-7	Ethyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
994-05-8	Tert-amyl methyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
637-92-3	Ethyl tert-butyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	
108-20-3	Di-isopropyl ether	<68.6	<69.3	<63.7	<69.5	<58.5	<69.5	<54.0	<52.9	100000
75-65-0	Tert-Butanol / butyl alcohol	<1370	<1390	<1270	<1390	<1170	<1390	<1080	<1060	100000
123-91-1	1,4-Dioxane	<1370	<1390	<1270	<1390	<1170	<1390	<1080	<1060	10000
110-57-6	trans-1,4-Dichloro-2-butene	<343	<347	<318	<348	<292	<347	<270	<264	200
64-17-5	Ethanol	<13700	<13900	<12700	<13900	<11700	<13900	<10800	<10600	100000

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazrdous Materials List (MOHML) revised (effective) February 14, 2008

Environmental & Construction Management Services, Inc.

TABLE 3

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SS-1	SS-2	SSS-3	SSS-4	SSS-5	SSS-6	SSS-7	SSS-8	SSS-9	MassDEP Reportable Concentrations
Laboratory ID		SC58794-01	SC58794-02	SC58794-10	SC58794-11	SC58794-12	SC58794-13	SC58794-14	SC58794-15	SC58794-16	
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	
Sample Depth		24"	22"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Semi-Volatile Organic Compounds (SVOCs) - SW846 8270D (µg/kg)											
83-32-9	Acenaphthene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	4000
208-96-8	Acenaphthylene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000
62-53-3	Aniline	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
120-12-7	Anthracene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
103-33-3	Azobenzene/Diphenyldiazene	<368	<369	<396	<367	<379	<352	<394	<379	<415	50000
92-87-5	Benzidine	<736	<738	<792	<735	<759	<704	<787	<757	<829	10000
56-55-3	Benzo (a) anthracene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	7000
50-32-8	Benzo (a) pyrene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	2000
205-99-2	Benzo (b) fluoranthene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	7000
191-24-2	Benzo (g,h,i) perylene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
207-08-9	Benzo (k) fluoranthene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
65-85-0	Benzoic acid	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
100-51-6	Benzyl alcohol	<368	<369	<396	<367	<379	<352	<394	<379	<415	-
111-91-1	Bis(2-chloroethoxy)methane	<368	<369	<396	<367	<379	<352	<394	<379	<415	500000
111-44-4	Bis(2-chloroethyl)ether	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
108-60-1	Bis(2-chloroisopropyl)ether	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
117-81-7	Bis(2-ethylhexyl)phthalate	<186	<187	<201	<186	<192	<178	<199	<192	<210	200000
101-55-3	4-Bromophenyl phenyl ether	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
85-68-7	Butyl benzyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
86-74-8	Carbazole	<186	<187	<201	<186	<192	<178	<199	<192	<210	-
59-50-7	4-Chloro-3-methylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
106-47-8	4-Chloroaniline	<186	<187	<201	<186	<192	<178	<199	<192	<210	1000
91-58-7	2-Chloronaphthalene	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
95-57-8	2-Chlorophenol	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
7005-72-3	4-Chlorophenyl phenyl ether	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
218-01-9	Chrysene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	70000
53-70-3	Dibenzo (a,h) anthracene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	700
132-64-9	Dibenzofuran	<186	<187	<201	<186	<192	<178	<199	<192	<210	100000
95-50-1	1,2-Dichlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	9000
541-73-1	1,3-Dichlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000
106-46-7	1,4-Dichlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	700
91-94-1	3,3´-Dichlorobenzidine	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000
120-83-2	2,4-Dichlorophenol	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
84-66-2	Diethyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	10000
131-11-3	Dimethyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	30000
105-67-9	2,4-Dimethylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	700
84-74-2	Di-n-butyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	50000
534-52-1	4,6-Dinitro-2-methylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	50000
51-28-5	2,4-Dinitrophenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	3000
121-14-2	2,4-Dinitrotoluene	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
606-20-2	2,6-Dinitrotoluene	<186	<187	<201	<186	<192	<178	<199	<192	<210	100000
117-84-0	Di-n-octyl phthalate	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000
206-44-0	Fluoranthene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
86-73-7	Fluorene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
118-74-1	Hexachlorobenzene	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
87-68-3	Hexachlorobutadiene	<186	<187	<201	<186	<192	<178	<199	<192	<210	6000
77-47-4	Hexachlorocyclopentadiene	<186	<187	<201	<186	<192	<178	<199	<192	<210	50000
67-72-1	Hexachloroethane	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
193-39-5	Indeno (1,2,3-cd) pyrene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	7000
78-59-1	Isophorone	<186	<187	<201	<186	<192	<178	<199	<192	<210	100000
91-57-6	2-Methylnaphthalene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	700
95-48-7	2-Methylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	500000
108-39-4, 106-44-5	3 & 4-Methylphenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	500000
91-20-3	Naphthalene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	4000
88-74-4	2-Nitroaniline	<368	<369	<396	<367	<379	<352	<394	<379	<415	-
99-09-2	3-Nitroaniline	<368	<369	<396	<367	<379	<352	<394	<379	<415	-
100-01-6	4-Nitroaniline	<186	<187	<201	<186	<192	<178	<199	<192	<210	1000000
98-95-3	Nitrobenzene	<186	<187	<201	<186	<192	<178	<199	<192	<210	500000
88-75-5	2-Nitrophenol	<186	<187	<201	<186	<192	<178	<199	<192	<210	100000
100-02-7	4-Nitrophenol	<1470	<1480	<1580	<1470	<1520	<1410	<1570	<1510	<1660	100000
62-75-9	N-Nitrosodimethylamine	<186	<187	<201	<186	<192	<178	<199	<192	<210	50000
621-64-7	N-Nitrosodi-n-propylamine	<186	<187	<201	<186	<192	<178	<199	<192	<210	50000
86-30-6	N-Nitrosodiphenylamine	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
87-86-5	Pentachlorophenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	3000
85-01-8	Phenanthrene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	10000
108-95-2	Phenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000
129-00-0	Pyrene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	1000000
110-86-1	Pyridine	<368	<369	<396	<367	<379	<352	<394	<379	<415	500000
120-82-1	1,2,4-Trichlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	2000
90-12-0	1-Methylnaphthalene	<74.4	<74.6	<80.1	<74.3	<76.7	<71.1	<79.6	<76.5	<83.8	-
95-95-4	2,4,5-Trichlorophenol	<368	<369	<396	<367	<379	<352	<394	<379	<415	3000
88-06-2	2,4,6-Trichlorophenol	<186	<187	<201	<186	<192	<178	<199	<192	<210	700
82-68-8	Pentachloronitrobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	100000
95-94-3	1,2,4,5-Tetrachlorobenzene	<368	<369	<396	<367	<379	<352	<394	<379	<415	1000000

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Boldfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 3

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SSS-10	SSS-11	SSS-12	SSS-13	SSS-14	SSS-15	SSS-16	SSS-17	MassDEP Reportable Concentrations
Laboratory ID		SC58794-03	SC58794-04	SC58794-05	SC58794-06	SC58794-07	SC58794-17	SC58794-08	SC58794-09	
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	
Sample Depth		2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Semi-Volatile Organic Compounds (SVOCs) - SW846 8270D (µg/kg)										
83-32-9	Acenaphthene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	4000
208-96-8	Acenaphthylene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000
62-53-3	Aniline	<407	<405	<385	<414	<375	<407	<361	<356	100000
120-12-7	Anthracene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
103-33-3	Azobenzene/Diphenyldiazene	<407	<405	<385	<414	<375	<407	<361	<356	50000
92-87-5	Benzidine	<815	<809	<771	<828	<750	<814	<722	<713	10000
56-55-3	Benzo (a) anthracene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	7000
50-32-8	Benzo (a) pyrene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	2000
205-99-2	Benzo (b) fluoranthene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	7000
191-24-2	Benzo (g,h,i) perylene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
207-08-9	Benzo (k) fluoranthene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
65-85-0	Benzoic acid	<407	<405	<385	<414	<375	<407	<361	<356	1000000
100-51-6	Benzyl alcohol	<407	<405	<385	<414	<375	<407	<361	<356	-
111-91-1	Bis(2-chloroethoxy)methane	<407	<405	<385	<414	<375	<407	<361	<356	500000
111-44-4	Bis(2-chloroethyl)ether	<206	<205	<195	<210	<190	<206	<183	<180	700
108-60-1	Bis(2-chloroisopropyl)ether	<206	<205	<195	<210	<190	<206	<183	<180	700
117-81-7	Bis(2-ethylhexyl)phthalate	305	<205	<195	<210	<190	<206	<183	<180	200000
101-55-3	4-Bromophenyl phenyl ether	<407	<405	<385	<414	<375	<407	<361	<356	100000
85-68-7	Butyl benzyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	100000
86-74-8	Carbazole	<206	<205	<195	<210	<190	<206	<183	<180	-
59-50-7	4-Chloro-3-methylphenol	<407	<405	<385	<414	<375	<407	<361	<356	1000000
106-47-8	4-Chloroaniline	<206	<205	<195	<210	<190	<206	<183	<180	1000
91-58-7	2-Chloronaphthalene	<407	<405	<385	<414	<375	<407	<361	<356	1000000
95-57-8	2-Chlorophenol	<206	<205	<195	<210	<190	<206	<183	<180	700
7005-72-3	4-Chlorophenyl phenyl ether	<407	<405	<385	<414	<375	<407	<361	<356	1000000
218-01-9	Chrysene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	70000
53-70-3	Dibenzo (a,h) anthracene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	700
132-64-9	Dibenzofuran	<206	<205	<195	<210	<190	<206	<183	<180	100000
95-50-1	1,2-Dichlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	9000
541-73-1	1,3-Dichlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	1000
106-46-7	1,4-Dichlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	700
91-94-1	3,3'-Dichlorobenzidine	<407	<405	<385	<414	<375	<407	<361	<356	1000
120-83-2	2,4-Dichlorophenol	<206	<205	<195	<210	<190	<206	<183	<180	700
84-66-2	Diethyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	10000
131-11-3	Dimethyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	30000
105-67-9	2,4-Dimethylphenol	<407	<405	<385	<414	<375	<407	<361	<356	700
84-74-2	Di-n-butyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	50000
534-52-1	4,6-Dinitro-2-methylphenol	<407	<405	<385	<414	<375	<407	<361	<356	50000
51-28-5	2,4-Dinitrophenol	<407	<405	<385	<414	<375	<407	<361	<356	3000
121-14-2	2,4-Dinitrotoluene	<206	<205	<195	<210	<190	<206	<183	<180	700
606-20-2	2,6-Dinitrotoluene	<206	<205	<195	<210	<190	<206	<183	<180	100000
117-84-0	Di-n-octyl phthalate	<407	<405	<385	<414	<375	<407	<361	<356	1000000
206-44-0	Fluoranthene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
86-73-7	Fluorene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
118-74-1	Hexachlorobenzene	<206	<205	<195	<210	<190	<206	<183	<180	700
87-68-3	Hexachlorobutadiene	<206	<205	<195	<210	<190	<206	<183	<180	6000
77-47-4	Hexachlorocyclopentadiene	<206	<205	<195	<210	<190	<206	<183	<180	50000
67-72-1	Hexachloroethane	<206	<205	<195	<210	<190	<206	<183	<180	700
193-39-5	Indeno (1,2,3-cd) pyrene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	7000
78-59-1	Isophorone	<206	<205	<195	<210	<190	<206	<183	<180	100000
91-57-6	2-Methylnaphthalene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	700
95-48-7	2-Methylphenol	<407	<405	<385	<414	<375	<407	<361	<356	500000
108-39-4, 106-44-5	3 & 4-Methylphenol	<407	<405	<385	<414	<375	<407	<361	<356	500000
91-20-3	Naphthalene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	4000
88-74-4	2-Nitroaniline	<407	<405	<385	<414	<375	<407	<361	<356	-
99-09-2	3-Nitroaniline	<407	<405	<385	<414	<375	<407	<361	<356	-
100-01-6	4-Nitroaniline	<206	<205	<195	<210	<190	<206	<183	<180	1000000
98-95-3	Nitrobenzene	<206	<205	<195	<210	<190	<206	<183	<180	500000
88-75-5	2-Nitrophenol	<206	<205	<195	<210	<190	<206	<183	<180	100000
100-02-7	4-Nitrophenol	<1630	<1620	<1540	<1660	<1500	<1630	<1440	<1430	100000
62-75-9	N-Nitrosodimethylamine	<206	<205	<195	<210	<190	<206	<183	<180	50000
621-64-7	N-Nitrosodi-n-propylamine	<206	<205	<195	<210	<190	<206	<183	<180	50000
86-30-6	N-Nitrosodiphenylamine	<407	<405	<385	<414	<375	<407	<361	<356	100000
87-86-5	Pentachlorophenol	<407	<405	<385	<414	<375	<407	<361	<356	3000
85-01-8	Phenanthrene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	10000
108-95-2	Phenol	<407	<405	<385	<414	<375	<407	<361	<356	1000
129-00-0	Pyrene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	1000000
110-86-1	Pyridine	<407	<405	<385	<414	<375	<407	<361	<356	500000
120-82-1	1,2,4-Trichlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	2000
90-12-0	1-Methylnaphthalene	<82.3	<81.8	<77.9	<83.7	<75.8	<82.3	<73.0	<72.0	-
95-95-4	2,4,5-Trichlorophenol	<407	<405	<385	<414	<375	<407	<361	<356	3000
88-06-2	2,4,6-Trichlorophenol	<206	<205	<195	<210	<190	<206	<183	<180	700
82-68-8	Pentachloronitrobenzene	<407	<405	<385	<414	<375	<407	<361	<356	100000
95-94-3	1,2,4,5-Tetrachlorobenzene	<407	<405	<385	<414	<375	<407	<361	<356	1000000

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Boldfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 4

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR PESTICIDES AND HERBICIDES

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SS-1	SS-2	SSS-3	SSS-4	SSS-5	SSS-6	SSS-7	SSS-8	SSS-9	MCP
Laboratory ID		SC58794-01	SC58794-02	SC58794-10	SC58794-11	SC58794-12	SC58794-13	SC58794-14	SC58794-15	SC58794-16	Reportable
Sample Date		7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	7/9/2020	Concentrations
Sample Depth		24"	22"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	2-6"	RCS-1
Pesticides - SW846 8081B (µg/kg)											
319-84-6	a-BHC	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	50000
319-85-7	b-BHC	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	10000
319-86-8	d-BHC	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	10000
58-89-9	g-BHC (Lindane)	<3.32	<3.34	<3.46	<3.23	<3.46	<3.22	<3.57	<3.45	<3.80	3000
76-44-8	Heptachlor	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	200
309-00-2	Aldrin	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	100000
1024-57-3	Heptachlor epoxide	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	90
959-98-8	Endosulfan I	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	500
60-57-1	Dieldrin	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	50
72-55-9	4,4' -DDE	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	3000
72-20-8	Endrin	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	8000
33213-65-9	Endosulfan II	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	500
72-54-8	4,4' -DDD	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	4000
1031-07-8	Endosulfan sulfate	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	-
50-29-3	4,4' -DDT	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	-
72-43-5	Methoxychlor	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	200000
53494-70-5	Endrin ketone	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	8000
7421-93-4	Endrin aldehyde	<8.85	<8.90	<9.24	<8.60	<9.21	<8.58	<9.51	<9.19	<10.1	10000
5103-71-9	alpha-Chlordane	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	-
5103-74-2	gamma-Chlordane	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	-
8001-35-2	Toxaphene	<111	<111	<115	<108	<115	<107	<119	<115	<127	10000
57-74-9	Chlordane	<22.1	<22.3	<23.1	<21.5	<23.0	<21.4	<23.8	<23.0	<25.3	700
15972-60-8	Alachlor	<5.53	<5.56	<5.77	<5.38	<5.76	<5.36	<5.94	<5.75	<6.34	100
Herbicides - SW846 8151A (µg/kg)											
93-76-5	2,4,5-T	<80	<80	<80	<80	<80	<80	<80	<80	<80	100000
93-72-1	2,4,5-TP (Silvex)	<80	<80	<80	<80	<80	<80	<80	<80	<80	100000
94-75-7	2,4-D	<80	<80	<80	<80	<80	<80	<80	<80	<80	100000
94-82-6	2,4-DB	<80	<80	<80	<80	<80	<80	<80	<80	<80	100000
75-99-0	Dalapon	<80	<80	<80	<80	<80	<80	<80	<80	<80	1000000
1918-00-9	Dicamba	<80	<80	<80	<80	<80	<80	<80	<80	<80	500000
120-36-5	Dichloroprop	<80	<80	<80	<80	<80	<80	<80	<80	<80	-
88-85-7	Dinoseb	<80	<80	<80	<80	<80	<80	<80	<80	<80	500000
94-74-6	MCPA	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	100000
7085-19-0	MCPP	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	-

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Boldfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

TABLE 4

SUMMARY OF TOPSOIL/LOAM & SUBSOIL SAMPLES FOR PESTICIDES AND HERBICIDES

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location Laboratory ID Sample Date Sample Depth		SSS-10 SC58794-03 7/9/2020 2-6"	SSS-11 SC58794-04 7/9/2020 2-6"	SSS-12 SC58794-05 7/9/2020 2-6"	SSS-13 SC58794-06 7/9/2020 2-6"	SSS-14 SC58794-07 7/9/2020 2-6"	SSS-15 SC58794-17 7/9/2020 2-6"	SSS-16 SC58794-08 7/9/2020 2-6"	SSS-17 SC58794-09 7/9/2020 2-6"	MCP Reportable Concentrations RCS-1
Pesticides - SW846 8081B (µg/kg)										
319-84-6	a-BHC	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	4000
319-85-7	b-BHC	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	3000
319-86-8	d-BHC	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	3000
58-89-9	g-BHC (Lindane)	<3.64	<3.69	<3.51	<3.78	<3.38	<3.73	<3.26	<3.34	50000
76-44-8	Heptachlor	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	100
309-00-2	Aldrin	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	100000
1024-57-3	Heptachlor epoxide	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	10000
959-98-8	Endosulfan I	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	700
60-57-1	Dieldrin	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	10000
72-55-9	4,4' -DDE	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	50
72-20-8	Endrin	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	500
33213-65-9	Endosulfan II	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	500
72-54-8	4,4' -DDD	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	-
1031-07-8	Endosulfan sulfate	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	8000
50-29-3	4,4' -DDT	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	10000
72-43-5	Methoxychlor	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	8000
53494-70-5	Endrin ketone	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	3000
7421-93-4	Endrin aldehyde	<9.71	<9.84	<9.36	<10.1	<9.01	<9.95	<8.71	<8.92	200
5103-71-9	alpha-Chlordane	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	90
5103-74-2	gamma-Chlordane	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	700
8001-35-2	Toxaphene	<121	<123	<117	<126	<113	<124	<109	<111	200000
57-74-9	Chlordane	<24.3	<24.6	<23.4	<25.2	<22.5	<24.9	<21.8	<22.3	10000
15972-60-8	Alachlor	<6.07	<6.15	<5.85	<6.30	<5.63	<6.22	<5.44	<5.57	-
Herbicides - SW846 8151A (µg/kg)										
93-76-5	2,4,5-T	<80	<80	<80	<80	<80	<80	<80	<80	100000
93-72-1	2,4,5-TP (Silvex)	<80	<80	<80	<80	<80	<80	<80	<80	100000
94-75-7	2,4-D	<80	<80	<80	<80	<80	<80	<80	<80	100000
94-82-6	2,4-DB	<80	<80	<80	<80	<80	<80	<80	<80	100000
75-99-0	Dalapon	<80	<80	<80	<80	<80	<80	<80	<80	1000000
1918-00-9	Dicamba	<80	<80	<80	<80	<80	<80	<80	<80	500000
120-36-5	Dichloroprop	<80	<80	<80	<80	<80	<80	<80	<80	-
88-85-7	Dinoseb	<80	<80	<80	<80	<80	<80	<80	<80	500000
94-74-6	MCPA	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	100000
7085-19-0	MCPP	<3300	<3300	<3300	<3300	<3300	<3300	<3300	<3300	-

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Boldfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

TABLE 5

SUMMARY OF BASEBALL INFIELD SOIL SAMPLES FOR MASSDEP 14 METALS

Cashman School
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SSS-18	SSS-19	SSS-20	SSS-21	SSS-22	SSS-23	SSS-24	SSS-25	MassDEP Reportable Concentrations	MassDEP Imminent Hazard
Laboratory ID		SC58954-01	SC58954-02	SC58954-03	SC58954-04	SC58954-05	SC58954-06	SC58954-07	SC58954-08		
Sample Date		7/31/2020	7/31/2020	7/31/2020	7/31/2020	7/31/2020	7/31/2020	7/31/2020	7/31/2020		
Sample Location		Randall Field - 1st Base	Randall Field - 2nd Base	Randall Field - 3rd Base	Randall Field - Home Plate	Packer Field - 1st Base	Packer Field - 2nd Base	Packer Field - 3rd Base	Packer Field - Home Plate	RCS-1	
Sample Depth		Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	(mg/kg)	
SM2540 G (11) Mod. (%)											
solids	% Solids	86.9	90.9	90.9	86.7	90.1	90.2	87.5	90.0	NA	
MassDEP 14 Metals - SW846 6010C (mg/kg)											
7440-36-0	Antimony	<5.90	<5.43	<5.43	<6.07	<5.13	<5.45	<5.68	<5.61	20	
7440-38-2	Arsenic	10.9	11.6	10.7	15.8	13.6	14.8	13.4	15.3	20	40
7440-41-7	Beryllium	<0.590	<0.543	<0.543	<0.607	<0.513	<0.545	<0.568	<0.561	90	
7440-43-9	Cadmium	<0.590	<0.543	<0.543	<0.607	<0.513	<0.545	<0.568	<0.561	70	
7440-47-3	Chromium	10.8	14.6	11.1	11.8	9.20	7.74	9.07	8.99	100	
7439-92-1	Lead	6.88	7.03	6.04	8.03	6.24	7.26	6.72	6.88	200	
7440-02-0	Nickel	5.65	6.67	6.73	6.81	5.25	5.20	4.90	5.42	600	
7782-49-2	Selenium	<1.77	<1.63	<1.63	<1.82	<1.54	<1.63	<1.70	<1.68	400	
7440-22-4	Silver	<3.54	<3.26	<3.26	<3.64	<3.08	<3.27	<3.41	<3.37	100	
7440-28-0	Thallium	<3.54	<3.26	<3.26	<3.64	<3.08	<3.27	<3.41	<3.37	8	
7440-62-2	Vanadium	13.6	14.4	14.6	17.2	15.6	15.8	16.2	15.5	400	
7440-66-6	Zinc	25.3	24.6	22.6	28.1	26.0	27.0	27.8	27.6	1000	
7440-39-3	Barium	31.4	33.2	27.0	45.7	29.4	25.4	31.5	29.2	1000	
RCRA Metals - SW846 7471B (mg/kg)											
7439-97-6	Mercury	<0.0323	<0.0363	<0.0310	<0.0305	<0.0388	<0.0321	<0.0319	<0.0330	20	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014

Environmental & Construction Management Services, Inc.

TABLE 6

SUMMARY OF BACKGROUND SOIL SAMPLES FOR MASSDEP 14 METALS

Cashman School & Woodsom Farm Property
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		SSS-26**	SSS-27**	SSS-28	SSS-29	SSS-30	SSS-31	SSS-32	SSS-33	MassDEP Reportable Concentrations	MassDEP Imminent Hazard
Laboratory ID		SC59063-01	SC59063-02	SC59063-03	SC59063-04	SC59063-05	SC59063-06	SC59063-07	SC59063-08		
Sample Date		8/12/2020	8/12/2020	8/12/2020	8/12/2020	8/12/2020	8/12/2020	8/12/2020	8/12/2020		
Sample Location		Background-Woods	Background-Woods	Randall Field - Outfield	Background-Woodsom Farm	Background-Woodsom Farm	Background-Woodsom Farm	Background-Woodsom Farm	Packer Field - Outfield	RCS-1	
Sample Depth		0-6"	12"	18-24"	6"	18-22"	6"	18-22"	14-18"	(mg/kg)	
SM2540 G (11) Mod. (%)											
solids	% Solids	93.3	93.1	95.6	89.8	84.7	90.2	94.9	89.6	NA	
MassDEP 14 Metals - SW846 6010C (mg/kg)											
7440-36-0	Antimony	<5.34	<5.50	<4.92	<5.21	<5.68	<5.70	<5.25	<5.56	20	
7440-38-2	Arsenic	**56.1**	**65.5**	4.89	**27.7**	**31.2**	**74.8**	**89.6**	**62.3**	20	40
7440-41-7	Beryllium	<0.534	<0.550	<0.492	0.590	<0.568	<0.570	<0.525	<0.556	90	
7440-43-9	Cadmium	<0.534	<0.550	<0.492	<0.521	<0.568	<0.570	<0.525	<0.556	70	
7440-47-3	Chromium	32.0	32.8	7.71	35.6	32.3	60.3	50.5	24.7	100	
7439-92-1	Lead	40.0	35.4	2.80	29.6	25.9	32.3	30.7	13.7	200	
7440-02-0	Nickel	52.2	61.9	4.15	25.4	25.6	41.3	41.2	52.9	600	
7782-49-2	Selenium	<1.60	<1.65	<1.48	<1.56	<1.70	<1.71	<1.58	<1.67	400	
7440-22-4	Silver	<3.20	<3.30	<2.95	<3.13	<3.41	<3.42	<3.15	<3.33	100	
7440-28-0	Thallium	<3.20	<3.30	<2.95	<3.13	<3.41	<3.42	<3.15	<3.33	8	
7440-62-2	Vanadium	33.5	29.4	7.97	33.9	29.7	23.6	24.2	23.4	400	
7440-66-6	Zinc	56.6	57.7	7.36	44.5	38.6	66.2	62.2	64.5	1000	
7440-39-3	Barium	24.6	26.8	16.4	37.3	33.3	32.1	26.2	27.9	1000	
RCRA Metals - SW846 7471B (mg/kg)											
7439-97-6	Mercury	0.0764	0.0655	<0.0337	0.0650	0.0583	0.541	0.471	<0.0305	20	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014
** MassDEP also collectd soil samples for laboratory analysis

Environmental & Construction Management Services, Inc.

TABLE 7

SUMMARY OF MASSDEP COLLECTED BACKGROUND SOIL SAMPLES FOR ARSENIC AND LEAD

Cashman School & Woodsom Farm Property
Amesbury, Massachusetts
***ECMS* Project No. 1009.073**
MassDEP RTN 3-36397

Sample Location		DEP S-1 Little League Field	DEP S-2 Little League Field	DEP S-3 Background	DEP S-4 Background	MassDEP Reportable Concentrations	MassDEP Imminent Hazard
Laboratory ID		L2033028-01	L2033028-02	L2033028-03	L2033028-04		
Sample Date		8/12/2020	8/12/2020	8/12/2020	8/12/2020		
Sample Location		Little League Field	Background-Woods	Background	Background	RCS-1	
Sample Depth		0-6"	12"	18-24"	14-18"	(mg/kg)	
SM2540 G (11) Mod. (%)							
solids	% Solids	97	94	90	94	NA	
Metals - SW846 6010C (mg/kg)							
7440-38-2	Arsenic	**46.1**	**45.2**	**57.3**	**66.6**	20	40
7439-92-1	Lead	14.2	10.9	38.8	29.5	200	

< indicates less than the respective method detection limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Bolfaced type indicates an exceedance.
Pursuant to MCP 310 CMR 40.0975(6)(a-c): MCP Method 1 Soil Standards, and Massachusetts Oil and Hazardous Materials List (MOHML) revised (effective) 2014
** MassDEP collected and Alpha Analytical analyzed the above soil samples for laboratory analysis

Environmental & Construction Management Services, Inc.

APPENDIX A

REVIEW OF APPLICATIONS AND GUIDANCE ON THE MEASUREMENT OF ARSENIC IN SOIL USING XRF BY THE UNIVERSITY OF FLORIDA (UF) DATED JUNE 20, 2013

UF | UNIVERSITY of FLORIDA

Center for Environment & Human Toxicology

PO Box 110885
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352-392-2243 Tel
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June 20, 2013

Ligia Mora-Applegate
Bureau of Waste Cleanup
Florida Department of Environmental Protection
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Review of Applications and Guidance on the Measurement of Arsenic in Soil Using XRF

Dear Ms. Mora-Applegate:

Recently there has been interest in an expanded role for the use of field-portable x-ray fluorescence (XRF) instruments to assess site soil contamination. XRF offers potential advantages over conventional fixed-based laboratory analyses in terms of cost and speed with which soil concentration data can be obtained. However, field portable XRF devices are currently considered to provide primarily screening level data, to be used in conjunction with confirmatory analysis by other U.S.EPA-approved methods. The ability of XRF-generated data alone to support decision-making at sites (e.g., whether or not remediation in specific areas is required), is dependent on the precision of the individual instrument and its ability to identify the specific analyte of concern and to determine the true concentration of the analyte in the specific matrix.. To facilitate Department review of any proposed expanded use of XRF beyond field screening, we have summarized existing guidance and relevant peer-reviewed literature with particular attention to methods for assessing the quality of data from XRF. We have included information specific to arsenic, as the use of XRF for assessment of arsenic soil contamination has been recently proposed.

General Recommendations on the Use of XRF

The portable XRF can be used in the field to assess metals in soil using three different procedures: 1) *in-situ* soil testing - the XRF measures the metal concentrations in soil directly by placing the instrument on the surface of the ground, without any sample processing, 2) bagged soil testing - the soil sample is placed in a thin plastic bag, the XRF is used to measure the metal concentrations through the bag and 3) prepared soil - the soil samples are dried (if necessary), sieved and homogenized prior to analysis by XRF. The prepared soil is considered the most accurate method, while the *in-situ* and bagged soil sample testing are considered field-screening methods (Innov-X Systems 2003; Olympus/Innov-X Systems 2010).

EPA Reference Method 6200 (U.S. EPA 2007) provides guidance on the use of XRF for measuring metals in soil and sediment. It indicates that XRF is intended as a screening method, recommending confirmatory analysis by a total-digestion EPA analytical protocol. However, if comparisons with laboratory-based measurements indicate that XRF meets definitive data quality objectives, it could potentially be used to make a decision based upon an action level with respect to site remediation.

Criteria Used to Evaluate XRF Field Performance

The applicability of field XRF technologies to measure trace elements in the soil have been previously evaluated by the U.S. EPA under the Superfund Innovative Technology Evaluation (SITE) Program (U.S. EPA 1998; U.S. EPA 2006). However, individual instrument performance is dependent on the analyte being measured as well as the physical and chemical properties of the matrix of concern, and therefor XRF performance should be characterized for the analyte of interest, under field-specific conditions.

Evaluation criteria used by the U.S. EPA to assess instrument performance based on method detection limit (MDL), accuracy and precision are summarized below.

Method Detection Limit

The usefulness of XRF for site characterization depends in part on the limits of detection for elements of interest. MDL of the instrument is dependent on a number of factors, including the sample matrix, the analyte being measured, inter-elemental interferences, and measuring time. The detection limits reported for each instrument by the manufacturer, are based on a clean spiked SiO_2 matrix, with a 1-2 min measuring time, in the absence of interfering elements (Olympus LOD brochure; U.S. EPA 2007). These detection limits will not necessarily apply to field samples due to potential matrix interferences. EPA Method 6200 indicates that limits of detection for a given instrument should to be established in the matrix of interest based upon spike recoveries. Alternatively, certified reference material from the appropriate matrix can be used.

Accuracy of the instrument

To evaluate the accuracy of the instrument, data obtained using XRF is compared with paired laboratory data obtained using EPA-approved analytical methods. The accuracy of the instrument is assessed based on the absolute value of the relative percent difference (RPD), and correlation plots between the XRF and laboratory data.

As an example, the U.S. EPA evaluated the accuracy of XRF measurements for several elements in soil (U.S. EPA, 1998). The RPD between the reference laboratory results and the paired XRF value was calculated for 70 samples, using the following equation:

$$RPD = \frac{(M_R - M_D)}{Average(M_R - M_D)}$$

M_R = mean reference laboratory measurement
M_D = mean XRF instrument measurement

The median and absolute RPD values were used to classify the data quality in the following categories:

Excellent- Median RPD 0%-10%
Good- Median RPD 10-25%
Fair- Median RPD 25-50%
Poor- Median RPD above 50%

To assess the effects of analyte concentrations on the accuracy of the instruments the data were grouped based on concentration ranges (ie. low, medium and high). Comparability of the XRF data with the laboratory results was also analyzed using linear correlation plots. The linear regression calculation and correlation coefficient (r^2) were used to assess general bias of the instrument.

Instrument Precision

The precision of the XRF instrument was evaluated for the target analytes by calculating the relative standard deviation (RSD) for replicate samples, using the equation below:

$$RSD = \left| \frac{SD}{\overline{C}} \right| * 100$$

RSD = Relative standard deviation
SD = Standard deviation
$\overline{C}$ = Mean concentration

In the U.S. EPA's evaluation of XRF instruments (U.S. EPA 1998), the precision of the XRF technology for each analyte was classified based on the median RSD from high to low, using the following criteria:

High- Median RSD: 0%-5%
Moderate- Median RSD 5%-10%
Low- Median RSD- 10%-20%
Very Low- Median RSD above 20%

U.S. EPA Method 6200 also has precision criteria. In order for XRF data to be considered adequately precise, the RSD should be no greater than 20%, with the exception of chromium (which should be no greater than 30%).

Data quality requirements

The 1998 U.S. EPA Technology Verification Report for field XRF analyzers categorized the data based on one of the following three data quality levels: 1) definitive, 2) quantitative screening and 3) qualitative screening (U.S. EPA 1998).

Definitive level data is considered analyte-specific, and has a high degree of quantitative accuracy. Quantitative screening data provide analyte-specific identification; however the concentration quantification is not precise. The Quality Assurance/Quality Control Guidance for Removal Activities (U.S. EPA 1990) recommends that a minimum of 10% of the screening level data samples be verified using an EPA-approved method with QA/QC criteria associated with definitive data. Qualitative screening level data provide information regarding the presence or absence of contaminants. They do not, however, provide accurate concentration estimates. The statistical requirements for each of these data quality levels are summarized in the table below.

Table1. Quality criteria used by the U.S. EPA to validate field XRF data based on confirmatory laboratory values.

Data Quality Level	Statistical requirements
Definitive Level	r^2 = 0.85 to 1.0. Relative standard deviation (RSD) less than or equal to 10%. Inferential statistics indicate that the two sets of data are statistically similar.
Quantitative Screening Level	r^2 = 0.70 to 1.0. Relative standard deviation (RSD) < 20%. Inferential statistics indicate that the two sets of data are statistically different.
Qualitative Screening Level	r^2 >0.70. Relative standard deviation (RSD) > 20%. The data should have less than 10% false negative rate.

From U.S. EPA 1998

Application of field- portable XRF technology to evaluate arsenic in soil

Portable XRF technology has been shown to be a promising method that can be used in the field to measure soil levels of arsenic (U.S. EPA 1990; U.S. EPA 1998; U.S. EPA 2004), even at trace concentrations (low ppm) (Parsons et al. 2012). The commercially available Delta Handheld XRF Analyzers report the limits of detection (LODs) for arsenic ranging between 1 and 4 ppm in a bulk SiO_2 matrix free of any interfering elements (Olympus 2013). The LOD for arsenic reported for the 2003 Delta XRF model is 9 ppm. The correlation between soil arsenic concentration measured using Delta XRF analyzer and laboratory results has a calculated r^2 value of 0.99 according to the manufacturer. However, the LODs and accuracy of the XRF devices for the analysis of arsenic in the field can be affected by different factors. Consequently, instrument performance should be evaluated on a site-specific basis.

A recent study by Parsons et al. (2012) evaluated the effects of instrument parameters, sample preparation techniques and matrix characteristics on the level of detection and the data quality for measuring trace levels of arsenic in a floodplain soil. The method for arsenic characterization *in situ,* where the soil was homogenized, sieved (<2 mm) and compacted in the field reported an estimated

MDL of 6.8 ppm with 14.4% RSD precision. Comparison between the paired field and laboratory data resulted in an r^2 of 0.93. Improvements in the MDL, precision and r^2 were observed with increased soil preparation steps, such as drying and homogenization and grinding the samples.

The lowest MDL for arsenic reported in this study was 5.8 ppm, with an r^2 = 0.96 when XRF results from extensively prepared samples were compared with measurements using ICP-MS. The soil preparation method with the lowest MDL involved homogenization, sieving (<2 mm), lyophilization, grinding to >63 μm, compaction, and measuring the arsenic concentrations using XRF sample cups. The study concluded that careful sample preparation and instrument calibration based on site-specific standards can improve the limits of detection for arsenic, accuracy and precision.

Lead interferences with arsenic measurements

The presence of lead in the soil interferes with arsenic measurements by overlapping the arsenic Kα spectral peak (U.S. EPA 2007; Olympus 2010). However, the instrument's software is designed to correct for the lead interference, and it may only be of concern when the arsenic concentrations measured are low, or if the lead to arsenic ratio is above 10. The presence of lead in soil is reported by the manufacturer to result in higher detection levels for arsenic, and decrease the precision of the instrument.

In summary, XRF instrument performance can vary depending upon the instrument, analyte, and site-specific conditions. The performance of the instrument on a site-specific basis, along with the data quality objectives for the site, determine the limits on the use of XRF data (i.e., screening versus definitive). The U.S. EPA provides guidance for determining XRF instrument accuracy, precision, and MDL, as well as data quality requirements for its intended uses.

We hope that this background information is helpful to the Department when considering proposals for expanded use of XRF, in particular for generating definitive data. Please let us know if you have any questions.

Sincerely,

Roxana E. Weil, Ph.D.

Leah D. Stuchal, Ph.D.

Stephen M. Roberts, Ph.D.

References

Innov-X Systems 2003. Metals in Soil Analysis Using Field Portable X-ray Fluorescence. A guideline to using portable XRF according to EPA Method 6200, basic overview of the technique of x-ray fluorescence (RF), appropriate data quality assurance protocols and sample preparation steps for operators analyzing prepared soil samples.

Olympus/Innov-X Systems 2010. User Manual. Delta™ Family: Handheld XRF Analyzers

Olympus 2013. Delta Handheld XRF for Environmental Inspection.

Parsons C., Grabulosa E.M Pili, E., Floor, G.H., Roman-Ross, G., Charlet, L. (2012). Quantification of trace arsenic in soils by field-portable X-ray fluorescence spectrometry: Considerations for sample preparation and measurement condition. Journal of Hazardous Materials (E.pub ahead of print)

U.S. EPA 1990. Quality Assurance/Quality Control Guidance for Removal Activities.

U.S. EPA 1998. Environmental Technology Verification Report. Field Portable X-ray Fluorescence Analyzer. Niton XL Spectrum Analyzer. Office of Research and Development, Washington. DC.

U.S. EPA 2004. Monitoring Arsenic in the Environment: A review of Science and Technologies for Field Measurements and Sensors. Office of Superfund Remediation and Technology Innovation.

U.S. EPA 2006. Innovative Technology Verification Report. Niton XLU+I 700 Series XRF Analyzer. Office of Research and Development, Washington. DC.

U.S.EPA 2007. EPA method 6200 Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment.

APPENDIX B

SIMILAR SOILS PROVISION GUIDANCE "GUIDANCE FOR IDENTIFYING WHEN SOIL CONCENTRATIONS AT A RECEIVING LOCATION ARE "NOT SIGNIFICANTLY LOWER THAN" MANAGED SOIL CONCENTRATIONS PURSUANT TO 310 CMR 40.0032(3) WSC#-13-500 DATED SEPTEMBER 4, 2014

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Similar Soils Provision Guidance

Guidance for Identifying When Soil Concentrations at a Receiving Location Are "Not Significantly Lower Than" Managed Soil Concentrations Pursuant to 310 CMR 40.0032(3)

September 4, 2014[1]
(Originally published October 2, 2013 and revised April 25, 2014[2])

WSC#-13-500

The information contained in this document is intended solely as guidance. This guidance does not create any substantive or procedural rights, and is not enforceable by any party in any administrative proceeding with the Commonwealth. Parties using this guidance should be aware that there may be other acceptable alternatives for achieving and documenting compliance with the applicable regulatory requirements and performance standards of the Massachusetts Contingency Plan.

I. Purpose and Scope

The Massachusetts Contingency Plan ("MCP", 310 CMR 40.0000) establishes conditions and requirements for the management of soil excavated at a disposal site. This guidance addresses the specific requirements of 310 CMR 40.0032(3) and the criteria by which a Licensed Site Professional ("LSP") may determine that soil may be moved without prior notice to or approval from the Department. Soil managed pursuant to 310 CMR 40.0032(3) may be transported using a Bill of Lading ("BOL"), but a BOL is not required. Attachment 1 provides a flowchart depiction of the Similar Soil regulations and guidance.

This guidance is not applicable to the excavation and movement of soil from locations other than M.G.L. Chapter 21E disposal sites, nor to the management of soils considered Remediation Waste under the MCP.

[1] Updated to revise an inaccurate RCS-1 concentration for lead in Table 2 and an inaccurate RCS-2 concentration for selenium in Table 3.
[2] Updated to reflect the 2014 revisions to the Massachusetts Contingency Plan, 310 CMR 40.0000

II. Relationship to Other Local, State or Federal Requirements

This guidance is intended to clarify and more fully describe regulatory requirements contained within the MCP. Nothing in this guidance eliminates, supersedes or otherwise modifies any local, state or federal requirements that apply to the management of soil, including any local, state or federal permits or approvals necessary before placing the soil at the receiving location, including, *but not limited to,* those related to placement of fill, noise, traffic, dust control, wetlands, groundwater or drinking water source protection.

III. Requirements of 310 CMR 40.0032(3)

The requirements specified in 310 CMR 40.0032(3) are:

> (3) Soils containing oil or waste oil at concentrations less than an otherwise applicable Reportable Concentration and that are not otherwise a hazardous waste, and soils that contain one or more hazardous materials at concentrations less than an otherwise applicable Reportable Concentration and that are not a hazardous waste, may be transported from a disposal site without notice to or approval from the Department under the provisions of this Contingency Plan, provided that such soils:
>
> (a) are not disposed or reused at locations where the concentrations of oil or hazardous materials in the soil would be in excess of a release notification threshold applicable at the receiving site, as delineated in 310 CMR 40.0300 and 40.1600; and
>
> (b) are not disposed or reused at locations where existing concentrations of oil and/or hazardous material at the receiving site are significantly lower than the levels of those oil and/or hazardous materials present in the soil being disposed or reused.

There are therefore four requirements that must be met before the managed soil can be moved to and re-used (or disposed) at a new location without notice to or approval from MassDEP. Each requirement (A. through D.) is addressed below.

A. The Managed Soil Must Not Be a Hazardous Waste

310 CMR 40.0032(3) applies to soils containing oil or waste oil that are not otherwise a hazardous waste, and to soils containing hazardous materials that are not a hazardous waste. The MCP definition of hazardous waste (310 CMR 40.0006) refers to the definitions promulgated in the Massachusetts Hazardous Waste Regulations, 310 CMR 30.000.

Under the federal Resource Conservation and Recovery Act of 1976 ("RCRA", 42 U.S.C. §§6901 *et. seq.*), the Massachusetts Hazardous Waste Management Act (M.G.L. c.21C), and the Massachusetts Hazardous Waste Regulations (310 CMR 30.000), soil is considered to contain a hazardous waste (hazardous waste soil) if, when generated, it meets either or both of the following two conditions:

- the soil exhibits one or more of the characteristics of a hazardous waste pursuant to 310 CMR 30.120 [such as exhibiting a characteristic of toxicity under 310 CMR 30.125 and 30.155 (Toxicity Characteristic Leaching Procedure, or TCLP)]; or
- the soil contains hazardous constituents from a listed hazardous waste identified in 310 CMR 30.130 or Title 40, Chapter I, Part 261 (Identification and Listing of Hazardous Waste) of the Code of Federal Regulations.

MassDEP has published a Technical Update entitled: *Considerations for Managing Contaminated Soil: RCRA Land Disposal Restrictions and Contained-In Determinations* (August 2010, http://www.mass.gov/eea/docs/dep/cleanup/laws/contain.pdf) that focuses on the determination of whether contaminated soil must be managed as a hazardous waste subject to RCRA requirements, and the presumptive approval process an LSP/PRP can use to document such a determination.

B. The Managed Soil Must Be Less Than Reportable Concentrations (RCs).

This requirement is intended to ensure that the soil being excavated and relocated from a disposal site is not "Contaminated Soil" and therefore neither "Contaminated Media" nor "Remediation Waste" as those terms are defined in 310 CMR 40.0006[3].

310 CMR 40.0361 sets forth two reporting categories for soil (RCS-1 and RCS-2). Reporting Category RCS-1 applies to locations with the highest potential for exposure, such as residences, playgrounds and schools, and to locations within the boundaries of a groundwater resource area. Reporting Category RCS-2 applies to all other locations.

Note that the "applicable Reportable Concentrations" referred to in 310 CMR 40.0032(3) may be the RCS-1 or RCS-2 criteria, depending upon which category would apply to the soils being excavated *at the original disposal site location*, not the RCs applicable to the soils at the receiving location (see Section III.C. below).

> **EXAMPLE:** If soil is being excavated from a disposal site at an RCS-2 location and the soil contaminant concentrations are found to be less than the RCS-2 criteria, then the soil is not "Contaminated Soil" since the soil is less than the release notification threshold established for RCS-2 soil by 310 CMR 40.0300 and 40.1600. The RCS-2 soil in this example is not "Contaminated Soil" even if one or more constituent concentration is greater than an RCS-1 value.

Also, the language at 310 CMR 40.0032(3) specifies the *applicable* RCs. If a notification exemption (listed at 310 CMR 40.0317) applies to the OHM in soil at its original location, then the corresponding Reportable Concentration is not *applicable*. Thus 310 CMR 40.0032(3) should be read to apply to soils containing concentrations of oil or hazardous material ("OHM") less than the applicable RCs *or* covered by a notification exemption. This interpretation of the requirement is consistent with the definition of Contaminated Soil, which uses the term "notification threshold" rather than "Reportable Concentration."

---

[3] Contaminated Soil - means soil containing oil and/or hazardous material at concentrations equal to or greater than a release notification threshold established by 310 CMR 40.0300 and 40.1600.

Contaminated Media - means Contaminated Groundwater, Contaminated Sediment, Contaminated Soil, and/or Contaminated Surface Water.

Remediation Waste - means any Uncontainerized Waste, Contaminated Media, and/or Contaminated Debris that is managed pursuant to 310 CMR 40.0030. The term "Remediation Waste" does not include Containerized Waste.

C. The Managed Soil Must Not Create a Notifiable Condition at the Receiving Location.

This requirement is intended to prevent the creation of new reportable releases that must be subsequently assessed and remediated.

If the contaminant concentrations in the soil being relocated are less than the RCS-1 criteria, then placement of the soil in any RCS-1 location would not create a new notifiable condition. There are, however, conditions that could result in a notifiable condition.

First, if the soil is excavated from an RCS-2 location (as described in the example in Section III.B. above) with contaminant concentrations ***between*** the RCS-1 and RCS-2 criteria, then the placement of that soil at an RCS-1 receiving location would create a notifiable condition since one or more concentrations of OHM would then exceed the RCS-1 criteria in the RCS-1 receiving location.

Second, a notification exemption that applies to the original location of the soil may not apply to the receiving location. (For example, the lead paint exemption at 310 CMR 40.0317(8) is specific to "the point of application.") In cases where a notification exemption applies only to the original location, the managed soil must be evaluated solely based on whether its OHM concentrations exceed the applicable RCs at the receiving location.

D. The Managed Soil Must Not Be Significantly More Contaminated Than the Soil at the Receiving Location.

This requirement has been referred to as the "anti-degradation provision" although it is more accurately described as the "Similar Soils Provision." 310 CMR 40.00032(3)(b) requires that the concentrations of OHM at the receiving location not be "significantly lower" than the relocated soil OHM concentrations. One could also say that the provision requires that "there is no significant difference between the relocated soil and the soil at the receiving location," or that "the soils being brought to the receiving location are similar to what is already there." This requirement embodies several considerations.

First, as a general principle, M.G.L. c.21E is intended to clean up contaminated properties and leave them better than they started -- even to clean sites to background conditions, if feasible. It would be inconsistent with this principle to then raise the ambient levels of contamination in the environment as a consequence of a response action conducted under the MCP.

Second, despite the three other requirements (A. through C. above) of 310 CMR 40.0032(3), decisions about the movement of the managed soil will be based upon sampling of soil that is likely to have significant heterogeneity. The Similar Soils Provision is an additional measure to minimize the adverse effects of soil characterization that may not be representative of such heterogeneity.

Third, none of the criteria of 310 CMR 40.0032(3) address the question of whether the soil poses a *risk* in its original or receiving location, although the hazardous waste- and notification-related requirements seem to *imply* risk-based decision making. Put simply, soil that is not a hazardous waste and does not require notification may still pose incremental risk at the receiving location. The Similar Soils Provision is intended to ensure that the managed soil does not increase risk of harm to health, safety, public welfare or the environment at the receiving location, since it will be similar to what is already there.

The "not… significantly lower" language of 310 CMR 40.0032(3)(b) can be interpreted to mean either a quantitative "not statistically different" analysis, or a semi-quantitative, albeit somewhat subjective, approach. MassDEP does not believe that a statistics-driven quantitative approach is necessary when comparing managed soil to known or assumed background conditions, given (a) the relatively low concentrations at issue and (b) the cost of such an analysis, driven by the quantity of sampling needed to show a statistical difference.

The regulations imply that the LSP must have knowledge about the concentrations of OHM in the soil at the receiving location in order to apply the Similar Soils Provision. The regulations also imply that the new soil may contain concentrations of OHM that are *somewhat* higher than those levels at the receiving location – just not "significantly" higher.

MassDEP recognizes that there may be several approaches to address this "knowledge" issue when implementing the Similar Soils Provision of the MCP.

- **Assume the soils at the receiving location are natural background**. Sampling of the soil at the receiving location is not necessary if it is assumed that the concentrations of OHM there are consistent with natural background conditions. MassDEP acknowledges that there is a range of background levels, and that the concentrations at any given location may be lower than the statewide levels published by the Department[4], but the costs associated with determining site-specific background are not justified by likely differences. Further, the published "natural background" levels are similarly used in several areas of the MCP as an acceptable endpoint, including site delineation and the development of the MCP cleanup standards.

  Of course, routine due diligence about the receiving location may still reveal factors that would make the location inappropriate to receive the proposed fill material. Nothing in this guidance relieves any party of the obligation to conduct such due diligence and appropriately consider and act on information thereby obtained.

[4] *See* Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil (May, 2002) http://www.mass.gov/eea/docs/dep/cleanup/laws/backtu.pdf

- **Sample the soils at the receiving location**.
  The sampling plan should include a sufficient number of samples taken at locations selected to provide an understanding of the concentrations of OHM present and the distribution of OHM throughout the receiving location. In order to provide data appropriate for the Similar Soils comparison, the soil at the receiving location should be analyzed for constituents that are likely to be present there (e.g., naturally occurring metals) as well as any OHM known or likely to be present in the soil brought from the disposal site. If a receiving location has been adequately and comprehensively characterized, that data may then be used for comparison to the OHM concentrations in any subsequent soil deliveries - additional sampling is not required.

- **Provide Technical Justification for an Alternative Approach**
  There may be situations for which a different combination of analytical and non-analytical information available for both the source and receiving locations is sufficient to conclude that the nature and concentrations of OHM in the soils are not significantly different. Guidance on recognizing such conditions and the level of documentation that would be necessary to support such a technical justification is beyond the scope of this guidance.

Once the concentrations of OHM in the soils are known (or assumed consistent with this guidance), the LSP must compare the concentrations of the source and receiving locations and determine whether the concentrations at the receiving location are "significantly lower" than those in the soil proposed to be relocated from the disposal site. This comparison may be conducted in several ways, including analyses with appropriate statistical power and confidence. MassDEP has also developed a *rule-of-thumb* comparison to simplify this determination, as described in Section IV.

IV. Determining whether soils at the receiving location are "significantly lower" using a simplified approach

The simplified comparison shall be made using the *maximum* values of the OHM concentrations in both the soil at the receiving location and the soil proposed to be disposed of or reused.

Use of the maximum values is appropriate for several reasons. First, the provisions of 310 CMR 40.0032(3) include comparisons to Reportable Concentrations, and notification is triggered by any single value (i.e., maximum value) exceeding the RC. Second, soil is by its nature heterogeneous, and the use of maximum values is a means of minimizing sampling costs while addressing the expected variability of results. Third, if natural background levels are assumed at the receiving location, the MassDEP published background concentrations are upper percentile levels that are only appropriately compared to similar (e.g., maximum) values of the soil data set.

Note also that when using the maximum reported concentrations for comparison purposes, the typical or average concentration will be lower. This is important to recognize if/when the question of the risk posed by the soil is raised. For example, the RCS-1 and the Method 1 S-1 standard for arsenic are both 20 mg/kg. The Reportable Concentration is applied as a not-to-be-exceeded value, triggering the need to report the release and investigate further. However the S-1 standard is applied as an average value, considering exposure over time. At a location where the highest arsenic value found is less than 20 mg/kg, the average concentration would be well below the Method 1 S-1 standard.

The maximum concentration in the soil at the receiving location may be less than that in the proposed disposed/reused soil by some amount and not be considered "significantly lower." The question is how much lower is "significantly lower"? In this guidance, MassDEP establishes a multiplying factor to be applied to the concentration in the soil at the receiving location. The multiplying factor varies depending upon the concentration in the soil at the receiving location, as shown in Table 1.

Table 1. Receiving Soil Concentration Multiplying Factors

If the concentration in soil at the receiving location for a given OHM is:	Then use a multiplying factor of:
< 10 mg/kg	10
10 mg/kg ≤ *x* <100 mg/kg	7.5
100 mg/kg ≤ *x* <1,000 mg/kg	5
≥ 1,000 mg/kg	2.5

EXAMPLE: The soil at a receiving location that is considered RCS-1 is appropriately sampled and the maximum concentration of silver is found to be 6 mg/kg. Using Table 1, the concentration of silver at the receiving location would not be considered "significantly lower" than *10 x 6 mg/kg = 60 mg/kg*. Since 60 mg/kg is less than the silver RCS-1 value of 100 mg/kg, soil containing a maximum concentration that is less than 60 mg/kg silver could be reused at this location.

EXAMPLE: The soil at a receiving location that is considered RCS-1 is assumed to be consistent with natural background. The MassDEP published natural background level for arsenic is 20 mg/kg. Using Table 1, the concentration of arsenic at the receiving location would not be considered "significantly lower" than *7.5 x 20 mg/kg = 150 mg/kg*. However, since 150 mg/kg is greater than the arsenic RCS-1 value of 20 mg/kg, only soil containing a maximum concentration that is less than 20 mg/kg arsenic could be reused at this location. [The managed soil must not create a notifiable condition at the receiving location, see Section III.C. above.]

> **EXAMPLE:** The soil at a receiving location that is considered RCS-2 is assumed to be consistent with natural background. The MassDEP published natural background level for benzo[a]anthracene is 2 mg/kg. Using Table 1, the concentration of benzo[a]anthracene at the receiving location would not be considered "significantly lower" than *10 x 2 mg/kg = 20 mg/kg*. Since 20 mg/kg is less than the benzo[a]anthracene RCS-2 value of 40 mg/kg, soil containing a maximum concentration that is less than 20 mg/kg benzo[a]anthracene could be reused at this location. [Note that due to the lower reportable concentration, RCS-1 receiving locations could only accept soil containing less than 7 mg/kg benzo[a]anthracene.]

The multiplying factors in Table 1 and the MassDEP published natural background levels can be used to establish concentrations of OHM in soil that would be acceptable for reuse at an RCS-1 receiving location, consistent with the requirements of 310 CMR 40.0032(3). Table 2 lists such concentrations. Note that soil that meets the criteria in Table 2 could be re-used at *any* location (RCS-1 or RCS-2). Similarly, Table 3 lists concentrations of OHM in soil that would be acceptable for reuse at an RCS-2 receiving location (but *not* RCS-1 locations).

If a chemical is not listed on these tables, then MassDEP has not established a natural background concentration[5]. This guidance is limited to the use of only MassDEP-published statewide background concentrations. Therefore an alternative approach, such as sampling the receiving location and comparing maximum reported concentrations, would be appropriate to meet the requirements of 310 CMR 40.0032(3).

[5] For example, MassDEP has not established natural background levels for PCBs, volatile organic compounds (VOCs) or petroleum-related constituents.

Table 2.
Limits to the Concentration of OHM In Soil for Re-Use
Assuming Natural Background Conditions at an RCS-1 Receiving Location

OIL OR HAZARDOUS MATERIAL	Concentration In "Natural" Soil mg/kg	Rule-of-Thumb Multiplier	Multiplied Value mg/kg	RCS-1 mg/kg	Limiting[1] Soil Concentration mg/kg	
ACENAPHTHENE	0.5	10	5	4	<	4
ACENAPHTHYLENE	0.5	10	5	1	<	1
ALUMINUM	10,000	2.5	25000		<	25000
ANTHRACENE	1	10	10	1000	<	10
ANTIMONY	1	10	10	20	<	10
ARSENIC	20	7.5	150	20	<	20
BARIUM	50	7.5	375	1000	<	375
BENZO(a)ANTHRACENE	2	10	20	7	<	7
BENZO(a)PYRENE	2	10	20	2	<	2
BENZO(b)FLUORANTHENE	2	10	20	7	<	7
BENZO(g,h,i)PERYLENE	1	10	10	1000	<	10
BENZO(k)FLUORANTHENE	1	10	10	70	<	10
BERYLLIUM	0.4	10	4	90	<	4
CADMIUM	2	10	20	70	<	20
CHROMIUM (TOTAL)	30	7.5	225	100	<	100
CHROMIUM(III)	30	7.5	225	1000	<	225
CHROMIUM(VI)	30	7.5	225	100	<	100
CHRYSENE	2	10	20	70	<	20
COBALT	4	10	40		<	40
COPPER	40	7.5	300		<	300
DIBENZO(a,h)ANTHRACENE	0.5	10	5	0.7	<	0.7
FLUORANTHENE	4	10	40	1000	<	40
FLUORENE	1	10	10	1000	<	10
INDENO(1,2,3-cd)PYRENE	1	10	10	7	<	7
IRON	20,000	2.5	50000		<	50000
LEAD	100	5	500	200	<	200
MAGNESIUM	5,000	2.5	12500		<	12500
MANGANESE	300	5	1500		<	1500
MERCURY	0.3	10	3	20	<	3
METHYLNAPHTHALENE, 2-	0.5	10	5	0.7	<	0.7
NAPHTHALENE	0.5	10	5	4	<	4
NICKEL	20	7.5	150	600	<	150
PHENANTHRENE	3	10	30	10	<	10
PYRENE	4	10	40	1000	<	40
SELENIUM	0.5	10	5	400	<	5
SILVER	0.6	10	6	100	<	6
THALLIUM	0.6	10	6	8	<	6
VANADIUM	30	7.5	225	400	<	225
ZINC	100	5	500	1000	<	500

[1] Concentration of OHM in soil must be LESS THAN (not equal or greater than) this value.

Table 3.
Limits to the Concentration of OHM In Soil for Re-Use
Assuming Natural Background Conditions at an RCS-2 Receiving Location

OIL OR HAZARDOUS MATERIAL	Concentration In "Natural" Soil mg/kg	Rule-of-Thumb Multiplier	Multiplied Value mg/kg	RCS-2 mg/kg	Limiting[1] Soil Concentration mg/kg	
ACENAPHTHENE	0.5	10	5	3000	<	5
ACENAPHTHYLENE	0.5	10	5	10	<	5
ALUMINUM	10,000	2.5	25000		<	25000
ANTHRACENE	1	10	10	3000	<	10
ANTIMONY	1	10	10	30	<	10
ARSENIC	20	7.5	150	20	<	20
BARIUM	50	7.5	375	3000	<	375
BENZO(a)ANTHRACENE	2	10	20	40	<	20
BENZO(a)PYRENE	2	10	20	7	<	7
BENZO(b)FLUORANTHENE	2	10	20	40	<	20
BENZO(g,h,i)PERYLENE	1	10	10	3000	<	10
BENZO(k)FLUORANTHENE	1	10	10	400	<	10
BERYLLIUM	0.4	10	4	200	<	4
CADMIUM	2	10	20	100	<	20
CHROMIUM (TOTAL)	30	7.5	225	200	<	200
CHROMIUM(III)	30	7.5	225	3000	<	225
CHROMIUM(VI)	30	7.5	225	200	<	200
CHRYSENE	2	10	20	400	<	20
COBALT	4	10	40		<	40
COPPER	40	7.5	300		<	300
DIBENZO(a,h)ANTHRACENE	0.5	10	5	4	<	4
FLUORANTHENE	4	10	40	3000	<	40
FLUORENE	1	10	10	3000	<	10
INDENO(1,2,3-cd)PYRENE	1	10	10	40	<	10
IRON	20,000	2.5	50000		<	50000
LEAD	100	5	500	600	<	500
MAGNESIUM	5,000	2.5	12500		<	12500
MANGANESE	300	5	1500		<	1500
MERCURY	0.3	10	3	30	<	3
METHYLNAPHTHALENE, 2-	0.5	10	5	80	<	5
NAPHTHALENE	0.5	10	5	20	<	5
NICKEL	20	7.5	150	1000	<	150
PHENANTHRENE	3	10	30	1000	<	30
PYRENE	4	10	40	3000	<	40
SELENIUM	0.5	10	5	700	<	5
SILVER	0.6	10	6	200	<	6
THALLIUM	0.6	10	6	60	<	6
VANADIUM	30	7.5	225	700	<	225
ZINC	100	5	500	3000	<	500

[1] Concentration of OHM in soil must be LESS THAN (not equal or greater than) this value.

V. Sampling Considerations

The soil proposed for disposal/re-use should be sampled at sufficient and adequately distributed locations so that the concentrations of the contaminants of concern in the soil are adequately characterized. This includes sampling for the purpose of MCP site assessment and sampling to characterize the soil in any given stockpile/shipment leaving the site. The factors listed below should be considered when developing and implementing such a sampling plan. Evaluation of release, source, and site specific conditions assist in developing the basis for the selection of field screening techniques, sampling methodologies, sampling frequencies, and the contaminants of concern (e.g., analytical parameters) used to characterize the soil. These include, but are not necessarily limited to the following:

- the type(s) and likely constituents known or suspected to be in the soil;
- current and former site uses, past incidents involving the spill or release of OHM, and past and present management practices of OHM at the site;
- the potential for the soil to contain listed hazardous waste or to be a characteristic hazardous waste;
- the presence or likelihood of any other OHM (e.g., chlorinated solvents, metals, polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOCs) , halogenated volatile organic compounds (VOCs));
- visual/olfactory observations, field screening, analytical data, and/or in-situ pre-characterization data;
- soil matrix type - naturally occurring soil or fill/soil mixtures (e.g., homogeneous or heterogeneous soil conditions);
- the identification and segregation of discrete "hot spots";
- the concentration variability in the soil;
- the volume of soil;
- the current and likely future exposure potential at the receiving location, including the potential for sensitive receptors, such as young children, to contact the soil (for example, more extensive sampling of the stockpiles would be warranted for soil slated to be moved to a residential setting than for soil being moved to a secure, low-exposure potential regulated receiving facility); and
- any sampling requirements stipulated by the receiving location.

The assessment of the soil, including the nature and concentrations of OHM therein, is a component of the MCP site assessment and therefore must meet all applicable performance standards, including those for environmental sample collection, analysis and data usability[6]. The assessment should address the precision, accuracy, completeness, representativeness, and comparability of the sampling and analytical results used to determine whether the soil

[6] Additional guidance on data usability is available in Policy #WSC-07-350, MCP Representativeness Evaluations and Data Usability Assessments. http://www.mass.gov/eea/docs/dep/cleanup/laws/07-350.pdf

stockpiles meet the Similar Soils Provision requirements. The representativeness of any site assessment sampling data if used to characterize contaminant concentrations in soil to be moved and reused offsite should be carefully evaluated. Additional guidance on soil sampling considerations is available from U.S. EPA and other state environmental agencies.[7]

VI. Segregation and Management of Soils of Different Known Quality

Soil containing concentrations of OHM equal to or greater than the values listed in Table 3 cannot be managed using the streamlined approach described in this guidance. Such soil must be managed in a manner consistent with its regulatory classification, which may include management as a hazardous waste, as a remediation waste, or under a case-specific Similar Soils determination.

Segregation of soil of different quality should occur based upon *in-situ* pre-characterization sampling results. Stockpiles of soil are mixtures that would require more extensive sampling to document the effectiveness of any attempted post-excavation segregation.

The known presence of soil that exceeds the Table 3 concentrations and the subsequent segregation of soil is one factor that would indicate the need for more frequent sampling (at least in that area of soil excavation) as described in Section V.

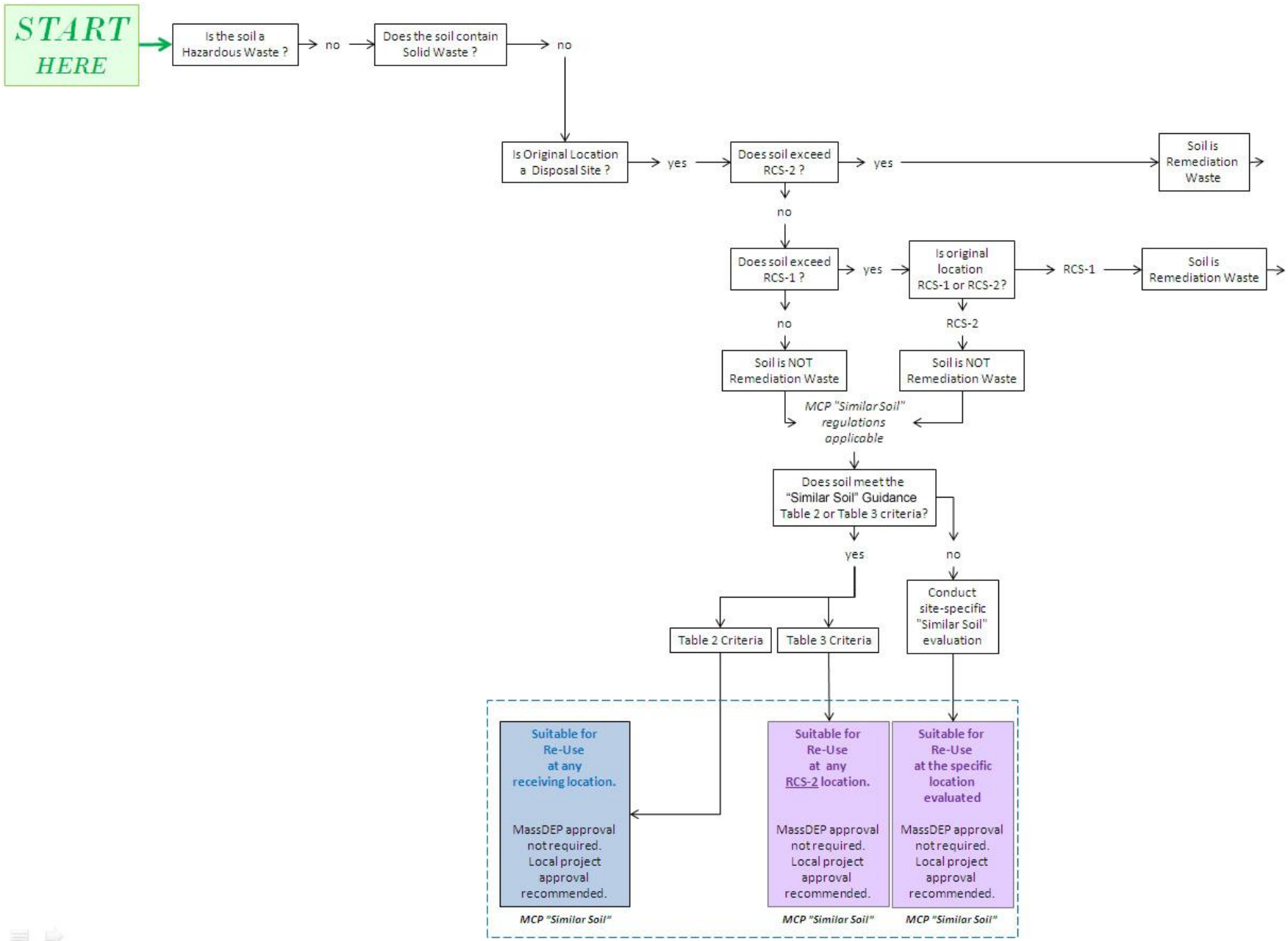
[7] Note that the guidance below are not specific to MGL Chapter 21E disposal sites and may not reflect MCP-specific considerations to determine the suitability of soils for offsite transport and use, such as for residential and other S-1 locations.

NJDEP. 2011. Alternative and Clean Fill Guidance for SRP Sites.
New Jersey Department of Environmental Protection Site Remediation Program
http://www.state.nj.us/dep/srp/guidance/srra/fill_protocol.pdf

USEPA. 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term.
Office of Solid Waste and Emergency Response (OSWER), Washington, DC
http://www.epa.gov/oswer/riskassessment/pdf/1992_0622_concentrationterm.pdf

USEPA. 1995. Superfund Program Representative Sampling Guidance Volume 1: Soil.
OSWER. Washington, DC.
(Note that guidance for determining the number of samples for statistical analysis is addressed in Section 5.4.1).
http://www.epa.gov/tio/download/char/sf_rep_samp_guid_soil.pdf

Attachment 1 – Similar Soil Flowchart



APPENDIX C

QUALIFICATIONS/LIMITATIONS

QUALIFICATIONS/LIMITATIONS

Environmental & Construction Management Services, Inc. (ECMS) professional services have been performed, our findings obtained, and our recommendations prepared in accordance with customary principles and practices in the fields of environmental science and engineering. This warranty is in lieu of all other warranties either expressed or implied. *ECMS* is not responsible for the independent conclusions, opinions or recommendations made by others based on the records review, site inspection, field exploration, and laboratory test data presented in this report.

Factual information regarding on-site business operations, conditions, and historical data provided to *ECMS* is assumed to be correct and complete. *ECMS* assumes no responsibility for hidden or latent conditions or misrepresentation by the property owner, its representatives, public information officials or any authority consulted in connection with the compilation of this report.

The findings set forth in the attached Site assessment report are strictly limited in time and scope to the date of the evaluation(s). The conclusions presented in the Report are based solely on the services described therein, and not on scientific tasks or procedures beyond the scope of agreed upon services or the time and budgeting restraints imposed by the client.

The purpose of this report was to assess the physical characteristics of the subject Site with respect to the presence in the environment of hazardous material or oil. No specific attempt was made to check on the compliance of present or past owners or operators or of the Site with Federal, State or local laws and regulations, environmental, or otherwise.

Partial findings of this investigation are based on data provided by others. No warranty is expressed or implied with the usage of such data. Much of the information provided in this report is based upon personal interviews and research of all available documents, records and maps held by the appropriate government and private agencies. This is subject to the limitations of historical documentation, availability and accuracy of pertinent records, and the personal recollection of those persons contacted by *ECMS* personnel. *ECMS* is not a professional title insurance firm and makes no guarantee, explicit or implied that the listing, which was reviewed, represented a comprehensive delineation of past Site ownership or tenancy for legal purposes.

Observations were made of the Site and of structures on the Site as indicated within the Report. Where access to portions of the Site or to structures on the Site was unavailable or limited, *ECMS* is unable to render an opinion as to the presence of hazardous material or oil, or to the presence if indirect evidence relating to hazardous material or oil, in that portion of the Site or structure. In addition, *ECMS* renders no opinion as to the presence of hazardous material or oil, where direct observation of the interior walls, floor, or ceiling of a structure on a Site was obstructed by objects or coverings on or over these surfaces.

The initial site investigation took into account the natural and man-made features of the Site, including any unusual or suspect phenomenon. These factors combined with the Site's geology, hydrology, topography, and past and present land uses served as a basis for choosing a methodology and location for subsurface exploration as well as ground water and subsurface sampling, if done. The subsurface data, if provided, is meant as a representative overview of the Site.

The conclusions and recommendations contained in this report may be based in part upon various types of chemical data and are contingent upon their validity. As indicated within the Report, some

of these data are preliminary "screening" level data, and should be confirmed with quantitative analyses if more specific information is necessary. It should be noted that variations in the types and concentrations of contaminants and variations in their flow paths may occur due to seasonal water table fluctuations, past disposal practices, the passage of time, and other factors. Should additional data or variations of current data become available in the future, these data should be reviewed, and the conclusions and recommendations presented herein modified accordingly.

Chemical analyses may have been performed for specific parameters during the course of this Site assessment, as described in the text. However, it should be noted that additional chemical constituents not searched for during the current study might be present in soil and/or ground water at the Site.

SECTION 315000

EXCAVATION SUPPORT

PART 1 GENERAL

1.01 GENERAL PROVISIONS

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements (if any), apply to the work specified in this Section.

B. Provide facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section, and as shown on the Drawings.

C. Examine all Drawings and all Sections of the Specifications for requirements and provisions affecting the work of this Section.

D. Coordinate work with that of all other trades or contracts affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK

A. The work covered by this Section, without limiting the generality thereof, consists of furnishing all plans, labor, equipment, appliances, material and performing all operations in connection with following:

1. Providing lateral support of the excavation and prevent damage to existing, structures and utilities.
2. Coordination of the below-grade excavation procedures, methods, sequences, and equipment with the Contractor's construction sequences, shoring system, and all trades affecting the work.
3. Design, installation and maintenance of wall and bracing systems as required for temporary lateral support of excavation for the construction of the foundations for the proposed building.
4. The excavation support wall shall remain in place, cut off 5 feet below final ground surface. All internal bracing (if any) shall be removed.
5. Protecting adjacent structures and utilities during excavation support wall construction, and below grade excavation.

B. In general, loads on the temporary lateral support system will be those from soil, and construction equipment surcharges.

C. It is essential that wall movements during excavation for construction of foundations and below-grade areas be kept to a minimum along the wall in order to minimize impacts to adjacent utilities and structures.

D. In order to limit movements of the excavation support wall and resulting settlements outside the excavation, it is critical that the sequence and extent of excavation and installation of bracing, if needed, be tightly controlled.

E. The arrangement, design, construction, testing, and maintenance of all walls and bracing systems for temporary lateral support of excavations shall be the sole responsibility of the Contractor.

1.03 RELATED SECTIONS

The following items are not included in this Section and are specified under the designated Sections:

A. Section 312000 – Earthwork

B. Section 312319 - Dewatering

1.04 REFERENCES STANDARDS

A. ASTM: Specifications of the American Society for Testing and Materials.

B. AWS: Standard Code for Welding in Building Construction, of the American Welding Society.

C. AASHTO: American Association of State Highway and Transportation Officials.

D. ACI: American Concrete Institute.

E. Code: Current Edition of Massachusetts State Building Code.

F. OSHA: Occupational Safety and Health Administration.

1.05 QUALITY ASSURANCE

A. The Contractor's engineer shall be registered in the Commonwealth of Massachusetts and shall have not less than ten (10) years of experience in the design of excavation support systems on similar projects.

B. All work under this Section shall be performed by a qualified Contractor experienced with the design and construction of excavation support systems. Minimum qualifications shall include five years of experience in constructing excavation support systems of the same type, size and depth as specified and in similar subsurface conditions. To be considered skilled and experienced, the Contractor must demonstrate that the Contractor's key personnel or subcontractor has installed, constructed and completed work involving similar excavation support systems and has competently managed and supervised the manpower, materials, equipment and tools necessary to complete such work as required by the size and complexity of this contract; and that the Work was successfully completed within the time frame allotted; and that the Work was done to the satisfaction of the Owner.

C. The Contractor shall furnish a project list of satisfactorily completed excavation support systems. The project list shall include the name of the Owner for whom the Work was performed, the scope and value of the shaft installations, and the names of the Contractor's or subcontractor's project superintendent(s) and assistant superintendent(s).

D. On-site supervisors shall have a minimum of two years of experience in supervising construction of project of similar size and difficulty to those shown in the Plans, and similar geotechnical conditions to those described in the geotechnical report.

1.06 SUBMITTALS

A. Qualifications: Submit qualifications demonstrating the requirements of Section 1.05 for the Contractor, the Contractor's onsite supervisor and the Contractor's engineer, not more than 30 calendar days following Notice to Proceed.

B. At least four (4) weeks prior to the start of excavation or other work associated with the earth support or dewatering systems, provide shop drawings and calculations for the earth support system for review and acceptance by the Architect. The Contractor shall forward submittals in advance considering that re-submittals may be required prior to acceptance.

C. Submit shop drawings as specified below:

1. Provide overall plan layout of each system (scale 1 in. = 20 ft.), indicating wall types, clearances from existing and proposed utilities, structures or other obstructions. Indicate dimensions, material properties, locations, spacing and penetration depths of all members, sequence of installation and locations of various types of lateral supports.

2. Provide elevation views showing all excavation, support system members, together with soil stratigraphy and groundwater levels in adjacent ground based on nearby borings and any additional subsurface exploration programs performed by the Contractor.

3. Views showing connections, including corner connections, wale brackets, and connections at all interfaces between dissimilar materials.

4. Views showing support framing and lagging details around any openings in the support system walls, such as those required to accommodate pipe penetrations.

5. For internal and external bracing systems (if any), provide details of locations, layouts and sizes of all members, details of connections, sequence of installation and removal. Indicate the levels to which excavation will be carried out before the temporary bracing is installed. Locations of internal and external bracing members shall not interfere with the construction of permanent elements and other structural features and shall permit access for their removal.

6. Indicate on the Drawings the actual locations of existing utilities, foundations or other obstructions in relation to the proposed construction.

D. Submit written data and calculations, including the following:

1. Engineering calculations and design assumptions for determination of loads and stresses acting in the excavation lateral support systems during intermediate construction stages as well as final conditions.

2. Include estimates of the deflections of the excavation lateral support systems under applied loads at critical stages.

3. Include engineering calculations and design assumptions for bracing design if required.

4. Anticipated equipment, traffic (and other surcharge) loads on adjacent ground during construction.

5. Methods of resolving difficulties arising from misalignment and/or mislocation of excavation support system exposed during excavation.

6. Estimated impacts to adjacent structures and facilities.

E. At least 30 days before commencing any excavation support activity, submit Plan of Actions to be implemented in the event any Response Value for deformation, as specified in Article 3.5E of this specification, is reached. These contingency measures shall be submitted to the Geotechnical Engineer for review prior to the initiation of excavation

F. The Plan of Actions shall be positive measures by the Contractor to limit further movement of the wall including but not limited to placement of granular earth berms against the wall, installation of additional bracing, or a combination thereof. The details of the mitigating measures shall include a schedule of implementation, location and/or availability of materials, structural details for all connections to the wall and support elements, and a detailed description of the method of implementation. The Contractor shall be prepared to work twenty-four (24) hours per day to implement such measures.

G. Submit Welder Qualifications and Welding Procedures in accordance with AWS D1.5.

H. Submit descriptive data and operating procedures for all equipment to be used. This shall include, at a minimum, machinery required to install tiebacks, bracing, excavate soil, and remove obstructions. Submit all pertinent data including sizes, weights, capacities, torques and operating frequencies.

I. Review of the excavation support system by the Geotechnical and Structural Engineers will not relieve the Contractor from the responsibility for the adequacy of the design and construction of excavation support system to achieve the required results.

J. As-built Information: After installation of excavation lateral support systems, prepare a detailed as-built location plan of all members, to include identification, size, plan location at the top and excavation level for each member, length and top elevation of each member, support levels, location of wales and other supplementary members, and other pertinent data. Indicate modifications, if any, to the original proposed system.

K. Removal: Provide for review the proposed schedule and sequence of removal of internal components of the retention and bracing system.

1.07 DESIGN CRITERIA

A. The excavation lateral support system shall retain and provide support for adjacent soil, water, structures, utilities, streets and other features and protect them from detrimental movement or damage due to settlement, lateral movement, loss-of-ground, vibration, heave or any other causes related to this construction. All precautions shall be taken to prevent such damage and detrimental movement.

B. Minimum Design Criteria

1. Design the component members of the temporary excavation support systems to support, as applicable, the earth pressures, applicable hydrostatic pressures, temporary and permanent surcharge loads, construction equipment loads and other surcharge loads.

a. Design each component of the excavation support system to support the maximum combination of loading that can occur during construction.

b. A minimum lateral surcharge of 250 psf/foot of wall shall be assumed for design. Higher lateral surcharge loads shall be used if larger equipment or stockpile loads result in higher lateral surcharge loads.

c. Design the temporary excavation and vertical load support system in a manner permitting safe and expeditious construction of permanent structures, minimizing movement or settlement of the ground and preventing damage to adjacent facilities.

d. The excavation support system shall be designed to accommodate additional depth of excavation in locations where over excavation of unsuitable subgrade material is required.

C. Coordinate the excavation support system design with the design of the dewatering system specified in Section 312319 - Dewatering

D. Design the excavation lateral support system in accordance with the sequence of excavation and permanent building construction. Stage the removal of temporary bracing (if any) in accordance with the reviewed construction and backfilling sequence.

E. Design and install excavation lateral support system to provide the required free excavated space and to permit safe and expeditious construction of permanent structures and utilities.

F. Acceptance of the Contractor's plans, proposed sequence, design calculations and methods of construction by the Owner and Architect (and its subconsultants), does not relieve the Contractor of the responsibility for the adequacy for the excavation lateral support system, preventing damage to structures, utilities and streets adjacent to excavations, and the safety of persons working within excavated areas and the public at large.

1.08 PROJECT CONDITIONS

A. The Contractor is also hereby made aware that there are infringement restrictions pertaining to abutting and nearby properties that will impact the nature of the excavation support system design and construction.

B. Refer to the boring logs referenced in SECTION 0312000 - EARTHWORK for Subsurface Data.

C. Consult official records of existing above and below grade utilities, and their connections, to be fully informed of all existing conditions and limitations as they apply to this work and its relation to other construction work.

D. By submitting a Bid, the Contractor affirms that the site and all conditions affecting the Work under this Section have been carefully examined. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation at the site.

E. After obtaining Owner's permission, the Contractor may take additional subsurface explorations at no expense to the Owner.

1.09 PERMITS, CODES, AND SAFETY REGULATIONS

A. All work shall conform to the Drawings and Specifications and shall comply with applicable codes, permits, and regulations.

B. Comply with all rules, regulations, laws, permits and ordinances of all authorities having jurisdiction including, but not limited to, OSHA, U.S. Department of Environmental Protection (EPA), Massachusetts Department of Environmental Protection (DEP), the City of Amesbury, and the Commonwealth of Massachusetts. All labor, materials, equipment, and services necessary to make the work comply with such requirements shall be provided without additional cost to the Owner.

C. Unless otherwise noted in the Supplementary Conditions, the Contractor shall procure and pay for all permits and licenses required for the complete work specified herein and shown on the Drawings.

D. The Contractor shall not close or obstruct any street, sidewalk, or passageway unless otherwise approved by the Owner. The Contractor shall conduct its operations during times previously agreed to by the Owner to avoid possible conflict with the use ordinarily made of all railways, roads, driveways, sidewalks, or other facilities near enough to the work to be affected thereby.

PART 2 PRODUCTS

2.01 All timber, structural steel, and steel sheet piling used for the supporting systems, whether new or used, shall be sound and free from defects that may impair their strength.

2.02 Structural steel for sheet piling or temporary structural support members shall conform to ASTM A572, Grade 50 or ASTM A36, Grade 36 as determined by the design of the support members. No members with permanent deformations are to be provided. Members shall not be spliced unless approved by the Structural Engineer.

2.03 Pipe piles shall conform to ASTM A252, Grade 3 (45 ksi), or better unless approved otherwise.

2.04 Steel sheet piling shall conform to ASTM A328 or ASTM A572 or ASTM A690, unless approved otherwise. All steel sheet piling conforming to ASTM A 572 shall be Grade 50 or better.

2.05 Concrete shall conform to ASTM C33 and ASTM C150 unless otherwise approved.

2.06 All timber shall be structural grade with a minimum allowable flexural strength of 1100 psi. Timber lagging shall be at least 3 inches thick and free of large or loose knots.

PART 3 EXECUTION

3.01 GENERAL

A. Install and maintain the excavation support system in accordance with the accepted working drawings, and in such a manner as to prevent movement, settlement, or loss of ground, removal of fines from the adjacent ground, and damage to or movement of adjacent structures and utilities.

B. Perform field welding by certified welders in accordance with American Welding Society Standards AWS D 1.5, "Bridge Welding Code."

C. Implement the Plan of Actions as submitted under Article 1.04.d, if Response Values, as specified in Article 3.05E of this specification, are reached.

3.02 PROTECTION OF ADJACENT WORK

A. Protect all adjacent structures, roadways, utilities, etc., which may be damaged by excavation work, including service utilities and pipe chases. All construction induced damage shall be repaired by the Contractor at no additional expense to the Owner.

B. The Contractor shall repair all damage to adjacent properties and restore the surfaces and finishes to the original state.

C. The Contractor is hereby warned that construction activities, such as installing steel soldier piles or sheeting, may cause vibrations strong enough to settle granular and miscellaneous fill layers. The Contractor shall take all necessary steps to minimize vibrations and protect all existing structures and utilities.

D. If in the opinion of the Architect the structural integrity of any building is jeopardized, the Contractor shall immediately discontinue further excavation in the affected area and implement accepted Plan of Action to mitigate further movement. Mitigating measures shall remain in effect until such time that the Architect evaluates the impact on the structure and may direct the Contractor to perform any remedial work. The Contractor shall submit proposed remedial measures to the Architect for review. Submittals shall include methods and names of subcontractors. The Contractor shall proceed with remedial work upon acceptance by the Architect. Mitigating measures shall be at no additional cost to the Owner.

E. Control vibrations and noise associated with installation of earth support systems.

3.04 EXCAVATION SUPPORT WALL INSTALLATION

A. The Contractor shall propose methods, equipment and sequence to be used for wall construction for review a minimum of four (4) weeks prior to beginning any work at the site.

B. Excavation and installation sequence of internal bracing (if any) to provide lateral support for the wall shall be planned and executed with the primary objective of limiting wall and adjacent ground movement and maintaining the structural integrity of the adjacent foundation systems and utilities. Prior to design of the system, the Contractor, shall carefully review all available information pertaining to these structures and their foundations.

C. The Owner may choose to monitor vibrations during excavation support wall installation. The maximum allowable peak particle velocity measured at any on-site or off-site structures or utilities shall not exceed 0.5 inches per second for predominant frequencies above twenty cycles per second (20 Hz), and 0.25 inches per second for predominant frequencies below 20 Hz, whichever is lower. The Contractor shall modify driving procedures as necessary to not exceed this limit while meeting the minimum requirements specified herein.

3.05 DETECTION OF MOVEMENT

A. Prior to excavation and after installation of earth support wall, survey the position of top of the earth support wall to establish baseline. Monitoring shall commence at least three (3) days prior to excavation. A minimum of two (2) sets of independent baseline readings shall be taken and submitted to the Architect prior to the start of excavation. Survey the positions in all three dimensions.

B. Perform daily survey of monitoring points on the earth support wall from the beginning of excavation until exaction is complete. Upon completion of excavation, the Contractor shall monitor said points once per week until construction (foundations in place and backfilled, etc.) is complete, unless otherwise approved by the Architect. The Contractor shall make its own interpretations of the data resulting from monitoring program.

C. All monitoring data shall be reported to the Contractor with concurrent copies to the Architect within forty-eight (48) hours of measurement in tabular format, allowing comparison of current data to previous data, including baseline.

D. Threshold and Limiting Values (collectively “Response Values”) for monitoring points:

	Threshold Value	Limiting Value
horizontal	1.0 inch	2.0 inch
vertical	0.5 inch	1.0 inch

E. These values are subject to adjustment by the Architect as indicated by prevailing conditions and/or circumstances.

F. If a Threshold Value is reached:

1. Architect and Contractor shall meet to discuss remedial measures.
2. Contractor shall increase the instrument monitoring frequency as directed by the Owner.
3. Contractor shall install and monitor additional instruments as directed.
4. Contractor shall implement the remedial measures in the event the Threshold Value is reached, so the Limiting Value is not reached.
5. Contractor to take all necessary steps so that the Limiting Value is not exceeded. Contractor may be directed to suspend activities in the affected area with the exception of those actions necessary to avoid exceeding the Limiting Value.

G. If a Limiting Value is reached, all work shall stop and the site secured until remedial measures have been submitted and approved by the Owner.

END OF SECTION

Division 32
Exterior Improvements

SECTION 321200

FLEXIBLE PAVING - VEHICULAR

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 SCOPE OF WORK

A. The work of this Section includes, but is not limited to, the following:

1. Bituminous Concrete Roadway and Parking Area Pavement.
2. Existing Bituminous Concrete Pavement Cutting and Patching.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. The following items of related work are specified and included in other Sections of the Specifications:

1. Demolition of existing pavement - SECTION 311000 - SITE PREPARATION
2. Gravel Base Course - SECTION 312000 – EARTHWORK
3. Finish Grading – SECTION 312219 – FINISH GRADING
4. Concrete Pavements and Walkways - SECTION 321313 - SITE CONCRETE
5. Curbing – SECTION 321600 CURBS and GUTTERS
6. Roadway markings – SECTION 321700 – PAVING SPECIALTIES

1.04 DEFINITIONS

A. The following related items are included herein and shall mean:

1. Standard Specifications: Commonwealth of Massachusetts, Department of Transportation (MDOT), Standard Specifications for Highways and Bridges, latest edition.
2. ASTM: American Society for Testing and Materials.
3. AASHTO: American Association of State Highway and Transportation Officials.

1.05 SAMPLES AND SUBMITTALS

A. Submit the following in accordance with the provisions of Section 013300 – SUBMITTALS.

B. Samples and Submittals: At least thirty (30) days prior to intended use, the Contractor shall provide the following submittals and samples for approval. Do not order materials until Architect's approval of samples, certifications or test results have been obtained. Delivered materials shall closely match the approved samples.

C. Submittals for the following:

1. Bituminous concrete pavement design mix
2. Tack coat asphalt information.
3. Sieve tests of base materials

1.06 STORAGE AND PROTECTION

A. All materials shall be stored to prevent damage from the elements and other causes.

1.07 QUALITY ASSURANCE

A. Bituminous Concrete:

1. MDOT Specifications Section 460 for bituminous pavement for roadways and parking areas and Section 402 for dense graded crushed stone for base course.
2. MDOT Specifications Section 472 for repairs to existing pavements after installation of new curb.
3. The existing bituminous concrete pavement to be removed shall be removed from the site, legally disposed of.

B. Paving work and base course shall be done only after excavation and construction work that might damage them has been completed. Damage caused during construction shall be repaired before acceptance.

C. Pavement subbase shall not be placed on a muddy or frozen subgrade. Pavement courses shall not be placed on frozen or contaminated base course or binder.

D. Existing pavement under state or local jurisdiction shall, if damaged during the course of this project, be repaired or replaced under this section of the specifications. Materials and construction shall match local or state paving standards and cross sections, whichever is most stringent.

1.08 TESTING AND INSPECTION

A. The Owner reserves the right to retain an independent testing laboratory to perform inspection and testing of paving during the construction process.

PART 2 PRODUCTS

2.01 BITUMINOUS CONCRETE PAVEMENTS

A. Bituminous concrete for roadway, parking lot pavements, walkways and patching shall be Class I, Type I-1, furnished in accordance with Section M3 of the MDOT Specifications, except as modified herein.

1. Bituminous concrete pavement for roadways and parking lots shall consist of two (2) courses of bituminous concrete with a minimum finished pavement depth after rolling equal to the following:

    a. Total Compacted Pavement Thickness: As indicated on the Drawings

    b. Binder course shall be to thickness as indicated on Drawings consisting of one lift of Binder Course bituminous concrete.

    c. Finished top course shall be to thickness as indicated on Drawings consisting of one course of Top Course bituminous concrete as modified herein or Dense Mix Top Course in locations as shown on the drawings.

2. Bituminous concrete patch shall consist of Top Course and Binder Course bituminous concrete in depths to match existing roadways.

3. Bituminous concrete material shall conform to MDOT Specifications Paragraph M3.11.03 Job-Mix Formula, Table A, as follows:

    a. For main driveways and parking areas, top course shall be in accordance with standard “Top Course" per the referenced table.

    b. For pedestrian walkways and paved play areas, both with and without vehicular traffic, top course shall be in accordance with "Dense Mix" per the referenced table.

    c. For main driveways and parking areas, and for athletic and play surfaces, binder course shall be in accordance with "Binder Course" per the referenced table.

    d. For porous asphalt locations, see the applicable sections below.

B. Bituminous crack sealer shall be hot-applied bituminous sealer conforming to Fed. Spec SS-S-1401.

C. Tack coat shall consist of asphalt emulsion, Type RS-1 or RS-2 as described in the MDOT Specifications.

D. Base and subbase materials shall consist of Dense Graded Crushed Stone or Dense Gravel Base Course and Reclaimed Asphalt Base Course as shown on the Drawings and as specified under Section 312000 - EARTHWORK.

2.02 POROUS ASPHALT PAVEMENT

A. Porous Media Infiltration Beds:

1. Infiltration Bed: Below the porous asphalt itself are located various layers intended for structure, hydrologic control, and water quality improvement. From top to bottom: a 4" minimum thickness layer of choker course of crushed stone; an 8" minimum thickness layer of filter course of poorly graded sand (a.k.a. bank run gravel); 3" minimum thickness filter blanket (pea gravel) that is an intermediate setting bed between the filter course and the reservoir course below; and an 8" thick reservoir course of crushed stone. The fine gradation of the filter course is for enhanced filtration (water quality improvement) and delaying infiltration. The high air void content of the uniformly graded crushed stone reservoir course maximizes storage of filtered water thereby allowing more time for water to infiltrate the native soil below between storms; and creates a capillary barrier that arrests any upwards vertical water movement and in doing so prevents the winter freeze-thaw and heaving. The filter blanket is placed to prevent downward migration of filter course material into the reservoir course. Nonwoven geotextile fabric is used only for stabilizing the sides of the porous asphalt system excavation and is not to be used on the bottom of the system.

B. Choker Course Material and Reservoir Course Material shall meet the following:

1. Maximum Wash Loss of 0.5%
2. Maximum Durability Index of 35
3. Maximum Abrasion Loss of 10% for 100 revolutions, and maximum of 50% for 500 revolutions.
4. Material for the choker course and reservoir course shall have the AASHTO No. 57 and AASHTO No. 3 gradations, respectively as specified in the table below. If the AASHTO No. 3 gradation cannot be met, AASHTO No. 5 is acceptable with approval of the Engineer. AASHTO No. 3 is also suitable for the choker course.

Figure: Typical Cross-Section for Porous Pavement System



Table: Gradations of choker, filter and reservoir course materials

US Standard Sieve Size (Inches)	Per Cent Passing (%)			
	Choker Course (AASHTO No. 57/No. 67*)	Filter Course (Manufactured Sand)	Reservoir Course (AASHTO No. 3)	Reservoir Course Alternative** (AASHTO No. 5)
6	-	100	-	
2 1/2	-		100	-
2	-		90 - 100	-
1 1/2	100		35 - 70	100
1	95 - 100		0 - 15	90 - 100
3/4	-		-	20 - 55
1/2	25 - 60		0 - 5	0 - 10
3/8	-		-	0 - 5
#4	0 - 10	25 - 70	-	
#8	0 - 5	0 - 4	-	

* Alternate gradations (e.g. AASHTO No. 67) may be accepted upon Engineer's approval.
** Alternate gradations (e.g. AASHTO No. 5) may be accepted upon Engineer's approval.

C. Reservoir Course Thickness:

1. An 12-inch minimum thickness of reservoir course.
2. Subdrains, if included, are elevated to the top of this course as shown on the drawings to provide storage and infiltration. This subdrain shall be day lighted or connected as shown on the approved plans.

D. Filter Course Material:

1. Shall have a hydraulic conductivity of 10 to 60 ft/day at 95% compaction unless otherwise approved by the Engineer. Great care needs to be used to not over-compact materials. The coefficient of permeability for the selected filter course material shall be measured by ASTM D5084 and reported to the Engineer.

E. Filter Blanket Material:

1. Shall be clean washed pea gravel with a median particle diameter of 3/8".

F. Non-Woven Geotextile Filter Fabric:

1. For the sides of the porous asphalt system excavation shall conform to the specifications in the table below. Fabric shall be a non-woven geotextile compromised of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Fabric should be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

Table: Non-Woven Geotextile Filter Fabric Properties

Mechanical Properties	**Test Method**	**Unit**	**Minimum Average Roll Values**	
			MD*	**CD***
Grab Tensile Strength	ASTM D 4632	kN (lbs)	0.71 (160)	0.71 (160)
Grab Tensile Elongation	ASTM D 4632	%	50	50
Trapezoid Shear Strength	ASTM D 4533	kN (lbs)	0.27 (60)	0.27 (60)
Mullen Burst Strength	ASTM D 3786	kPa (psi)	2100 (305)	2100 (305)
Puncture Strength	ASTM D 4833	kN (lbs)	0.42 (95)	0.42 (95)
Apparent Opening Size	ASTM D 4751	mm (US Sieve)	0.212 (70)	0.212 (70)
Permittivity	ASTM D 4491	sec^{-1}	1.4	1.4
Permeability	ASTM D 4491	cm/sec	0.22	0.22
Flow Rate	ASTM D 4491	lpm/m^2 (gpm/ft^2)	4477 (110)	4477 (110)
UV Resistance	ASTM D 4355	% strength retained	70	70

Physical Properties	**Test Method**	**Unit**	**Typical Value**
Weight	ASTM D 5261	g/m^2 (oz/yd^2)	217 (6.4)
Thickness	ASTM D 5199	mm (mils)	1.9 (75)
Roll Dimension (width x length)		m (ft)	4.5 x 91 (15 x 300)
Roll Area		m^2 (yd^2)	410 (500)
Estimated Roll Weight		kg (lb)	99 (217)

G. Porous Asphalt Mix:

1. Mix Materials: Shall consist of performance grade asphalt binder, coarse and fine aggregates, and optional additives such as polymer-modified asphalt, fibers or other select additives. Materials shall meet the requirements of the NAPA's Design, Construction and Maintenance of Open-Graded Friction Courses, Information Series 115 (2002) and Design, Construction and Maintenance Guide for Porous Asphalt Pavements, Information Series 131, except where noted otherwise below or approved in writing by the Engineer.

2. Polymer Modified Performance Grade Asphalt Binder: The asphalt binder shall be a polymer and/or fiber modified performance grade asphalt binder (PGAB) used in the production of Superpave Hot Mix Asphalt (HMA) mixtures. The PGAB shall be two grades stiffer than that required for dense mix asphalt (DMA) parking lot installation. The standard DMA asphalt binder is PG 64-28, meaning that the preferred asphalt binder for porous asphalt applications is PG 76-22. The PGAB polymer modifiers are to be either styrene butadiene rubber (SBR) or styrene butadiene styrene (SBS). The dosage of fiber additives shall be added at 1.5% by total mixture volume. The binder shall meet the requirements of AASHTO M320.

3. Mix Designs:

   a. PG 64-28 with 5 pounds of fibers per ton of asphalt mix: This mix may be used as a base course where approved by the Engineer. It shall not be used for a wearing course.

   b. Post-Blended PG 64-28 SBR (to effectively obtain PG 76-22) at 1.5% volume with 5 pounds of fibers per ton of asphalt mix: The SBR shall be supplied by an approved PGAB supplier holding a Quality Control Plan approved by MassDOT. A Bill of Landing (BOL) will be delivered with each transport of PG 64-28 SBR. A copy of the BOL will be furnished to the quality assurance at the plant. A Post-Blended SBR Binder Quality Control Plan shall be submitted to the Engineer for approval at least 10 working days prior to production.

   c. Pre-Blended PG 76-28 modified with SBS: The SBS shall be supplied by an approved PGAB supplier holding a quality control plan approved by MassDOT. A Bill of Landing will be delivered with each transport of PG 76-28 SBS. A copy of the BOL will be furnished to the quality assurance inspector at the plant.

4. Quality Control: Certain quality control testing requirements during production may not be feasible for small projects in which limited asphalt is generated. Some testing methods cannot be completed during the time needed during small batch (less than approximately 50 tons of porous asphalt mix) production. The feasibility should be assessed with the Engineer and producer.

5. Anti-Stripping Mix Additives: The mix shall be tested for moisture susceptibility and asphalt stripping from the aggregate by AASHTO T283, or approved updated method. If the retained tensile strength (TSR) < 80% upon testing, a heat stable additive shall be furnished to improve the anti-stripping properties of the asphalt binder. Test with one freeze-thaw cycle. The amount and type of additive to be used shall be based on the manufacturer's recommendations, the mix design test results and shall be approved by the Engineer.

   Silicone shall be added to the binder at a rate of 1.0 oz. per 5,000 gallons.

   Fibers may be added per manufacturer and NAPA IS 115 recommendation if the draindown requirement cannot be met (<0.3% via ASTM D6390) provided that the air void content requirement is met (>18%, or 16% as tested with CoreLok device).

6. Course Aggregate: Course aggregate shall be that part of the aggregate retained on the No. 8 sieve; it shall consist of clean, tough durable fragments of crushed stone, or crushed grave of uniform quality throughout.

   Coarse aggregate shall be crushed stone or crushed gravel and shall have a percentage of wear as determined by AASHTO T96 of not more than 40%. In the mixture, at least 75%, by weight, of the material coarser than the No. 4 sieve shall have at least two fractured faces, and 90% shall have one or more fractured faces (ASTM D5821). Coarse aggregate shall be free from clay balls, organic matter, deleterious substances and not more than 8.0% of flat or elongated pieces (>3:1) as specified in ASTM D4791.

7. Fine Aggregate: The fine aggregate shall be part of the aggregate mixture passing the No. 8 sieve and shall consist of sand, screenings or combination thereof with uniform quality throughout. Fine aggregate shall consist of durable particles, free from injurious foreign matter. Screenings shall be of the same or similar materials as specified for coarse aggregate. The plasticity index of that part of the fine aggregate passing the No. 40 sieve shall be not more than 6 when tested in accordance with AASHTO T90. Fine aggregate from the total mixture shall meet plasticity requirements.

8. Recycled Asphalt Pavement (RAP): Recycled asphalt for use as fine aggregate is not allowed.

9. Porous Asphalt Mix Design Procedures: The Contractor shall submit a mix design at least 10 working days prior to the beginning of production. The Contractor shall make available samples of coarse aggregate, fine aggregate, RAP, fibers and a sample of the PGAB that will be used in the design of the mixture. A certificate of analysis (COA) of the PGAB shall be submitted with the mix design. The COA shall be certified by a laboratory meeting the requirements of AASHTO R18. The laboratory shall be certified by the MassDOT or qualified under ASTM D3666. Technicians shall be certified by the regional certification agency in the discipline of HMA Plant Technician.

The mixture shall be designed according to the NAPA IS 131, with the exception for testing for air void content. Bulk specific gravity (SG) used in air void content calculations shall not be determined and results shall not be accepted using AASHTO T166. Bulk SG shall be calculated using AASHTO T275 or ASTM D6752. Air void content shall be calculated from the bulk SG and maximum theoretical SG (AASHTO T209) using ASTM D3203.

The materials shall be combined and graded to meet the composition limits by weight as shown in the table below:

Table: Porous Asphalt Mix Design Criteria

Sieve Size (inch)	**Percent Passing (%)**
0.75	100
0.50	85 - 100
0.37	55 - 75
No. 4	10 - 25
No. 8	5 - 12
No. 200	2 - 4
Binder Content (AASHTO T164)	5.8 - 6.5%
Air Void Content (ASTM D6752)	16.0 - 22.0%
Draindown (ASTM D6390)*	≤ 0.3%
Retained Tensile Strength (AASHTO 283)**	≥ 80%
Cantabro abrasion test on unaged samples	≤ 20%
Cantabro abrasion test on 7 day aged samples	≤ 30%

* Either method is acceptable.
** Cellulose, mineral or polyester fibers may be used to reduce draindown.
*** If the TSR (retained tensile strength) values fall below 80% when tested per NAPA IS 131 (with a single freeze-thaw cycle ranther than 5), then in Step 4, the Contractor shall employ an antistrip additive, such as dehydrated lime (ASTM C977) or a fatty amine, to raise the TSR value above 80%.

10. Porous Asphalt Mix Production:

    a. Mixing Plants: Mixing plants shall meet the requirements of hot mix asphalt (HMA) plants as specified by the MassDOT unless otherwise approved by the Engineer.

    b. Preparation of Asphalt Binder: The asphalt material shall be heated to the temperature specified by the MassDOT specification in a manner that will avoid local overheating. A continuous supple of asphalt material shall be furnished to the mixer at a uniform temperature.

c. Preparation of Aggregates: The aggregate for the mixture shall be dried and heated at the mixing plant before being placed in the mixer. Flames used for drying and heating shall be properly adjusted to avoid damaging the aggregate and depositing soot or unburned fuel on the aggregate.

Mineral filler, if required to meet the grading requirements, shall be added in a manner approved by the Engineer after the aggregates have passed through the dryer.

The above preparation of aggregates does not apply for drum-mix plants.

d. Mixing: The dried aggregate shall be combined in the mixer in the amount of each fraction of aggregate required to meet the job-mix formula and thoroughly mixed prior to adding the asphalt material.

The dried aggregates shall be combined with the asphalt material in such a manner as to produce a mixture that when discharged from the pugmill is at a target temperature in the range that corresponds to a recommended range supplied by the PGAB supplier.

The asphalt material shall be measured or gauged and introduced into the mixer in the quantity determined by the Engineer for the particular material being used and at the temperature specified by the relevant specification.

After the required quantity of aggregate and asphalt material has been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the asphalt material throughout the aggregate is secured and there is no residual in the coated aggregate.

All plants shall have a positive means of eliminating oversized and foreign material from being incorporated into the mixer.

e. Quality Control During Production: The Contractor shall provide process control and/or quality control test results to the Engineer or the Engineer's designee. The Engineer and the producer shall assess the feasibility of the quality testing requirements.

The mixing plant shall employ a Quality Control Technician (QCT). The QCT shall perform quality control testing and shall be certified in the discipline of HMA Plant Technician by the relative certifying agency. The Contractor shall sample, test and evaluate the mix in accordance with the methods and minimum frequencies in the table below:

Table: QA/QC Testing Requirements During Production

Test	Min. Frequency	Test Method
Temperature in truck at plant	6 times per day	
Gradation	Greater of either: (a) 1 per 500 tons (b) 2 per day (c) 3 per job	AASHTO T30
Binder Content	Greater of either: (a) 1 per 500 tons (b) 2 per day (c) 3 per job	AASHTO T164
Air Void Content	Greater of either: (a) 1 per 500 tons (b) 2 per day (c) 3 per job	ASTM D6752
Binder Draindown	Greater of either: (a) 1 per 500 tons (b) 1 per day (c) 1 per job	ASTM D6390

If an analyzed sample is outside the testing tolerances, the Contractor shall take immediate corrective action. After the corrective action has been taken, the resulting mix shall be sampled and tested. If the re-sampled mix test values are outside the tolerances the Engineer will be immediately informed. The Engineer may determine that it is in the best interest of the project that production is ceased. The Contractor will be responsible for all mix produced for the project.

f. Testing Tolerances During Production: Testing of the quality control requirements shall be within the limits set in the table above. The paving mixture produced shall not vary from the design criteria for aggregate gradation and binder content by more than the tolerances in the table below:

Table: QA/QC Testing Tolerances During Production

Sieve Size (inch)	Percent Passing (%)
0.75	-
0.50	± 6.0
0.375	± 6.0
0.187	± 5.0
0.093	± 4.0
0.0029	± 2.0
% PGAB	± 0.3

g. Plant Shutdown and Rejection of the Mix: Should the porous asphalt mix not meet the tolerances specified in this section upon repeat testing, the Engineer may reject further loads of the mix. Mix that is loaded into trucks during the time that the plant is changing operations to comply with a failed test shall not be accepted and should be recycled at the plant.

PART 3 EXECUTION

3.01 BITUMINOUS CONCRETE PAVEMENTS

A. Grading:

1. Areas to be paved shall be compacted and brought to approximately subgrade elevation under SECTION 312000 - EARTHWORK, before work of this section is performed. Final fine grading, filling, and compaction of subgrade to receive paving to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required lines as shown on the plans shall be done under this Section. The base preparation shall conform to Mass. DOT Standard Specifications for Highways and Bridges, Section 460.60. Also see SECTION 312000 – EARTHWORK for Reclaimed Base Course.

2. Existing subgrade material that will not readily compact as specified by this Section shall be removed and replaced with satisfactory materials. Additional materials needed to bring subgrade to required line and grade and to replace unsuitable material removed shall be material conforming to this Section.

3. Subgrade of areas to be paved shall be recompacted to bring top 8 inches of material immediately below base course to a compaction of at least 95 percent of maximum density, as determined by ASTM D 1557, Method D. Subgrade compaction shall extend for a distance of at least 12 inches beyond pavement edge.

4. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade or subbase subsequent backfill and compaction shall be performed as directed by the Owner's Representative as specified in SECTION 312000 - EARTHWORK. Completed subgrade after filling such areas shall be uniformly and properly graded.

5. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 2 inches deep in subgrade shall be graded out, reshaped, and recompacted before placing pavement. Materials shall not be stored or stockpiled on subgrade.

6. Disposal of debris and other material excavated and/or stripped under this section, and material unsuitable for or in excess of requirements for completing work of this Section shall be legally disposed of off-site.

7. Prepared subgrade will be inspected by the Owner's Representative. Subgrade shall be approved by the Owner's Representative before installation of paving base course. Disturbance to subgrade caused by inspection procedures shall be repaired under this Section of the Specification.

B. Bituminous Paving

1. Bituminous paving mixture, equipment, methods of mixing and placing, and precautions to be observed as to weather, condition of base, and related requirements shall conform to the following:

a. Road and Parking: MDOT Specifications Section 460 - Class I Bituminous Concrete Pavement for roadway and parking areas.

2. Bituminous binder and wearing surface courses shall each be applied individually, in single lifts of full thickness indicated on the Drawings.

3. No mix shall be placed on wet or damp surfaces. No mix shall be placed when ambient temperatures are 40 degrees F and falling.

4. The temperature of bituminous concrete mixture when delivered to the site shall conform to MHD Specifications Section 460.61.

5. The Owner's Representative may require the Contractor to remove and replace at this own expense any defective mix not conforming to the specified job mix formula. If, at any time before the final acceptance of the work, any soft, imperfect places or spots shall develop in the surface, all such places shall be removed and replaced with new materials and then compacted until the edges at which the new work connects with the old become invisible.

6. Adjacent paving and curb work shall be protected from stain and damage during entire operation. Damaged and stained areas shall be replaced or repaired to equal their original condition.

7. Existing paved surfaces to be resurfaced shall be cleaned of foreign and objectionable matter with blowers, power brooms, or hand brooms immediately before applying bituminous pavement. Cracks shall be cleaned, and bituminous crack sealer applied to fully seal pavement.

8. Application of Tack Coat: Areas to receive tack coat prior to paving operations shall be swept clean of loose materials, dirt or other extraneous materials. Application of tack coat shall be at a rate of 0.10 gallon per square yard. The following areas shall be treated:

   a. All cut edges of existing bituminous concrete pavement adjacent to placement of new paving.

   b. Against all vertical structures.

   c. As a tack coat for all bituminous base courses that do not have the top course installed within a 24 hr. period after placement of the base course.

9. Deliveries shall be timed to permit spreading and rolling all material during daylight hours, unless artificial light, satisfactory to Owner's Representative, is provided. Loads that have been wet by rain or otherwise will not be accepted. Hauling over freshly laid or rolled material will not be permitted.

10. Spreading and Finishing:

    a. The equipment for spreading and finishing shall be mechanical, self-powered pavers, capable of spreading and finishing the mixture true to lines, grade, width and crown by means of fully automated controls for both longitudinal and transverse slope.

b. During construction, if it is found that the spreading and finishing equipment in use leaves tracks or indented areas, or produces other permanent blemishes in the pavement, that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued and other satisfactory spreading and finishing equipment shall be provided by the Contractor.

c. The mixtures shall be placed and compacted only at such times as to permit the proper inspection and checking by the Owner's Representative.

d. The mixtures shall be placed only upon surfaces that have been inspected by the engineer or representative that the surfaces are clean from foreign materials and dry; and when weather conditions are suitable.

e. The contact surfaces of curbing, manholes, catch basins or other appurtenant structures in pavement shall be painted thoroughly with a thin uniform coating of bitumen (MHD Specifications RS-1) just before any mixture is placed against them. This requirement shall be included as work incidental to paving operations.

f. Machine Spreading: All mixtures shall be deposited in a mechanical spreader and immediately spread thereby, and then struck off in a uniform layer to the full width required and of such depth that each course, when compacted, shall have the required thickness and shall conform to the grade and cross section contour specified.

g. Hand Spreading: Spreading by hand methods will be permitted only for particular locations in the work which because of irregularity, inaccessibility or other unavoidable obstacles do not allow mechanical spreading and finishing.

11. Placing and rolling of mixture shall be as nearly continuous as possible. Rolling shall begin as soon after placing as mixture will bear the operation without undue displacement. Delays in rolling freshly spread mixture will not be permitted. Rolling shall proceed longitudinally, starting at edge of newly placed material and proceeding toward previously rolled areas. Rolling overlap on successive strips shall be greater than or equal to 1/2 width of roller rear wheel. Alternate trips of roller shall be of slightly different lengths. Corrections required in surface shall be made by removing or adding materials before rolling is completed. Skin patching of areas where rolling has been completed will not be permitted. Course shall be subjected to diagonal rolling, crossing lines of the first rolling while mixture is hot and in compactable condition. Displacement of mixture or other fault shall be corrected at once by use of rakes and application of fresh mixture or removal of mixture. Rolling of each course shall be continued until roller marks are eliminated. Roller shall pass over unprotected edge of course only when paving is to be discontinued for sufficient time to permit mixture to become cold.

12. In places not accessible to roller, mixture shall be compacted with hand tampers. Hand tampers shall weigh at least 50 pounds and shall have a tamping face less than or equal to 100 square inches. Mechanical tampers capable of equal compaction will be acceptable in areas in which they can be employed effectively.

13. Compaction:

    a. After the paving mixture has been properly spread, compaction shall be obtained by the use of power rollers of appropriate design and weight per inch of roller. The rollers shall be steel wheeled supplemented with pneumatic-tired rollers where appropriate.

    b. Along curbs, structures and all places not accessible with a roller, the mixture shall be thoroughly compacted with mechanical tamping devices. The surface of the mixture after compaction shall be smooth and true to the established line and grade.

    c. The densities of the completed pavement shall be not less than 95 percent of the density obtained from laboratory compaction of a mixture composed of the same materials in like proportions.

14. Portions of pavement courses that become mixed with foreign material or are in any way defective shall be removed, replaced, replaced with fresh mixture, and compacted to density of surrounding areas. Bituminous material spilled outside lines of finished pavement shall be immediately and completely removed. Such material shall not be employed in the work.

15. Joints shall present same texture, density, and smoothness as other sections of the course. Continuous bond shall be obtained between portions of existing and new pavements and between successive placements of new pavement. New material at joints shall be thick enough to allow for compaction when rolling. Compaction of pavement, base, and subgrade at joints shall be such that there is no yielding of new pavement relative to existing pavement when subjected to traffic.

16. Contact surfaces of previously constructed pavement (if greater than or equal to seven days since binder placed), manholes, and similar structures shall be thoroughly cleaned and painted with a thin uniform coating of bitumen immediately before fresh mixture is placed. Tack coat shall be applied at rate that will leave bituminous residue of 5 to 7 gallons/100 sq. yd. after evaporation of vehicle. Base surface shall be dry and clean when tack coat is applied. Bituminous paving material shall not be placed until vehicle has completely evaporated from tack coat. Adjoining new paving shall be placed before tack coat has dried or dusted over.

17. Earth or other approved material shall be placed along pavement edges in such quantity as will compact to thickness of course being constructed, allowing at least 12 inches (150 mm) of shoulder width to be rolled and compacted simultaneously with rolling and compacting surface. Pavement edge shall be trimmed neatly to line before placing earth or other approved material along edge. After final rolling, vehicular traffic shall not be permitted on pavement until it has cooled and hardened, and in no case less than six hours.

18. Variations in smoothness of finished surface shall be less than or equal to the following tolerances when tested with a 10 foot (3 m) straightedge, applied both parallel to and at right angles to centerline of paved area.

    a. For roadway and parking pavement surface course - 1/4 inch (6.4 mm) in 10 feet (3 m).

    b. At joint with existing pavement, and at other locations where an essentially flush transition is required, pavement elevation tolerance shall not exceed 0.01 feet.

    c. At other areas pavement elevation tolerance shall not exceed $\pm$ 0.05 feet.

    d. Irregularities exceeding these amounts or which retain water on surface shall be corrected by removing defective work and replacing with new material conforming to this Section.

19. No vehicular traffic of any kind shall be allowed to pass over the newly finished surface until it has had time to set. Twenty-four hours will be considered sufficient time for the pavement to set in most cases, but this period may be extended by the Owner's Representative as determined by weather or other reasons.

C. Repairs to Existing Pavement

1. Subgrade shall be done in strict accordance with Paragraph 3.01, above.

2. Aggregate base course shall be replaced in strict conformance with Paragraph 3.01 B, above.

3. Bituminous concrete paving mixture, equipment, and methods of mixing and placing shall conform to MHD Specifications Section 472 for Bituminous Concrete for Patching, and the relevant provisions of this Section.

D. Class 'A' Permanent Pavement Patch

1. Permanent pavement patches shall be constructed in areas shown on the Drawings and as directed by the Owner's Representative.

2. Saw cut existing bituminous concrete pavement edges at areas to receive patching. Width of pavement shall be cut to extend 2 feet wider than trench or in accordance to requirements of the Contract Documents.

3. Compact trench backfill to 95 percent maximum density in accordance with the requirements of SECTION 312000 - EARTHWORK, and as directed by Owner's Representative.

4. Place gravel borrow and compact in accordance with requirements of SECTION 312000 - EARTHWORK.

5. All exposed pavement edges at patch areas shall be coated with tack coat just prior to paving operations. Remove all loose pavement, stones and debris from pavement edges prior to tack coating.

6. Place and compact bituminous concrete binder and top courses in conformance to requirements for Bituminous Concrete Pavements, as specified in this Section.

3.02 POROUS ASPHALT PAVEMENT

A. Grade Control:

1. Establish and maintain required lines and elevations. The Engineer shall be notified for review and approval of final stake lines for the work before construction work is to begin. Finished surfaces shall be true to grade and even, free of roller marks and free of puddle-forming low spots. All areas must drain freely. Excavation elevations shall be within +/- 0.1 feet.

2. If, in the opinion of the Engineer, based upon reports of the testing service and inspection, the quality of work is below the standards, which have been specified, additional work and testing shall be required until satisfactory results are obtained.

B. Notification:

1. The Engineer shall be notified at least 48 hours prior to all porous media bed and porous pavement work.

C. Subgrade Preparation:

1. The existing native subgrade material under all bed areas shall NOT be compacted or subject to excessive construction equipment traffic prior to stone bed placement.

2. In areas where the existing subgrade material is below the elevation of the stone reservoir course, the area shall be brought up to the bottom elevation of the reservoir course with approved granular borrow. Area to be filled in 6 inch lifts and compacted to 95% compaction.

3. Where erosion of the native material subgrade has caused accumulation of fine materials and/or surface ponding at the base of the excavation and/or other areas compacted by construction activity, this material shall be removed with light equipment and the underlying soils scarified to a minimum depth of 6 inches with a York rake, or equivalent and light tractor.

4. Bring subgrade of stone porous media bed to line, grade and elevations indicated. Fill and lightly regrade any areas damaged by erosion, ponding or traffic compaction before placing of the stone.

5. Install the Porous Asphalt Cell Dividers on the prepared subgrade as shown on the plan.

D. Porous Media Bed Installation:

1. Upon completion of subgrade work, the Engineer shall be notified and shall inspect at his/her discretion before proceeding with the porous media bed installation.

2. Side slope geotextile (when used) and porous media bed aggregate shall be placed immediately after approval of subgrade preparation. Any accumulation of debris or sediment, which has taken place after approval of subgrade work, shall be removed prior to installation of geotextile or porous media at no extra cost to the Owner.

3. Place side slope geotextile in accordance with the manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of 16 inches. Secure geotextile at least 4 feet outside of the bed excavation and take any steps necessary to prevent runoff or sediment from entering the storage bed.

4. Install coarse aggregate (reservoir course) in lifts no greater that 8 inches. Lightly compact each lift with equipment, keeping equipment movement over the storage bed subgrades to a minimum. Install aggregate to the grades indicated on the drawings. Install subdrain as required.

5. Install choker course base coarse aggregate evenly over surface of filter course bed, sufficient to allow placement of pavement and notify the Engineer for approval. Choker base course thickness shall be sufficient to allow for even placement of the porous asphalt but no less than the depth indicated on the drawings.

6. The infiltration rate of the compacted filter course shall be determined by ASTM D3385 or an approved alternate at the discretion of the Engineer. The infiltration rate shall be no less that 5-30 ft/day or 50% of the hydraulic conductivity (D2434) at 95% standard proctor compaction.

7. Following the placement of bed aggregate, the side slope geotextile shall be folded back along all bed edges to protect from sediment washout along the bed edges. At least a 4 foot edge strip shall be used to protect beds from adjacent bare soil. This edge strip shall remain in place until all bare soils contiguous to beds are stabilized and vegetated. In addition, take any other necessary steps to prevent sediment from washing into beds during site construction. When the site is fully stabilized, temporary sediment control devices shall be removed.

E. QA/QC Requirements for Porous Media Bed Construction:

1. Quality assurance/quality control activities are summarized in the table below:

Table: QA/QC Requirements for Porous Media Bed Construction

Activity	Schedule
Contractor to notify Engineer for approval	48 hours in advance of start of work
Contractor to notify Engineer for approval	After subgrade preparation, before construction of porous media bed
Contractor to notify Engineer for approval	After filter course placement, before placement of choker course and pavement to verify proper compaction of filter course by ASTM D3385

F.

G. Porous Asphalt Pavement Installation:

1. The mixing plant, hauling and placing equipment, and construction methods shall be in conformance with NAPA IS 131 and applicable sections of the MassDOT specifications for asphalt mixes.

2. The use of surge bins shall not be permitted.

3. Hauling Equipment: The open graded mix shall be transported in clean vehicles with tight, smooth dump beds that have been sprayed with a non-petroleum release agent or soap solution to prevent the mixture from adhering to the dump bodies. Mineral filler, fine aggregate, slag dust, etc. shall not be used to dust truck beds. The open graded mix shall be covered during transportation with a suitable material of such size sufficient to protect the mix from the weather and also minimize mix cooling and the prevention of lumps. When necessary, to ensure delivery of material at the specified temperature, truck bodies shall be insulated, and covers shall be securely fastened. Long hauls, particularly those in excess of 25 miles, may result in separation of the mix and its rejection.

4. Placing Equipment: The paver shall be a self-propelled unit with an activated screen or strike-off assembly, capable of being heated if necessary and capable of spreading and finishing the mixture without segregation for the widths and thickness required. In general, track pavers have proved superior for porous asphalt placement. The screed shall be adjusted to provide the desired cross-sectional shape. The finished surface shall be of uniform texture and evenness and shall not show any indication of tearing, shoving or pulling of the mixture. The machine shall, at all times, be in good mechanical condition and shall be operated by competent personnel.

   Pavers shall be equipped with the necessary attachments, designed to operate electronically, for controlling the grade of the finished surface.

5. Rollers: The rollers shall be in good mechanical condition, operated by competent personnel, capable of reversing without backlash, and operated at speeds slow enough to avoid displacement of the asphalt mixture. The weight of the rollers shall be sufficient to compact the mixture to the required density without crushing the aggregate. Rollers shall be equipped with tanks and sprinkling bars for wetting the rollers.

6. Conditioning of Existing Surface: Contact surfaces such as curbing, gutters and manholes shall be painted with a thin, uniform coat of Type RS-1, or equivalent emulsified asphalt immediately before the asphalt mixture is placed against them.

7. Temperature Requirements: The temperature of the asphalt mixture, at the time of discharge from the haul vehicle and at the paver, shall be between 275 to 325 degrees Fahrenheit, within 10 degrees Fahrenheit of the compaction temperature for the approved mix design.

8. Spreading and Finishing: The porous asphalt should be placed in two lifts at 2.0 inches each. One lift is not recommended because the uniform compaction is difficult to achieve. Great care must be taken to ensure that the porous asphalt layers join completely. This means: keeping the time between layer placements minimal; keeping the first layer clear from dust and moisture, and minimizing traffic on the first layer. However, care should be taken to allow sufficient time for the asphalt placement to set, generally the following day or when the surface temperature of the first lift cools to 100 degrees Fahrenheit. Two lifts afford better compaction of the entire lift, especially in colder weather. It also provided access to the site for finish work such as curbing. Care must be taken to not damage or impair permeability of the base course if a multiple lift scenario is chosen. If significant site work will take place between placement of base and wearing courses higher durability mixes should be used for both layers.

   The Contractor shall protect all exposed surfaces that are not to be treated from damage during all phases of the pavement operation.

   The asphalt mixture shall be spread and finished with the specified equipment. The mixture shall be struck off in a uniform layer to the full width required and of such depth that each course, when compacted, has the required thickness and conforms to the grade and elevation specified. Pavers shall be used to distribute the mixture over the entire width or over such partial widths as practical. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread and raked by hand tools.

   No material shall be produced so late in the day as to prohibit the completion of spreading and compaction of the mixture during daylight hours, unless night paving has been approved and established for the project.

   No traffic shall be permitted on material placed until the material has been thoroughly compacted and has been permitted to cool below 100 degrees Fahrenheit. The use of water to cool the pavement is not permitted. The Engineer reserves the right to require all work adjacent to the pavement, such as guardrail, cleanup and turf establishment, is completed prior to placing the wearing course when this work could cause damage to the pavement. On projects where traffic is to be maintained, the Contractor shall schedule daily pavement operations so that at the end of each working day travel lanes of the roadway on which work is being performed are paved to the same limits.

9. Compaction: Immediately after the asphalt mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The compaction objective is 16%-19% in place void content (Corelock).

   Breakdown rolling shall occur when the mix temperature is between 275 to 325 degrees Fahrenheit.

   Finish rolling shall occur when the mix temperature is between 150 to 200 degrees Fahrenheit. Care should be taken so as to not continually roll the same location for instance back and forth to a water source.

The cessation temperature occurs at approximately 175 degrees Fahrenheit, at which point the mix becomes resistant to compaction. If compaction has not been performed at the temperatures greater than the cessation temperature, the pavement will not achieve durability. The temperatures referenced herein are guidelines and have been used in the field to oversee successful porous asphalt installations.

The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving.

Rollers or oscillating vibratory rollers, ranging from 7.5 to 10 tons, shall be used for breakdown compaction. The number, weight and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition.

To prevent adhesion of the mixture to the rollers, rollers shall be kept moist with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot or lightly oiled hand tampers, smoothing irons or with mechanical tampers. On depressed areas, either a trench roller or cleated compression strips may be used under the roller to transmit compression to the depressed area.

Other combinations of rollers and/or methods of compacting may be used if approved in writing by the Engineer, provided the compaction requirements are met.

The speed of the roller shall be slow and uniform to avoid displacement of the mixture, and the speed of the roller should be kept in as continuous operation as practical. Finish rolling shall continue below the threshold temperature until all roller marks and ridges have been eliminated.

Rollers shall not be stopped or parked on the freshly placed porous asphalt.

It shall be the responsibility of the Contractor to conduct whatever process control the Contractor deems necessary. Acceptance of testing will be conducted by the Engineer using cores provided by the Contractor.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture. The mixture shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of binder shall be removed and replaced. These replacements shall be at the Contractor’s expense.

If the Engineer determines that unsatisfactory compaction or surface distortion is being obtained or damage to components and/or adjacent property is occurring using vibratory compaction equipment, the Contractor shall immediately cease using this equipment and proceed with the work in compliance with this subsection.

10. Joints: Between old and new pavements or between successive day's work shall be made to ensure a thorough and continuous bond between old and new mixtures. Whenever the spreading process is interrupted long enough for the mixture to attain its initial stability, the paver shall be removed from the mat and a joint constructed.

    Butt joints shall be formed by cutting the pavement in a vertical plane at right angles to the centerline, at locations approved by the Engineer. The Engineer will determine locations by using a straightedge at least 10 feet long. The butt joint shall be thoroughly coated with Type RS-1 or equivalent emulsified asphalt just prior to depositing the pavement mixture when pavement resumes.

    Longitudinal joints that have become cold shall be coated with Type RS-1 or equivalent emulsified asphalt before the adjacent mat is placed. If directed by the Engineer, joints shall be cut to a clean vertical edge prior to applying the emulsion.

11. Surface Tolerances: The surface shall be tested by the Engineer using a straightedge, at least 10 feet in length, at selected locations parallel with the centerline. Any variations exceeding 3/8 inch between any two contact points shall be satisfactorily eliminated. A straightedge at least 10 feet in length may be used on a vertical curve. The Contractor shall provide the straightedges.

12. Work shall be done expertly throughout, without staining or injury to other work. Transition to adjacent impervious asphalt pavement shall be merged neatly with flush, clean lines. Finished pavements shall be even, without pockets, and graded to elevations shown on the drawings.

13. Repair of Damaged Pavement: Any existing pavement on or adjacent to the site that has been damaged as a result of construction work shall be repaired to the satisfaction of the Engineer without additional cost to the Owner.

14. Striping Paint: See Section 321700 – Paving Specialties

H. QA/QC Requirements for Porous Paving Operations:

1. Contractor shall be responsible for testing the permeability of the installation. The full permeability of the pavement surface shall be tested by application of clean water at the rate of at least 5 gpm over the surface, using a hose or other distribution devise. Water used for the test shall be clean, free of suspended solids and deleterious liquids and shall be provided at no additional cost to the Owner. All applied water shall infiltrate directly without large puddle formation or surface runoff and shall be observed by the Project Engineer.

2. Testing and Inspection by Owner's Testing Agency:

    The owner will be employing a testing and inspection agency for testing and inspection of the pavement system work. The Owner's testing agency shall test in-place base and surface course for compliance with requirements for thickness and surface smoothness. Other tests include but are not limited to taking temperature readings of the asphalt mix arriving at the site. Inspection and a list of tests shall be reviewed and approved in writing by the Engineer prior to starting construction of the

Porous Pavement system and provided to the Contractor for coordination. All test reports must be signed by a licensed Engineer. Contractor shall Repair or remove and replace unacceptable work as directed by the Engineer.

3. The Contractor's Massachusetts Registered Professional Land Surveyor shall measure and confirm the base elevations prior to installation of the porous pavement system and provide an as-built plan to the Engineer for review and approval prior to start of installation. The Surveyor shall also provide an as-built plan of the finish grades of the installation. Contractor to adjust, repair or remove and replace unacceptable work as directed by the Engineer.

4. The Owner's testing agency shall test in-place base and surface course for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable work as directed by the Engineer.

5. Surface Smoothness:

   The owner's testing agency shall test the finished surface for smoothness using a 10 foot straightedge applied parallel with and at right angles to the centerline of the paved area. Surface will not be accepted if gaps or ridges exceed 3/8 inch.

6. Porous pavement beds shall not be used for equipment or materials storage during construction, and under no circumstances shall vehicles be allowed to deposit soil on paved porous surfaces.

7. QA/QC requirements during paving are summarized in the table below:

   Table: QA/QC Requirements During Paving

Activity	Schedule/Frequency	Tolerance
Inspect truck beds for pooling (draindown)	every truck	N/A
Take temp. of asphalt in truck	every truck	> 275° F
Take temp. of PA mix in the paver	each pull	Within 10° F of the recommended compaction temp.
Consult with Engineer to determine location of butt joints	as needed	N/A
Test surface smoothness and positive drainage with a 10' straightedge	after compaction	3/8"
Consult with Engineer to mark core locations	after compaction	N/A
Hose test with at least 5 gpm water	after compaction	immediate infiltration, no puddling

I. References:

1. Porous Asphalt Pavement References:

The design and specifications for porous asphalt pavement for this project are based on the following publication and further references contained therein:

University of New Hampshire Stormwater Center (UNHSC) Design Specifications for Porous Asphalt Pavement and Infiltration Beds, February 2014

The Contractor shall review and be familiar with those publications.

END OF SECTION

SECTION 321313

SITE CONCRETE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 WORK INCLUDED

A. Provide all labor, materials, equipment, services and transportation required to complete concrete work as shown on the Drawings and as specified herein or both.

1. Concrete Pavement Pedestrian – Concrete Pavement with color additive.
2. Concrete Pavement Pedestrian and Vehicular.
3. Concrete Walls, Ramps and Site Concrete footings.

1.03 RELATED WORK

A. The following related work is to be performed under the designated Sections.

1. Site Preparation – Section 311000
2. Earthwork – Section 312000
3. Finish Grading – 312219
4. Curbs and Gutters – Section 321600
5. Playground Safety Surfacing – Section 321810
6. Miscellaneous Site Improvements – Section 323000
7. Cast-In-Place Concrete - Section 033000
8. Electrical – Division 26

1.04 REFERENCES

A. The following standards are applicable to the Work of this Section to the extent referenced herein:

1. Commonwealth of Massachusetts, Massachusetts Highway Department (MHD), Standard Specifications for Highways and bridges, latest English Edition with amendments, hereinafter referred to as the "Standard Specifications." All referenced to method of measurement, basis of payment and payment items in the Standard Specifications are hereby deleted. References made to particular Sections or paragraphs in the Standard Specifications shall include all related articles mentioned therein.
2. Commonwealth of Massachusetts, Massachusetts Highway Department, Construction Standards, latest Edition with amendments hereinafter referred to as the "Construction Standards."
3. ASTM: American Society for Testing and Material.
4. AASHTO: American Association of State Highway and Transportation Officials.
5. ACI: American Concrete Institute.
6. All ramps and curb ramps shall comply with American Disabilities Act Accessibility Guidelines and the Massachusetts Architectural Access Board (MAAB).

1.05 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 013300 – Submittals.

B. Product Data: Manufacturer's current catalogue cuts and specifications and suppliers material certificates for the following:

1. Cement Concrete Design Mix.
    a. 5000 PSI mix.
    b. Coloring Agent.
2. Steel Reinforcement.
3. Expansion Dowels.
4. Concrete curing compound.
5. Expansion Joints.
    a. Caulking.
    b. Expansion Joint Filler.
6. Concrete sealing compound.

7. Cast Iron Tactile Warning Surfaces.

8. Tactile Warning Surfaces.

C. Certificates of Compliance

1. Reinforcing Steel: Certificate of compliance.

2. Concrete Mix Design: Ticket for each batch delivered showing the following:

a. Mix identification.

b. Weight of cement, aggregate, water, and admixtures, aggregate sizes/proportion, and air entrainment.

D. Shop Drawings

1. Minimum (3/8) inch scale drawings showing dimensions, sizes, thickness, gauges, finishes, joining, attachments and relationship of work to adjoining construction and existing conditions.

a. Tactile Warning Details and Tactile Warning Plans for each condition.

2. Coordinate all sleeves for utilities and other items and curbs and show them on the shop drawings.

E. Samples:

1. (3) inch x (3) inch concrete sample for the (6) integral color concrete pigment samples selected.

1.06 TESTING, CONTROL AND INSPECTION

A. The Contractor will retain the services of a qualified independent testing agency, approved by the Architect, to test aggregate and to prepare a mix design for each strength of concrete specified; and shall submit such mix designs and test results to the Architect for approval. Mix designs may also be based on proven current designs accompanied by test results. The costs of all such preliminary services shall be borne by the Contractor.

B. The Owner will retain the services of a concrete testing company to provide concrete sampling and testing.

1. Testing equipment shall be provided by and tests performed by the testing laboratory. Upon request by the Architect, the testing laboratory shall provide such auxiliary personnel and services needed to accomplish the testing work.

2. Concrete test cylinder tests shall be taken for each 50 cubic yards of concrete placed, but at least one set for each day of concrete placements.

3. Testing required because of changes requested by the Contractor in materials, sources of materials or mix proportions, and extra testing of concrete or materials because of failure to meet the Specification requirements shall be paid by the Contractor.

4. Concrete shall be sampled and tested for quality control as follows:

   a. Sampling fresh concrete: ASTM C172

   b. Concrete test specimens: ASTM C31

   c. Slump: ASTM C143. – Slump shall be one to three inches, or five to seven inches with Super plasticizer.

   d. Air Content: ASTM C231

   e. Compressive strength: ASTM C39 – Concrete shall be 5000 psi at (28) days

   f. Unit Weight: ASTM C29

1.07 QUALITY ASSURANCES

A. Mock Ups

1. The Sub-Contractor shall construct the following mock-up panels on site showing all joints, finishes and score lines for approval by the Landscape Architect.

2. The mock-up panels shall be removed at the end of construction of the concrete items and the specified materials be installed in place of the panels.

3. Mock-ups including expansion and control joints:

   a. Concrete Pavement (Pedestrian/Vehicular) – (6) inch x (6) inch mock-up

   b. Concrete Pavement Pedestrian- Colored – (6) x (6) inch mock-up

      1) (Three) mock-ups from colors selected from the (3) inch x (3) inch integral color concrete pigment samples

   c. Handicap ramp – (one) mock-up

1.08 PROJECT CONDITIONS

A. Work notification: Notify Landscape Architect at least (48) hours prior to installation of concrete.

B. Establish and maintain required lines, surfaces and elevations.

C. Do not install concrete work over wet, saturated, muddy or frozen subgrade.

D. Protect adjacent work.

1.09 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.10 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architect's designated representative.

PART 2 MATERIALS

2.01 DENSE GRADED CRUSHED STONE/AGGREGATE BASE: Refer to Section 312000 Earthwork for all requirements.

2.02 CONCRETE

A. Cast-in-place concrete shall be air-entrained concrete with minimum 28-day compressive strength of 5000 pounds per square inch, conforming to the requirements and applicable provisions of MDOT Specifications Section M4.02.

1. Air Content: Minimum (6) percent, maximum (7) percent at point of delivery for (¾) inch nominal aggregate size.
2. Slump: Concrete shall have a slump of (4) inches, plus or minus (1) inch.
3. Maximum water – cementitious material ratio: 0.40.
4. Thickness of Concrete: Depths shall be as noted on the Contract Documents.

B. Portland Cement: ASTM C-150 Type 1: All cement shall be from a single source.

C. Natural Aggregates:

1. Fine Aggregate for Concrete: Shall be natural sand consisting of clean, hard, durable, uncoated particles, conforming to ASTM C33. Organic content shall be determined according to ASTM C40. Allow no frozen or partially frozen aggregate in the mix.
2. Course Aggregate for Concrete: For regular weight concrete use crushed stone or gravel from approved source conforming to ASTM C33. Coarse aggregate shall not contain greater amounts of deleterious material than specified in table III, ASTM C33.

D. Water from approved source, potable, clean and free of oils, salt, alkali, organic matter and other deleterious material.

2.03 MIXTURE COMPONENTS

A. Concrete Type: Liquid or Powered integral color designed to color the cement paste in a concrete mixture.

B. Percentage: as recommended by supplier.

C. Product: Liquid or Powdered Integral color admixtures as produced by Davis Colors for Concrete (28 Colors), daviscolors.com; Schofield (28 colors), 800-800-9900, www.scofield.com, Interstar (84), 800-567-1857m ubterstar.ca.

D. Color:

1. Submit color and data charts or integral color admixture colors.
2. (Six) colors to be selected and submitted as (3) inch x (3) inch concrete samples.
3. (Three) colors will be selected to be mocked-up.
4. (One) colors will be selected for installation on the project.

2.04 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of (100) feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that shall not bond with, stain, or adversely affect concrete surfaces and that shall not impair subsequent treatments of concrete surfaces.

2.05 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

C. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A 82/A 82M

I. Deformed-Steel Wire: ASTM A 496/A 496M.

J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated.

K. Expansion Joint Stainless Steel Joint Dowel Bars: smooth-steel bars, (½) inch x (18) inch smooth with compatible waxed tube sleeve.

L. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

M. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

N. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

O. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

P. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

R. Zinc Repair Material: ASTM A 780.

2.06 DOWEL SLEEVES

A. Compatible waxed tube sleeve.

B. Dowels and sleeves shall be as furnished by A.H. Harris & Sons, Inc., by U.S. Steel Corp., by Edgecombe Steel Corp., or approved equal

2.07 EXPANSION JOINTS

A. Unless otherwise indicated on the Drawings, expansion joints shall be located 25 feet on center maximum.

B. Expansion joint filler with joint snap-cap: Closed cell polymer foam meeting requirements of ASTM D 1752, Sections 3.1 to 3.4, based on compression requirement of (10) pounds per square inch minimum and (25) pounds per square inch maximum. Recovery rate following (50) percent compression shall exceed 99 percent recovery, per ASTM D 545.

2.08 CURING COMPOUND FOR NON-COLORED CONCRETE

A. Curing shall be by moist curing or by use of curing compound.

B. Curing paper shall be non-staining; fiber reinforced laminated kraft bituminous product conforming to ASTM C 171. Four-mil polyethylene sheeting may be substituted for curing paper.

C. Curing compound shall be a resin-base, white pigmented compound conforming to ASTM C 309, Type 2.

2.09 CURING COMPOUND FOR COLORED CONCRETE: Color match, base and tint, low voc, curing compound for exterior flatwork from the same supplier as the integral color admixture supplier.

A. Schofield: Lithochrome Colorwax.

B. Interstar: SL-20, acrylic,

C. Davis: Color Seal II.

2.10 EXPANSION JOINT CAULKING:

A. Caulking for sealing of control joints and expansion joints in concrete band and expansion joints of concrete walks shall be a two component polyurethane based sealant conforming to ASTM C 920 with a Shore A hardness of 30±5, or better.

1. Color of caulking shall match the color of the concrete.
2. Primer shall be that recommended by the caulking manufacturer for the use intended.
3. Joint backing where required shall be as recommended by the sealant manufacturer.

2.11 CONCRETE SEALANT – COLORED AND NON-COLORED CONCRETE

A. Water repellant penetrating sealer, clear, non-staining, penetrating, solvent based concrete sealer for exterior use, VOC compliant, Pentreat 244-40-OTC hydrophobic, impregnating sealer preventing chloride-induced corrosion, scaling, corrosion, spalling and freeze-thaw damage by W. R. Meadows or approved equal.

1. ASHTO T259/T260
2. ASTM E514
3. ASTM C642
4. ASTM C672
5. National EPA VOC emission Standard for Architectural Coatings

B. Apply two coats as recommended by the manufacturer.

2.12 CAST IRON TACTILE WARNING SURFACE

A. Conforming to the current ADA and MAAB regulations for Detectable Warning Surfaces.

B. Cast Iron Plates, ASTM A48, Class 35B. Size as shown on the drawings. Radius and straight tiles, embedded in the concrete.

C. Manufacturers / Products:

1. Cast Iron Plates, Advantage Tactile Systems, Inc., 800-679-4022.
2. Detectable Warning Plates, Neenah Enterprises, Inc., 800-558-5075.
3. Duralast Detectable Warning Plates, by EJ, 800-626-4653.

2.13 TACTILE WARNING SURFACE

A. Conforming to the current ADA and MAAB regulations for Detectable Warning Surfaces.

B. Vitrified Polymer Composite or Homogeneous Glass and Carbon Reinforced Composite Cast-In-Place Replaceable Tiles, Compressive Strength: 28,000 psi minimum by: ADA Solutions, Inc., 800-372-0519 or Armor Tile, 1-800-682-2525 or

1. Color: Brick Red.

PART 3 EXECUTION

3.01 PREPARATION

A. Preparation of Subgrade:

1. Areas to be paved shall be compacted and brought to subgrade elevation under SECTION 312000 - EARTHWORK, before work of this Section is performed. Final fine grading, filling, and compaction of areas to receive paving, as required to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required lines, shall be done under this Section.
2. Existing subgrade material that shall not readily compact as required under this Section shall be removed and replaced with satisfactory materials. Additional materials needed to bring subgrade to required line and grade and to replace unsuitable material removed shall be material conforming to SECTION 312000 - EARTHWORK, and this Section.
3. Subgrade of areas to be paved shall be recompacted as required to bring the top (8) inches (200 mm) of material immediately below dense graded crushed stone base course to a compaction at optimum moisture of at least 95 percent of maximum density, as determined by ASTM D 1557. Subgrade compaction shall extend for a distance of at least (12) inches (305 mm) beyond pavement edge.
4. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade, subbase, base, or pavement, subsequent backfill and compaction shall be performed as specified in SECTION 312000 - EARTHWORK. Uniformly and properly grade all such completed subgrade areas after filling.
5. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to (2) inches (50 mm) deep in subgrade shall be graded out, reshaped as required to meet the plan and specifications, and recompacted before placing pavement.
6. Materials shall not be stored or stockpiled on subgrade.
7. Disposal of debris and other material excavated under this Section, and material unsuitable for or in excess of requirements for completing work of this Section shall be disposed of off-site.

B. Dense Graded Crushed Stone: Install Dense Graded Crushed Stone base course in accordance with the requirements of SECTION 312000 - EARTHWORK, of this Specification and as described in this Section.

C. Formwork: All forms shall be joined neatly and tightly, shall be set true to line and grade, well staked and braced, and shall have uniform bearing throughout their length.

1. Forms shall not be moved for (72) hours after the concrete has been placed.

2. Extreme care shall be taken in removing forms in order that no damage shall be done to the concrete.

3. Under no condition shall any bar, pick or other tool be used which depends upon leverage on the concrete for removal of the forms.

D. Steel Reinforcement:

1. Before being placed in position, reinforcing for reinforced concrete shall be thoroughly cleaned of loose mill and rust scale, dirt, ice, and other foreign material that may reduce the bond between the concrete and reinforcing. Where there is delay in placing concrete after reinforcement is in place, bars shall be re-inspected and cleaned when necessary.

2. Reinforcement shall be held firmly in place against vertical or transverse movement by means of satisfactory devices. Where steel reinforcement is spliced, it shall be lapped at least (12) inches (300 mm).

   a. Unless designated otherwise on the Contract Documents, steel reinforcement shall be placed midway within the depth, and parallel to the finished surface of concrete pavements.

   b. Do not pour concrete over top of reinforcement unless it is supported underneath.

E. Expansion Joints:

1. Expansion joints shall be (3/8) inches wide and shall be as located on the Contract Documents and as follows. Expansion joint shall be formed in the concrete to required width with preformed joint filler in place. Joint filler shall extend the full depth of the slab. Joint filler shall extend the full length of the expansion joint.

   a. Expansion joints shall be placed where pavement meets structures, including light bases, hydrants, buildings, piers and walls, and at other conditions as shown on the Contract Documents.

   b. Follow the manufacturer's application recommendations for joint filler and caulking.

   c. Joint alignment shall be straight and true.

3.02 CONCRETE PAVEMENT

A. Paving mix, equipment, methods of mixing and placing, and precautions to be observed as to weather, condition of base and other requirements to meet ACI 316R. Pavement shall be constructed in accordance with the Contract Documents.

B. The Owner's Representative shall be notified of concrete placement sufficiently in advance of start of operation to allow his representative to complete preliminary inspection of the work, including subgrade, forms, and reinforcing steel, if used. No concrete shall be deposited until the Owner's Representative has inspected the placing of reinforcement and given permission to place concrete.

C. Concrete Pavement – Integral Colored Concrete:

1. Provide colorant for the (one) selected colors in locations shown on the shop drawings, the proportions recommended by the manufacturer and as related to the approved mock-up. Each area of colored paving on the project shall be installed in continuous pours. Should more than (one) batch (truck load) be required to complete the area, the concrete color shall be consistent in formula with adjacent pour(s).
2. Provide Curing Compound at the rates of application and methods as recommended by the manufacturer. Follow the manufacturer's recommendations as to the timing of the sealant application.

D. Normal concrete placement procedures shall be followed. Concrete shall arrive at the job site so that no additional water shall be required to produce the desired slump. The concrete shall be transported from the mixer to its place of deposit by a method that will prevent segregation or loss of material.

1. Concrete pavement shall be placed in a series of alternate pours such that every other panel bounded by expansion joints shall be poured first.
2. The intervening panels shall then be poured as a secondary operation only after the first panels have hardened sufficiently to allow the removal of all temporary transverse forming supports.
3. Concrete shall be placed in one course, to full depth, as detailed on the Contract Documents.

E. Work shall not be performed during rainy weather or when temperature is less than 40° F.

F. Adjacent work shall be protected from stain and damage during entire operation. Damaged and stained areas shall be replaced or repaired to equal their original conditions.

G. Existing concrete, earth, and other water-permeable material against which new concrete is to be placed shall thoroughly damp when concrete is placed. There shall be no free water on surface.

H. Concrete which has set or partially set before placing shall not be employed. Re-tempering of concrete shall not be permitted.

I. Concrete shall be thoroughly spaded and tamped to secure a solid and homogeneous mass, thoroughly worked around reinforcement and into corners of forms.

J. Finishing:

1. Concrete flatwork surfaces shall be screeded off, bullfloated (or darbied), and hand floated and finished true to line and grade, and free of hollows and bumps. Surface shall be dense, smooth, and at exact level and slope required.
2. Finished concrete surface for concrete walks, pads, and concrete bands shall be wood-floated and steel troweled to a smooth surface. Surface shall not deviate more than (1/8) inch (3.2 mm) in (10) feet (3.05 m).
3. Unless otherwise indicated, horizontal surfaces of concrete pavement that will be exposed shall be given a **light broomed finish**, with direction of grooves in concrete surface perpendicular to length of concrete sidewalk, slab, or pad or as shown on the drawings. After concrete has set sufficiently to prevent coarse aggregate from being torn from surface, but before it has completely set, brooms shall be drawn across it to produce a pattern of small parallel grooves. Broomed surface shall be uniform, with no smooth, unduly rough or porous spots, or other irregularities. Coarse aggregate shall not be dislodged by the brooming operation.
4. Where finishing is performed before end of curing period, concrete shall not be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.
5. Immediately following finishing operations, edges and both sides of expansion joints shall be rounded to a 1/4 inch (6.4 mm) radius. Apply the light broom to the edges of all joints to achieve a uniform broom finish **without 'picture frames'** bordering the joints.
6. Control joints shall be saw cut using a masonry saw with a blade ¼ inch wide x 1.5 inches deep. Light broom to the edges of all joints to achieve a uniform broom finish **without 'picture frames'** bordering the joints.
7. All scoring, tooling and finishing of the concrete shall be subject to review and approval at any time during the construction project. The Contractor shall remove and replace, at no additional cost to the Owner, all concrete that is not acceptable.
8. Curing Colored Concrete: Refer to manufacturers recommendations for application.
9. Where finishing is performed before end of curing period, concrete shall not be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.

10. Surveillance: The Contractor shall provide adequate surveillance for all poured-in-place concrete pavements until concrete has set firmly, to prevent unwarranted markings of the concrete surface. Any unauthorized marking or graffiti in the finished surfaces shall be a cause for rejection by the Owner's Representative and replacement by the Contractor at no additional expense to the Owner.

K. Curing Non-Colored Concrete:

1. Concrete be kept continuously damp from time of placement until end of specified curing period. Water shall not be added to surface during floating and troweling operations, and not earlier than 24 hours after concrete placement. Between finishing operations surface shall be protected from rapid drying by a covering of waterproofing paper. Surface shall be damp when the covering is placed over it, and shall be kept damp by means of a fog spray of water, applied as often as necessary to prevent drying, but not sooner than 24 hours after placing concrete. None of the water so applied shall be troweled or floated into surface.

2. Concrete surfaces shall be cured by completely covering with curing paper or application of a curing compound.

   a. Concrete cured using waterproof paper shall be completely covered with paper with seams lapped and sealed with tape. Concrete surface shall not be allowed to become moistened between 24 and 36 hours after placing concrete. During curing period surface shall be checked frequently, and sprayed with water as often as necessary to prevent drying, but not earlier than 24 hours after placing concrete.

   b. If concrete is cured with a curing compound, compound shall be applied at a rate of 200 square feet per gallon, in two applications perpendicular to each other.

   c. Curing period shall be seven days minimum.

L. Curing Colored Concrete:

1. Refer to manufacturers recommendations for application.

M. Control Joints: Control joints shall be saw cut into the concrete slab, in pattern indicated on the Contract Documents. Joint shall be saw cut 24-48 hours after the concrete is poured and finished.

1. Apply the light broom to the edges of all joints to achieve a uniform broom finish without 'picture frames' bordering the joints.

N. Cold Weather Concreting:

1. Materials for concrete shall be heated when concrete is mixed, placed, or cured when the mean daily temperature is below 40°F or is expected to fall to below 40°F within 72 hours, and the concrete after placing shall be protected by covering, heat, or both.

2. Details of handling and protecting of concrete during freezing weather shall be subject to the approval and direction of the Owner's Representative. Procedures shall be in accordance with provisions of ACI 306R.

O. Hot Weather Concreting:

1. Concrete just placed shall be protected from the direct rays of the sun and the forms and reinforcement just prior to placing shall be sprinkled with cold water. Every effort shall be made to minimize delays, which will result in excessive mixing of the concrete after arrival on the job.

2. During periods of excessively hot weather (95°F., or above), ingredients in the concrete shall be cooled insofar as possible and cold mixing water shall be used to maintain the temperature of the concrete at permissible levels all in accordance with the provisions of ACI 305. Any concrete with a temperature above 95°F, when ready for placement will not be acceptable, and will be rejected.

3. Temperature records shall be maintained throughout the period of hot weather giving air temperature, general weather conditions (calm, windy, clear, cloudy, and relative humidity). Records shall include checks on temperature of concrete as delivered and after placing in forms. Data should be correlated with the progress of the work so that conditions surrounding the construction of any part of the structure can be ascertained.

P. Caulking of Joints: Where indicated on the Contract Documents, expansion joints and control joints in concrete banding and expansion joints in concrete walkways shall be sealed with joint sealant in accordance with the requirements of paragraph 2.01.

Q. Protection of Concrete Surfaces: Concrete surfaces shall be protected from traffic or damage until surfaces have hardened sufficiently. If necessary (1/2) inch thick plywood sheets shall be used to protect the exposed surface.

3.03 SEALING OF CONCRETE

A. Seal all concrete pavement in accordance with the manufacturer's recommendation.

3.04 CONCRETE ADA ACCESSIBLE RAMPS

A. Contractor shall install concrete ADA accessible curb cuts at all locations shown on plans. Curb cut configurations shall be as detailed on the Drawings.

B. All concrete curb cuts shall be isolated from surrounding concrete pavement when applicable.

C. Curb cuts shall be built with cut curbstone to match concrete curb cut slopes.

D. Curb cuts shall comply with all requirements established by the Architectural Access Board, Commonwealth of Massachusetts, CMR 521.

E. Curb cuts shall not exceed:

1. Cross-slopes at front and back of curb cuts: 1.5% max.
2. Curb cuts: 8% max
3. All planes of the finished curb cuts shall be field checked for slopes using a two-foot electronic “smart” level.
4. Curb cuts that do not comply with the slope requirements shall be cut out in their entirety and completely rebuilt.

3.05 TACTILE WARNING SURFACE

A. During all concrete pouring and Tile installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards..

B. The physical characteristics of the concrete shall be consistent with the Contract Specifications.

C. The concrete shall be poured and finished, true and smooth to the required dimensions and slope prior to Tile placement.

D. To the maximum extent possible, the Tiles shall be oriented such that the rows of in-line truncated domes are parallel with the direction of the ramp. When multiple REP Tiles regardless of size are used, the truncated domes shall be aligned between the detectable warning surface tiles and throughout the entire detectable warning surface installation.

E. The Tiles shall be tamped or vibrated into the fresh concrete to ensure that there are no voids or air pockets, and the field level of the detectable warning surface tile is flush to the adjacent concrete surface or as the Drawings indicate to permit proper water drainage and eliminate tripping hazards between adjacent finishes.

F. On Continuous Runs: The Installer shall leave a (1/8) inch nominal gap between successive Detectable Warning Surface Tiles. As part of the concrete finishing operation, the Installer shall apply (¼) inch edge treatment around the perimeter of the detectable warning surface tiles to facilitate future replacement of the detectable warning surface tile. A urethane sealant such as Sikaflex 1a or BASF NP1 shall be applied to the edge treatment for a watertight detectable warning surface tile installation.

G. During and after the REP Tile installation and the concrete curing stage, it is imperative that there are no walking, leaning or external forces placed on the Tile to rock the Tile, causing a void between the underside of the REP Tile and the concrete substrate.

H. Remove protective plastic sheeting from Tile at the end of paving operations in order to protect the Tiles from damage.

I. Clean Tiles by method specified by the manufacturer.

J. Seal outside edges and internal joints with a clear caulk.

3.06 PROTECTION:

A. Concrete surfaces shall be protected from traffic or damage until surfaces have hardened sufficiently. If necessary (½) inch thick plywood sheets shall be used to protect the exposed surface.

END OF SECTION

SECTION 321600

CURBS AND GUTTERS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. The work of this Section includes, but is not limited to, the following:

1. Granite Curbing
2. Concrete Wheel Stop

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. The following items of related work are specified and included in other Sections of the Specifications:

1. Removal of existing curbing – SECTION 311000 - SITE PREPARATION
2. Excavation and backfill – SECTION 312000 - EARTHWORK
3. Concrete pavements – SECTION 321300 – RIGID PAVING, SECTION 321313 – SITE CONCRETE
4. Bituminous pavements – SECTION 321800 – BITUMINOUS CONCRETE PAVING and ATHLETIC SURFACING, and SECTION 321200 – FLEXIBLE PAVING

1.04 DEFINITIONS

A. The following related items are included herein and shall mean:

1. Standard Specifications: Commonwealth of Massachusetts, Department of Transportation (MDOT), Standard Specifications for Highways and Bridges, latest edition.
2. ASTM: American Society for Testing and Materials.
3. AASHTO: American Association of State Highway and Transportation Officials.

1.05 SAMPLES AND SUBMITTALS

A. Submit the following in accordance with the provisions of Section 013300 – SUBMITTALS.

B. Samples and Submittals: At least thirty (30) days prior to intended use, the Contractor shall provide the following submittals and samples for approval. Do not order materials until Architect's approval of samples, certifications or test results have been obtained. Delivered materials shall closely match the approved samples.

C. Design mix for the following:

1. Bituminous concrete pavement

D. Shop Drawings: The Contractor shall submit the following for approval by the Architect prior to ordering materials for the project.

1. Prior to ordering materials for this project, submit manufacturer's detailed drawings and layout configuration plan, which is site verified for layout and dimensions by Contractor's registered surveyor, for all curbing. Drawings shall show all lengths, angles, transitions, pertinent dimensions, radius and corner sections as applicable, closure sections and typical cross sections. Layout shall be based upon the Contractor's confirmation of on-site layout conditions including any required amendments thereto by the Surveyor.

2. Provide schedule for quantities, lengths, and size of curbing

E. Manufacturer's Literature: Submit the following manufacturer's literature for the products:

1. Granite curbing showing standard lengths and cross section detail with all pertinent dimensions.

2. Precast Concrete Wheel Stop showing standard lengths and cross section detail with all pertinent dimensions.

1.06 STORAGE AND PROTECTION

A. All materials shall be stored to prevent damage from the elements and other causes

B. Cement and aggregates shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Any materials which have deteriorated, or which have been damaged, shall not be used for concrete.

C. Curbing shall be packaged to manufacturer’s standard and delivered on pallets. Curbing damaged in any manner will be rejected and shall be replaced with new material.

1.07 QUALITY ASSURANCE

A. Bituminous Concrete:

1. MDOT Specifications Section 460 for bituminous pavement for roadways and parking areas and Section 402 for dense graded crushed stone for base course.

2. MDOT Specifications Section 472 for repairs to existing pavements after installation of new curb.

3. The existing bituminous concrete pavement to be removed shall be removed from the site, legally disposed of.

PART 2 PRODUCTS

2.01 VERTICAL GRANITE CURBING

A. New granite curbing shall be hard, durable stone conforming to the requirements of VA-4 curb Mass. DOT Specifications of Highway Specifications, latest ed. (Standard Specification). Provide straight and curved curb sections as required in the plans. Curb sections to be set in transition or flush with pavements shall be cut to full depth with parallel sides. Curbing shall conform to the following:

1. Curbing shall have smooth sawn tops, split sides and bottom.
2. All curbing shall have sawn ends.
3. Any exposed edges shall be eased one sixteenth inch (1 /16").
4. No curbstone sawn surfaces shall exhibit markings from the cutting process, including but not limited to band marks from the saw. All sawn faces shall be smooth and uniform.
5. No curbstone shall contain veins or intrusions or obviously dissimilar characteristics including color, texture, and physical make-up. Stones that show obvious veins or intrusions of dissimilar materials will be rejected.
6. Split face surfaces shall not be flame finished.

B. Vehicular Granite Curbing is defined as vertical granite curbing that abuts driveways, roadways and parking areas as well as curbing that is associated with accessible curb cuts that connect directly to vehicular pavement areas.

C. Flush granite curb shall conform to the requirements for VA-4 curb of the Standard Specification.

D. Cement mortar shall meet the requirements of Section M4, Paragraph M4.02.15 of the Standard Specifications. Color shall be natural to match the color of the curb.

E. Concrete where designated for setting curbs shall be 4000 psi concrete conforming to Section M4 of the Standard Specifications except that it shall have zero slump and be placed essentially dry. It should be delivered in a cement truck.

2.02 CONCRETE WHEEL STOP

A. Precast concrete wheel stop: ASTM C150, Portland Type I or III; reinforcing steel: ASTM A165/A615M, deformed steel bars.

B. Nominal size: 6 inches high, 10 inches wide, 6 feet long; Profile: rectangular cross section with sloped vertical face.

C. Anchoring dowels: #5 rebar, 24 inch long (min).

PART 3 EXECUTION

3.01 VERTICAL GRANITE CURBING

A. Install curbing in the locations and in accordance with the details shown on the Drawings.

B. Excavate to the lines and grades required to establish the subgrade limits required to establish the subgrade limits required for curbing construction.

C. Provide grade stakes to check alignment for curb setting. Install the granite curb true to line and grade.

D. Each unit shall meet the next with a common tangent. Curb sections that are not plumb or are discontinuous or broken after installation will not be approved and shall be reset.

E. Placement and compaction of dense graded crushed stone shall be as specified under SECTION 312000 EARTHWORK.

F. Set granite curb as follows:

1. All spaces under the curb shall be filled with dry-placed, zero slump concrete so that the curb will be completely supported throughout its length.
2. After proper alignment of curbing and concrete base has been established, place additional concrete, of slightly wetter consistency, to extend the concrete up the face of the curbing as detailed.

G. Joints between curb stones shall be filled full-depth with cement mortar and neatly pointed in the top and exposed faces. After pointing, clean off all excess. Mortar and tool joints slightly below adjacent stone surfaces.

3.02 CONCRETE WHEEL STOP

A. Position the units accurately in the locations shown on the Contract Drawings.

B. Secure units in place with two (2) anchoring dowels for each unit. Dowels shall be flush with top of unit and extend 18 inches below bottom of unit.

END OF SECTION

SECTION 321700

PAVING SPECIALTIES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. The work of this Section includes, but is not limited to, the following:

1. Pavement Markings
2. Handicap Parking Signs
3. Wood Guardrails

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. The following items of related work are specified and included in other Sections of the Specifications:

1. Bituminous Pavements - SECTION 321200 – FLEXIBLE PAVING
2. Play Area surfacing - SECTION 321800 – BITUMINOUS CONCRETE and ATHLETIC SURFACING (If applicable)
3. Concrete foundation for posts - SECTION 033000 – CAST IN PLACE CONCRETE

1.04 DEFINITIONS

A. The following related items are included herein and shall mean:

1. Standard Specifications: Commonwealth of Massachusetts, Department of Transportation (MDOT), Standard Specifications for Highways and Bridges, latest edition.
2. ASTM: American Society for Testing and Materials.
3. AASHTO: American Association of State Highway and Transportation Officials.
4. MUTCD: Federal Highway Administration – “Manual on Uniform Traffic Control Devices”.

1.05 SAMPLES AND SUBMITTALS

A. Submit the following in accordance with the provisions of Section 013300 – SUBMITTALS.

B. Samples and Submittals: At least thirty (30) days prior to intended use, the Contractor shall provide the following submittals and samples for approval. Do not order materials until Architect's approval of samples, certifications or test results have been obtained. Delivered materials shall closely match the approved samples.

C. Shop Drawings: The Contractor shall submit the following for approval by the Architect prior to ordering materials for the project.

1. Painted lines and graphic symbols: Layout and composition for graphic symbols.
2. Wood Guardrails

D. Manufacturer's Literature: Submit the following manufacturer's literature for the products:

1. Pavement markings paint literature.
2. Handicap Signage literature.
3. Pressure Treated Timber literature on treatment materials (ACQ).
4. Paint for striping and graphic symbols.

1.06 STORAGE AND PROTECTION

A. All materials shall be stored to prevent damage from the elements and other causes

PART 2 PRODUCTS

2.01 PAVEMENT MARKINGS

A. Materials:

1. Materials for pavement markings shall conform to MDOT Specifications Section 860.40 (White, yellow and blue) Traffic Paint as indicated on the drawings), and Amesbury Department of Public Works Standards as applicable for the particular material.

B. Marking Equipment: Machines, tools and equipment used in the application of pavement markings shall conform to MDOT Specifications Section 860.60 and shall be approved and maintained in satisfactory operating condition.

2.02 WOOD GUARDRAILS

A. Wood guardrails to be constructed and located as indicated on drawings:

1. Rails: 4” x 10”
2. Posts: 8” x 8”

B. Anchoring Hardware: 3/4” bolts, nuts and washers to be galvanized.

C. Wood material to be select structural Douglas fir or Southern Yellow Pine, pressure treated with alkaline copper quaternary (ACQ).

PART 3 EXECUTION

3.01 PAVEMENT MARKINGS

A. Surface Preparation:

1. New pavement surfaces shall be allowed to cure for a period of not less than 48 hours before application of marking materials.
2. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed using scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion, as directed.

B. Application:

1. Marking materials shall be applied to clean, dry surfaces in accordance with the requirements of MDOT Specifications Section 860.62.
2. Paint shall be applied pneumatically with approved equipment.
3. Guidelines and templates shall be employed as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols.
4. Edges of markings shall be sharply outlined.
5. Maximum drying time requirements of the paint manufacturer shall be enforced to prevent undue softening of bitumen, and pickup, displacement or discoloration by vehicle tires.
6. If markings require more drying time than stated by the paint manufacturer, painting operations shall be discontinued until cause of the slow drying is determined and corrected.
7. If markings require more drying time than stated by the paint manufacturer, painting operations shall be discontinued until cause of the slow drying is determined and corrected.
8. Thickness of the paint application shall be in accordance with the manufacturer's specifications. Results shall be full coverage with no areas where the underlying pavement color is showing through. If full coverage is not achieved, the contractor shall include additional coat(s) as necessary.

C. Protection of Markings: Markings shall remain protected in accordance with MDOT Specifications Section 860.63.

3.02 WOOD GUARDRAILS

A. Installation:

1. Set posts plumb; installed 8' on center; posts to extend 36" min below finish grade.

2. Top of rail to be 25” above finish grade.

3. Attach rails securely to posts with anchoring hardware.

4. Trim bolt ends to leave no more than 1/4 inch beyond the nut and grind off burs and sharp edges of bolt end. Paint cut ends with galvanized paint.

B. Tolerances:

1. Posts – Maximum variation from plumb: 1/2”.

2. Rails – Maximum variation from finish grade: 1/2”.

END OF SECTION

SECTION 321800

BITUMINOUS CONCRETE PAVING – PEDESTRIAN

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Provide all labor, materials, equipment, services and transportation required to complete bituminous concrete pedestrian work as shown on the Drawings and as specified herein or both.

1.03 RELATED SECTIONS

A. The following related work is to be performed under the designated Sections.

1. Earthwork – Section 312000
2. Finish Grading – Section 312219
3. Vehicular Flexible Paving – Section 321200
4. Site Concrete – Section 321313
5. Curbs and Gutters – Section 321600
6. Athletic Surfacing – Section 321800
7. Miscellaneous Site Improvements – Section 323000
8. Fencing – Section 323100
9. Planting – Section 329000
10. Soil Preparation – Section 329113
11. Lawns and Grasses – Section 329200
12. Landscape Drainage – Section 334620

B. Unless otherwise specified, bituminous concrete material and workmanship shall comply with the applicable provisions of the latest edition Standard Specifications For Highways and Bridges, Department of Public Works of the Commonwealth of Massachusetts for the items noted herein. This document shall be referred to as The Standard Specifications.

1.04 SUBMITTALS

A. Submit the following in accordance with the provisions of Section 013300 – Submittals.

B. Product Data: Manufacturer's current catalogue cuts and specifications and suppliers material certificates for the following:

1. Bituminous Materials:

a. Bituminous Concrete Base Course.

b. Bituminous Concrete Dense Mix Top Course

c. Bituminous Tack Coat.

d. Certificates: Certificates that each material complies with the Specifications and “Standard Specifications”.

e. Test Reports:

1) Composition and Compaction Acceptance Test as required in M3.11.09, “Standard Specifications.”

C. Shop Drawings:

1. Minimum 1” = 10’ scale plan drawing of the play areas and showing the map, all lines, markings, numbers and markings including the location, dimensions and relationships.

1.05 QUALITY ASSURANCES

A. Installation of Bituminous Concrete Top Course resulting with no or minimal pin holes that transfer to the color surface.

B. MDOT Specifications Section 460 for bituminous pavement for roadway and parking areas and Section 402 for dense graded crushed stone for base course.

1.06 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury’s Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.07 DEFINITIONS

A References to Landscape Architect shall mean Architect or the Architects designated representative.

PART 2 – PRODUCTS

2.01 DENSE GRADED CRUSHED STONE

A. Refer to Section 312000 – Earthwork.

2.02 BITUMINOUS CONCRETE – VEHICULAR

A. Refer to Section 321200 Vehicular Flexible Paving.

2.03 BITUMINOUS CONCRETE – PEDESTRIAN

A. Bituminous Concrete Pedestrian Pavement shall be Class I, Type I-1, furnished in accordance with Section M3 of the MDOT Specifications, except as modified herein.

1. Bituminous Concrete Paving – Pedestrian shall consist of two (2) courses of bituminous concrete with a minimum finished pavement depth after rolling equaling the following:

a. Binder Course shall conform to Binder Course – Section M3.11.03 Job-Mix Formula, Table A.

1) Thickness as shown on the drawings after rolling consisting of one lift.

b. Top Course shall conform to Dense Mix – Section M3.11.03 Job-Mix Formula, Table A.

1) Thickness as shown on the drawings after rolling consisting of one lift.

c. Tack coat shall consist of asphalt emulsion, Type RS-1 or RS-2 as described in the MDOT Specifications.

PART 3 – INSTALLATION

3.01 EXAMINATION

A. Verification: Verify that bituminous paving has been completed prior to commencement of work and that the surface has been graded to allow for placement of Athletic Surfacing. Verify that all adjacent materials have been installed to allow for the Athletic Surfacing.

B. Notification: Notify Landscape Architect of conflicts discovered on the site, or prior work done by others, which would prevent proper installation of Athletic Surfacing.

3.02 BITUMINOUS INSTALLATION: REFER TO DETAILS FOR MATERIALS FOR EACH APPLICATION

A. Installation procedures for bituminous concrete pavements shall comply with Standard Specifications, Section 420.

B. Installation of bituminous concrete paving shall be as shown on the Drawings and specified herein.

C. Align bituminous concrete walks as shown on the Drawings.

1. Obtain landscape architect's approval layout of all walks before work is done. Make adjustments as required in the layout to ensure smooth continuous curves and straight lines and transitions.

D. Subgrade preparation and installation of Dense Graded Crushed Stone shall be found in Section 312000 – EARTHWORK, of these specifications.

E. Make any corrections necessary to subbase course (minor cuts and fills) furnished and installed under Section 312000 – EARTHWORK, to bring to the sections and elevations shown on the Drawings.

F. Remove loose material from compacted gravel base course surface immediately before installing bituminous concrete. Proof roll prepared gravel base surface to check for unstable areas requiring additional compaction. Do not begin paving work until deficient gravel base areas have been properly compacted as specified.

G. Construct Bituminous Concrete Paving in accordance with the Standard Specifications Sections 420 and 460.

H. No bituminous material shall be applied when the temperature is below 40° F.

I. No vehicular traffic of any kind shall be allowed to pass over the newly finished surface until it has had time to set. (24) hours shall be considered sufficient time for the pavement to set in most cases, but this period may be extended by the Engineer as required by weather or other reasons.

J. The Contractor shall ensure that positive drainage occurs on all walks, patches and court surfaces. All areas of finished paving on which water stands or which are found excessively uneven shall be promptly brought to the correct grade and line. There shall be no deviation from true surface planes represented by the grade elevations shown on the Drawings.

K. Pavement Edges: The Contractor shall construct a neat tamped edge as shown on the Drawings at all proposed pavement edges not abutting vertical faces of adjacent structures or pavements. New paving shall be well blended into adjoining existing paving and thoroughly rolled to present continuous uniform surface without perceptible arises or depressions at the jointure.

L. The bituminous pavement shall cure for (14) days prior to applying the Color Surfacing or Line Paint.

M. Do any repair or patching to pavements outside the project site damaged by the work of the Contract.

N. All cuts in existing pavement shall be "saw cut".

3.03 TACK COAT

A. Apply to contact surfaces of existing or previously constructed asphalt or portland cement concrete and surfaces abutting or projecting into bituminous concrete pavement. Distribute at a rate of 0.30 to 0.35 gallons per square yard of surface or greater to provide complete coverage.

1. Apply tack coat to vertical surface of all saw cut existing bituminous concrete.

B. Allow to dry or until at proper condition to receive paving.

END OF SECTION

SECTION 321810

PLAYGROUND SAFETY SURFACING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Provide all labor, materials, equipment, services and transportation required to complete playground safety surfacing work as shown on the Drawings and as specified herein or both.

1.03 RELATED WORK

A. The following Related Work to be performed under the designated Sections:

1. Earthwork - Section 312000
2. Finish Grading - Section 312219
3. Site Concrete – Section 321313
4. Athletic Surfacing – Section 321820
5. Fencing - Section 323100
6. Miscellaneous Site Improvements - Section 323000
7. Planting - Section 329000
8. Soil Preparation - Section 329113
9. Lawns - Section 329200
10. Storm Drainage – Section 334000
11. Landscape Subdrainage – Section 334610

B. Coordinate installation of Playground Surfacing with the Playground Play Equipment Improvements which are being performed under a separate contract to the Owner.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
2. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers. 02790 10025487 01 MS 12196 05/16/02 PTC.
3. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
4. ASTM D2859 Standard Test Method for Flammability of Finished Textile Floor Covering Materials.
5. ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
6. ASTM F1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment.
7. ASTM F1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

1.05 INSTALLATION OF PLAY EQUIPMENT

A. Review project plans and verify that equipment use zones, clearances, and reach ranges complies with ASTM F1487 and 1951 and with CAN/CSA-Z614

B. Confirm that the Playground Safety Surface is designed to meet or exceed the Fall Height requirements of the Playground Equipment.

C. Install Playground Safety Surfacing System including Washed Stone, Crushed Stone and Subdrain System after the installation of the Playground Equipment (Under Separate Contract to the Owner) as shown on the approved shop drawings.

1.06 SYSTEM DESCRIPTION - POURED IN PLACE PLAYGROUND SURFACING SYSTEM

A. Poured-in-place Playground Surfacing System Construction Drawings: The Construction Drawings showing the patterns and colors of the surfacing are diagrammatic. The patterns and colors will be modified by the Landscape Architect once the play equipment has been selected and designed using square, round, triangular and free forms patterns. The modified layout will be submitted to the contractor for installation at no additional cost to the owner.

B. Poured-in-place Playground Surfacing System Performance Requirements: Provide a (two) layer rubber-polyurethane playground surfacing system which has been designed, manufactured and installed to meet the following criteria:

1. Shock Attenuation (ASTM F1292):
    a. Gmax: Less than 200.
    b. Head Injury Criteria: Less than 1000.
2. Flammability (ASTM D2859): Pass.
3. Tensile Strength (ASTM D412): 60 psi (413 kPa).
4. Tear Resistance (ASTM D624): 140%.
5. Water Permeability: 0.4 gal/yd2/second.
6. Accessibility: Comply with requirements of ASTM F1951.
7. Fall Height: Depth of materials are shown on the drawings to accommodate the fall height of the playground equipment. Playground Equipment provided (Under Separate Contract to the Owner) as shown on the approved shop drawings.

C. Test results in accordance with ASTM F 1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

D. Certification that the surface meets the intent of the Americans with Disabilities Act (ADA).

E. Written manufacture's (25) year warranty against loss of resiliency, lifetime warranty of felt fabric material.

F. Provide product liability insurance certificate with project owner named as certificate holder.

1.07 QUALIFICATIONS/SPECIAL REQUIREMENTS

A. The playground safety materials shall be one manufacturer's materials only.

B. The Sub-Contractor shall have at least (five) years' experience and at least (10) completed projects located in New England installing playground surfacing materials.

1.08 SUBMITTALS

A. Submit the following in accordance with the provisions of Section 01 3300 – Submittals.

B. Washed Stone.

C. Crushed Stone: General contractor to confirm that the material specified is compatible with the playground safety surface selected to be installed. If the Crushed Stone is not compatible with the playground safety surface, the Contractor is to provide a material that is compatible at no cost to the Owner.

D. Product Data: Submit manufacturer's product data, installation instructions, and standard color chart and filter fabric.

E. Verification Samples: Submit manufacturer's verification samples of the color mix alternatives of (nine) inch x (nine) inch (229 × 229 mm) minimum for the Poured-in-place Playground Surfacing.

F. Shop Drawings:

1. Minimum (3/8) scale plans and section drawing of the area of Playground Surface installation showing the location, fall heights, dimensions details and relationships of the Playground Surfacing and Playground Equipment.

G. Quality Assurance/Control Submittals: Submit the following:

1. Certificate of qualifications of the playground surfacing installer.

H. Closeout Submittals: Submit the following:

1. Warranty documents specified herein.

2. Certified Impact Testing: (6) impact test areas for the play areas certifying that the playgrounds have a Critical Fall Height that exceeds the fall heights prescribed by the play equipment supplier and installer, complying with the requirements of ASTM F1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment.

1.09 QUALITY ASSURANCE

A. Qualifications: Utilize an installer approved and trained by the manufacturer of the playground surfacing system, having experience with other projects of the scope and scale of the work described in this section.

B. Certifications: Certification by manufacturer that installer is an approved applicator of the playground surfacing.

C. International Play Equipment Manufacturers Association (IPEMA) certified.

1.10 DELIVERY, STORAGE & HANDLING

A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F (4 degrees C) and a maximum temperature of 90 degrees F (32 degrees C).

1.11 PROJECT/SITE CONDITIONS

A. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F and maximum ambient temperature is 90 degrees F. Do not install in steady or heavy rain.

1.12 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.

1. Warranty Period: (five) years from date of completion of work.

1.13 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.14 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architects designated representative.

PART 2 MATERIALS

2.01 FILTER FABRIC: MIRAFI # 140 or approved equal.

2.02 WASHED STONE

A. The material specified meets the requirements for the Playbound Poured in Place by Surface America. Refer to Section 312000 - Earthwork for all requirements.

B. Contractor to confirm that the Washed Stone material meets the requirements of the other listed manufacturers for the Poured in Place Playground System or propose another material that meets the specification of the intended installed material at no cost to the Owner.

2.03 CRUSHED STONE

A. Crushed stone must be crushed so that it compact to 95% Standard Proctor Compaction (as per ASMTM). The stone should be a homogeneous mixture of the following sieve size stone:

	Percent Passing	
U.S. Sieve Size Number	Minimum	Maximum
1”	90	100
5/8”	50	80
¼”	30	50
#4	15	35
#8	10	30
#30	3	5
#200	0	3

B. Contractor to confirm that the Crushed Stone material meets the requirements of the other listed manufacturers for the Poured in Place Playground System or propose another material that meets the specification of the intended installed material at no cost to the Owner.

2.04 SUBDRAIN SYSTEM

A. Refer to Section 334610 - Landscape Subdrainage for all requirements.

2.05 POURED-IN-PLACE PLAYGROUND SURFACING SYSTEM (MEETING OR EXCEEDING THE REQUIREMENTS OF ARTICLE 1.06)

A. Manufacturer: PlayBound Poured in Place by Surface America, Inc., (800) 999-0555; or Spectra Pour Safety Surface by Spectraturf SpectraPour, 800-875-5788; or Vitriturf Poured in Place Playgound System by Hanover Specialties, Inc., 631-231-1300. The Surface America product is referenced below.

1. PlayBound Poured-In-Place Primer:
    a. Material: Polyurethane.
2. PlayBound Poured-in-Place Basemat:
    a. Material: Blend of 100% recycled SBR (styrene butadiene rubber) and polyurethane.
    b. Thickness: As shown on the drawings minus the thickness of the Poured in Place Top Surface.
    c. Formulation Components: Blend of strand and granular material.
    d. Basemat mix proportions by weight: 14% polyurethane, 86% rubber.
3. PlayBound Poured-In-Place Top Surface
    a. Material: Blend of recycled EPDM (ethylene propylene diene monomer) and polyurethane.
    b. Thickness: Nominal (1/2) inch (12.7 mm), minimum (3/8) inch (9.5 mm), maximum (5/8) inch (15.9 mm).
    c. Color: Selected by Landscape Architect from a minimum of twenty four (24) colors. Surface shall **be (2) colors areas with colors combined with gray or tan** mixed to the proportions as approved by the Landscape Architect to form a color. The use of non-yellowing binder shall be required for those standard colors for which it is recommended.
    d. Dry Static Coefficient of Friction (ASTM D2047): 1.0.
    e. Wet Static Coefficient of Friction (ASTM D2047): 0.9.
    f. Dry Skid Resistance (ASTM E303): 89.
    g. Wet Skid Resistance (ASTM E303): 57.
    h. Top surface mix proportions by weight: 18% polyurethane, 82% rubber.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions:

1. Verify that the playground equipment (Under a Separate Contract to the Owner) has been installed and conditions are suitable for the installation of the Landscape Subdrainage and the playground surfacing system.
2. Verify that the Landscape Subdrainage and substrate conditions are suitable for installation of the playground surfacing system.

B. Do not proceed with installation until unsuitable conditions are corrected.

3.02 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the Poured in Place Playground Surfacing manufacturer. The Surface America product installation is referenced below.

3.03 FILTER FABRIC INSTALLATION: Install as shown on the drawings.

3.04 SUBDRAINAGE INSTALLATION

A. Refer to Section 334610 – Landscape Subdrainage.

3.05 WASHED STONE AND CRUSHED STONE BASE INSTALLATION

A. Install to the depth as shown on the drawings or as recommended by the manufacturer.

B. Compact to 95% Standard Proctor Compaction using a tamper, roller or combination of both.

3.06 POURED-IN-PLACE PLAYGROUND SURFACING PREPARATION

A. Surface Preparation: Using a brush or short nap roller, apply primer to the substrate perimeter and any adjacent vertical barriers such as playground equipment support legs, curbs or slabs that will contact the surfacing system at the rate of 300 ft2/gal (7.5 m2/L) or as recommended by the manufacturer.

3.07 POURED-IN-PLACE PLAYGROUND SURFACING INSTALLATION

A. Do not proceed with playground surfacing installation until all applicable site work, including substrate preparation, fencing, playground equipment installation and other relevant work, has been completed.

B. Basemat Installation:

1. Using screeds and hand trowels, install the basemat at a consistent density of (29) pounds, (1) ounce per cubic foot (466 kg/m3) to the specified thickness.
2. Allow basemat to cure for sufficient time so that indentations are not left in the basemat from applicator foot traffic or equipment.
3. Do not allow foot traffic or use of the basemat surface until it is sufficiently cured.

C. Primer Application: Using a brush or short nap roller, apply primer to the basemat perimeter and any adjacent vertical barriers such as playground equipment support legs, curbs or slabs that will contact the surfacing system at the rate of 300 ft2/gal (7.5 m2/L).

D. Top Surface Installation:

1. Using a hand trowel, install top surface at a consistent density of (58) pounds, (9) ounces per cubic foot (938 kg/m3) to a nominal thickness of (½) inches (12.7 mm).
2. Allow top surface to cure for a minimum of (48) hours.
3. At the end of the minimum curing period, verify that the top surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.
4. Do not allow foot traffic or use of the surface until it is sufficiently cured.

3.08 PROTECTION

A. Protect the installed playground surface from damage resulting from subsequent construction activity on the site.

END OF SECTION

SECTION 321820

ATHLETIC SURFACING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Provide all labor, materials, equipment, services and transportation required to complete athletic color surfacing work as shown on the Drawings and as specified herein or both.

1.03 RELATED SECTIONS

A. The following related work is to be performed under the designated Sections.

1. Earthwork - Section 312000
2. Finish Grading - Section 312219
3. Flexible Paving –Vehicular – Section 321200
4. Curbs and Gutters – Section 321600
5. Miscellaneous Site Improvements - Section 323000
6. Fencing - Section 323100
7. Planting - Section 329000
8. Soil Preparation - Section 329113
9. Lawns - Section 329200
10. Site Concrete – Section 321313
11. Landscape Subdrainage – Section 334610

B. Unless otherwise specified, bituminous concrete material and workmanship shall comply with the applicable provisions of the latest edition Standard Specifications for Highways and Bridges, Department of Public Works of the Commonwealth of Massachusetts for the items noted herein. This document shall be referred to as The Standard Specifications.

1.04 SUBMITTALS

A. Submit the following in accordance with the provisions of Section 013300 – Submittals.

B. Product Data: Manufacturer's current catalogue cuts and specifications and suppliers material certificates for the following:

1. Play court, world map and playground athletic surfacing items:

a. Surface preparations

1) Court Patch Binder.

2) Acrylic Resurfacer.

3) Fortified Plexipave.

4) Line paint.

5) Fortified Plexipave color chips for each standard colors and special colors as defined in the specs.

6) Line paint color chips for each of the minimum (8) colors.

C. Shop Drawings:

1. Minimum 1” = 10’ scale plan drawing of the play areas and showing all lines, markings, numbers and markings including the location, dimensions and relationships.

1.05 QUALIFICATIONS/SPECIAL REQUIREMENTS

A. The athletic surfacing materials shall be one manufacturer's materials only.

B. The Contractor shall have at least (five) year’s experience and at least (10) completed projects installing athletic surfacing materials.

1.06 JOB CONDITIONS

A. Weather limitations

B. Play and Athletic surfacing systems weather limitations are as specified by the manufacturer.

1.07 GUARANTEE

A. Paving, Color Surfacing and Painted Lines

1. All paving, color surfacing and painted lines shall be guaranteed for a period of one year from final acceptance, against cracking, peeling, checking or other defect. The Contractor shall repair, recoat or otherwise make satisfactory, any failed paving, color surfacing or painted lines at no cost to the Owner.

1.08 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.09 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architects designated representative.

PART 2 PRODUCTS

2.01 PLAY COURT AND PLAYGROUND SURFACING: Items shall be the Plexipave Systems as manufactured by California Products Corporation, Cambridge, Massachusetts, The NESCO LATEX-ITE SYSTEM distributed by New England Sealcoating Co., Inc. Hingham, LATEX ITE SYSTEM distributed by Dalton Enterprises, Inc, Cheshire, CT, 888-711-7483 or approved equal. The Plexipave Athletic Surfacing Items for application over a bituminous concrete surface are listed below:

A. Plexipave Court Patch Binder shall be used to correct any minor surface deficiencies in the Bituminous Concrete Surface.

B. Plexipatch.

C. Acrylic Resurfacer.

D. Fortified Plexipave: Colors as shown on the drawings and as selected during the submittal process including standard and non-standard colors including Red, Black Grey, White, Orange, Blue, Dark Blue, Green, Light Green, Purple

1. Plexipave Color Base.
2. Plexichrome.

E. Plexicolor Line Paint (two) coats per each line (2) inches wide as shown on the drawings. White color.

2.02 MAP OF THE UNITED STATES

A. Acceptable Manufacturers supplying a United State of America Map no larger than and no smaller than (16) feet x (27) feet:

1. Approximately (16) feet x (27) feet – United Stated of America Map stencil available from worldmapsonline.com.
2. Approximately (16) feet x (27) feet – United States of America Map stencil available from peacefulplaygrounds.com.

B. Colors:

1. (Six) color for the United States: Fortified Plexipave - Red, White, Orange, Blue, Dark Blue, Purple.
2. Outline each state with line paint color.

PART 3 INSTALLATION

3.01 EXAMINATION

A. Verification: Verify that bituminous paving has been completed prior to commencement of work and that the surface has been graded to allow for placement of Athletic Surfacing. Verify that all adjacent materials have been installed to allow for the Athletic Surfacing.

B. Curing: the bituminous pavement shall cure for (14) days prior to applying Athletic Surfacing.

C. Notification: Notify Landscape Architect of conflicts discovered on the site, or prior work done by others, which would prevent proper installation of Athletic Surfacing.

3.02 APPLICATION OF PLAY COURT AND PLAYGROUND SURFACING AND LINES

A. Surfacing and lines shall be applied in strict conformance with the manufacturer's specifications and requirements and as specified herein.

B. Bituminous Paving Surface Preparation: Preparation for areas requiring athletic surfacing shall be cleaned before installation of each of these items as follows:

1. All dirt, sand, dust and other loose debris materials and grease, oils and other foreign materials shall be cleaned from the paved areas to be covered by sweeping with brooms and pressure washing with water and or other methods as applicable.
2. Prior to the application of surfacing materials, the entire surface shall be checked and all minor depressions or irregularities located.
3. The surface shall then be flooded and any depressions covering a nickel shall be located and corrected as follows:
    a. The Court Patch Binder, mixed as recommended by the manufacturer, shall be applied over all these depressions according to the manufacturer's instructions. Apply (one) coat of Tack Coat of (one) part Court Patch Binder and (two) parts water according to the manufacturer’s instructions.
    b. The finished patching surface shall not vary more than (2) inches in (10) feet measured in any direction and shall blend smoothly with adjacent unpatched areas.

C. Surface Course Preparation: Apply (two) application of Acrylic Resurfacer per manufacturer’s specifications.

D. Fortified Plexipave: Apply (three) coats as per manufacturer's specifications.

E. Plexicolor Line Paint: Apply (two) coats as per manufacturer's specifications.

END OF SECTION

SECTION 322000

PEDESTRIAN BRIDGE

PART 1 — GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this section

1.02 SCOPE OF WORK

A. These specifications are for fully engineered bridges of steel construction with parallel chords and shall be regarded as minimum standards for design and construction. The work included under this item shall consist of design, fabricating, finishing and transporting the steel truss bridge superstructure(s) including bearings. These specifications are based on products designed and manufactured by Contech Engineered Solutions, LLC.

1.03 RELATED WORK

A. The following Related Work to be performed under the designated Sections:

1. Earthwork – Section 312000
2. Finish Grading – Section 312219
3. Cast in Place Concrete – Section 033000
4. Site Concrete – Section 321313
5. Bituminous Concrete Paving and Athletic Surfacing – Section 321800
6. Soil Preparation – Section 329113
7. Lawn and Grasses – Section 329200
8. Erosion and Sedimentation Control – Section 321313

1.04 REFERENCES

A. Governing Specifications

1. Bridge(s) shall be designed in compliance with the LRFD Guide Specifications for Design of Pedestrian Bridges, 2nd Edition, by AASHTO. Calculations shall be in accordance with this document, and formulas shall reference the appropriate sections.

B. Other Reference Codes, Specifications and Standards

1. AISC, Steel Construction Manual, Latest Edition

2. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 5th Edition (AASHTO Signs)

3. American Welding Society, Structural Welding Code, D1.1, Latest Edition

4. International Building Code (IBC), Latest Edition

5. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures, Latest Edition

6. National Design Specification for Wood Construction, ANSI NDS-Latest Edition

7. Tropical Timbers of the World, US Forest Products Laboratory

C. The LRFD Guide Specifications for Design of Pedestrian Bridges, shall control if any conflicting requirements occur with the Other Reference Documents and/or other local Codes.

1.05 QUALIFICATIONS / SPECIAL REQUIREMENTS

A. The Bridge Manufacturer shall have as a direct employee, an engineer who is experienced in bridge design to perform all engineering related task and design. The engineer shall have a minimum of 10 years experience in bridge design and be a currently licensed civil or structural engineer in the State of Massachusetts.

B. Each Contractor is required to identify their intended supplier as part of the bid submittal. Qualified Bridge Manufacturers must have at least 5 years experience fabricating these types of structures and shall have an up to date certification by AISC as a Certified Bridge Fabrication - Intermediate (Major) with Fracture Critical Endorsement. All suppliers shall fabricate their product, no brokers are allowed.

C. Pre-Approved Bridge Manufacturer:

Contech Engineered Solutions, LLC
71 US Route 1, Suite F
Scarborough, Maine 04074
Justin Reardon, P.E. jreardon@contech.com

Bridge Manufacturers, other than those listed above, may be used provided the Architect receives a written request at least 10 days prior to the bid. The written request shall accompany the following information:

1. Acceptable Manufacturers:

   a. Big R Bridge
   19060 CO Road 66
   Greely, CO 80631
   bigrbridge.com

   b. U.S. Bridge
   201 Wheeling Ave
   Cambridge, Ohio 43725
   Usbridge.com

2. Bridge Manufacturer's Product Literature,

3. Name and resume of Bridge Manufacturer's design professional who will be signing and sealing the engineering submittals,

4. Copy of current AISC certification,

5. Representative copies of detailed drawings, field procedures, calculations, quality control manual, welder's certifications,

6. Listing of projects including owner, location, size, year of fabrication, contact person.

D. The above will be evaluated by the Architect for accuracy and ability to provide a bridge(s) in accordance with these specifications.

1.06 SUBMITTALS

A. Engineering drawings, 24 x 36 format, shall be prepared and submitted to the Contractor or Owner for their review after receipt of the order. Submittal drawings shall be unique drawings, prepared to illustrate the specific portion of the bridge being fabricated. All relative design information such as member size, ASTM material specification, dimension necessary to fabricate and required welding shall be clearly shown on the drawings. Drawings shall have cross referenced details and sheet numbers. All drawings shall be stamped, signed and dated by the Bridge Manufacturer's Design Professional.

B. Structural calculations for the design of the bridge superstructure shall be prepared by a Structural Engineer licensed in the State of Massachusetts and submitted to the Architect for their review after receipt of the order. Calculations shall include complete design, analysis and code checks for the controlling member, connectivity and support conditions, truss stability checks, deck design, deflection checks, bearings and all splices.

1.07 QUALITY CONTROL

A. AISC Certification

1. The bridge shall be fabricated in a shop owned by the Bridge Manufacturer. This facility shall have up to date certification by AISC as a Certified Bridge Fabrication - Intermediate (Major) with Fracture Critical Endorsement.

B. Certified Weld Inspector

1. The bridge manufacturer shall employ a Certified Weld Inspector (CWI), with endorsement by AWS QC1. This CWI shall be present during the complete fabrication of the bridge. The CWI shall provide written documentation that the bridge has been fabricated in accordance with these specifications and the approved design drawings.

C. Documentation

1. Material Certifications shall be available for review for all materials within the bridge. Traceability of heat numbers is required for all steel.

2. Documentation showing the performance of all critical quality checks shall also be made available for review by the Engineer or Owner.

D. Non-Destructive Testing

1. All welds within the structure, shall be visually inspected for conformance to size, under cut, profile and finish.

2. All shop splices of main truss members shall be magnetic particle tested.

1.08 DELIVERY, STORAGE & HANDLING

A. Delivery: Delivery shall be made via truck to a location nearest the site which is accessible to normal over-the-road equipment. All trucks delivering bridge materials will need to be unloaded at the time of arrival. If the erection Contractor needs special delivery or delivery is restricted he shall notify the Bridge Manufacturer prior to bid date. This includes site issues which may prevent over-the-road equipment from accessing the site. Steerable dollies are not used in the cost provided by the Bridge Manufacturer. Determining the length of bridge section which can be delivered is the responsibility of the Contractor, and shall be communicated to the Bridge Manufacturer prior to the bid date.

1.09 WARRANTY

A. The Bridge Manufacturer shall warrant their steel structure(s) to be free of design, material, and workmanship defects for a period of ten years from the earlier of the date of delivery or from 60 days after final fabrication. Naturally durable hardwood decking and hardwood attachments shall carry a one-year warranty against rot, termite damage, or fungal decay from the earlier of the date of delivery or from 60 days after installation on the structure. Other types of wood are excluded under this warranty. This warranty shall not cover defects in the bridge caused by abuse, misuse, overloading, accident, improper maintenance, alteration, or any other cause not the result of defective materials or workmanship. This warranty shall be void unless Owner's records can be supplied which shall indicated compliance with the minimum guidelines specified in the inspection and maintenance procedures. Paint, galvanizing and other special coatings shall be warranted by the coating manufacturer and is not covered by the Bridge Manufacturer. Repair or replacement shall be the exclusive remedy for defects under this warranty. The Bridge Manufacturer shall not be liable for any consequential or incidental damages for breach of any express or implied warranty on their structures.

1.10 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.11 DEFINITIONS

A. Owner: City of Amesbury, MA

B. Engineer: Selected Contractor's Sub-Consultant

C. Contractor: Entity who will be installing, and/or purchasing, the bridge(s).

D. Bridge Manufacturer: Contech Engineered Solutions or approved equal.

PART 2 — PRODUCTS

2.01 BRIDGE

A. The products, drawings and specification included in this specification are for a bridge system by Contech Engineered Solutions, LLC. Acceptable Manufacturers listed must meet or exceed the products and specifications contained herein.

B. Span: Bridge span shall be 38 feet (straight line dimension) and shall be as measured from each end of the bridge structure.

C. Width: Bridge width shall be 10 feet and shall be as measured from the inside face of structural elements at deck level.

D. Bridge System Type: Bridge(s) shall be designed as a Connector® (Half-Thru Pratt truss) (or equal), that has one (1) diagonal per panel and plumb end vertical members. Interior vertical members may be either plumb or perpendicular to the chord faces.

1. Bridge(s) shall be designed utilizing an underhung floor beam (top of floor beam welded to the bottom of the bottom chord) or be designed utilizing an H-Section configuration where the floor beams are placed up inside the trusses and attached to the truss verticals.
2. The bridge manufacturer shall determine the distance from the top of the deck to the top and bottom truss members based upon structural and/or shipping requirements.
3. The top of the top chord shall not be less than 48 inches above the deck (measured from the high point of the riding surface).

E. Member Components

1. All members of the vertical trusses (top and bottom chords, verticals, and diagonals) shall be fabricated from square and/or rectangular structural steel tubing. Other structural members and bracing shall be fabricated from structural steel shapes or square and rectangular structural steel tubing.
2. Unless the floor and fastenings are specifically designed to provide adequate lateral support to the top flange of open shape stringers (w-shapes or channels), a minimum of one stiffener shall be provided in each stringer at every floor beam location.

F. Attachments

1. Safety Rails

a. Vertical safety rails or pickets shall be placed on the structure to a minimum height of 48 inches above the deck surface. The pickets shall be spaced so as to prevent a 4 inch sphere from passing through the truss. Pickets may be placed on the inside or outside of the structure at the bridge fabricators option. The top of the vertical pickets shall have a continuous cap angle or some other means to prevent bridge users from cutting or scraping their hands.

b. The picket safety system shall be designed for an infill loading of 200 pounds, applied horizontally at right angles, to a one square foot area at any point in the system.

G. Toe Plate

1. The bridge shall be supplied with a steel toe plate mounted to the inside face of both trusses. The toe plate shall be a minimum of 4 inches high. Toe plating shall be welded to the truss members at a height adequate to provide a 2 inch gap between the bottom of the plate and the top of the deck or the top of the bottom chord, whichever is higher. The span of unstiffened flat toe plating (from center to center of supports) shall not exceed 5 feet – 8 inches.

H. Rubrails

1. The bridge shall be supplied with a 1"x 5-1/2" (actual size) naturally durable hardwood Ipe (Tabebuia Spp Lapacho Group) rubrail. Rubrail shall be partially air dried to a moisture content of 15% to 20%, shall be supplied S4S (surfaced four sides), E4E (eased four edges), with the edges eased to a radius of 1/8 inch. Measured at 30% moisture content, the width and thickness shall not vary from specified dimensions by more than □ 0.04 inches. Ends of each piece shall be sealed with “Anchorseal” Mobil CER-M or an equal aquious wax log sealer.

2. Rubrails shall be attached flush to the inside face of the bridge truss verticals and fastened with two carriage bolts at each support location. The span of the rubrail from centerline to centerline of support shall not exceed 6 feet 6 inches.

3. The top of the rubrail shall be x-xx above the top of the deck (measured at the outside edge of the deck).

I. Camber

1. The bridge shall have a vertical camber dimension at midspan equal to 100% of the full dead load deflection.

J. Elevation Difference

1. The bridge abutments shall be constructed at a different elevation on each end of the bridge.

2.02 STRUCTURAL DESIGN LOADS

A. **Pedestrian Loading (PL):** The bridge structure shall be designed for a uniform pedestrian loading of 90 psf. This loading shall be pattered to produce the maximum load effects. Consideration of dynamic load allowance is not required with this loading.

B. **Wind Load (WS):** Pedestrian bridges shall be designed for wind loads as specified in *AASHTO Signs*, Articles 3.8 and 3.9. The Wind Importance Factor shall be taken as 1.15. The loading shall be applied over the exposed area in front elevation including all enclosures.

C. **Fatigue Load (FL):** The fatigue loading shall be as specified in Section 11 of *AASHTO Signs*. The Natural Wind Gust specified in Article 11.7.3 and the Truck-Induced Gust specified in Article 11.7.4 of *AASHTO Signs* need not be considered.

D. Railing Loads (RL)

1. Each element of the pedestrian rail system shall be designed to support a uniformly applied load of 50 pounds per lineal foot, both transversely and vertically, acting simultaneously. In addition, each longitudinal element shall be designed to support a concentrated load of 200 pounds, which shall act simultaneously with the above uniform loads at any point and in any direction at the top of the longitudinal element.
2. The posts of the pedestrian rail system shall be designed for a concentrated load applied at either the center of gravity of the upper longitudinal element or 60" above the top of the walkway, whichever is less. This concentrated load shall be equal to 200 pounds plus 0.05 times the post spacing in feet.

E. Combination of Loads

1. The load combinations and load factors to be used shall be as per specified in AASHTO LRFD Table 3.4.1-1, with the following exceptions:
   a Load combinations Strength II, Strength IV, and Strength V need not be considered.
   b The load factor for Fatigue I load combination shall be taken as 1.0, and Fatigue II load combination need not be considered.

2.03 STRUCUTRAL DESIGN CRITERIA

A. Modeling

1. The bridge shall be modeled and analyzed utilizing a three-dimensional computer software which shall account for moments induced in members due to joint fixity where applicable. Moments due to both truss deflection and joint eccentricity must be considered. Analyzing the truss as a pure pinned structure shall not be allowed. All loads listed in Section 5 of these specifications shall be applied to the model and analyzed appropriately.

B. Lateral Frame Design

1. The bridge shall be designed and proportion such that appropriate lateral stiffness is provided locally and globally, to insure that the structure is stable.

2. For bridges without any overhead members (Half-Through Trusses), the vertical truss members, the floor beams and their connections shall be proportioned to resist a lateral force applied at the top of the truss verticals. This lateral force shall be applied as an additional load to the top of the vertical, creating a cantilever moment, which is then added to the forces obtained from the three-dimensional model. The magnitude of this lateral force shall not be less than 0.01/K times the average factored design compressive force in the two adjacent top chord members.

3. The top chord shall be analyzed as a column with elastic lateral supports at the panel points, taking into account all moments due to in-plane and out-of-plane bending, along with moments due to eccentricities of the members.

4. The U-Frame Stiffness of the verticals and floor beams shall be as determined in the AASHTO Guide Specification Section 7.1.2, assuming that the vertical and floor beam connection is rigid. This means that the following must be met:

   a Matched member widths in simple unreinforced HSS connections between the floor beam and vertical, that is, no deformation is allowed due to tube wall plastification of the member faces at service loads.

   b The connection of the floor beam to the vertical shall not include the HSS bottom chord member, that is, the vertical and floor beam shall not be connected to different sides of a HSS chord. These members shall not be connected to faces of the bottom chord at a 90-degree to one another.

   c All fixed end moments in the floor beams and verticals due to floor beam rotations, in addition to the loads derived from a U-Frame analysis have been accounted for in the strength design of the connections.

5. At no time shall a K>2.0 be used in the design of the top chord.

6. The end verticals shall be designed as a simple cantilever to carry the loads obtained from the three-dimensional model, plus the cantilever moment due to a lateral load of 0.01 times the axial force in the end vertical, applied laterally at the upper end of the end vertical.

7. The floor beams shall always be sized for the forces obtained from a simple span, pinned end analysis, or from the forces obtained from the three-dimensional model, whichever controls.

8. The diagonals and brace diagonals shall be analyzed as pinned-end connection members. All other members shall be analyzed as fixed-end connections.

C. Deflections

1. The vertical deflection of the bridge due to the unfactored pedestrian live loading shall not exceed 1/360 of the span length.

2. The horizontal deflection of the bridge under unfactored wind loading shall not exceed 1/360 of the span length.

D. Fracture

1. The fracture toughness requirements and designation of Fracture Critical Member and Main Member designation are hereby waived for these structures.

E. Vibrations

1. Vibration of the structure shall not cause discomfort or concern to the users of the bridges. To assure this, the fundamental frequency (f) of the pedestrian bridge in the vertical direction, without live load, shall be greater than 3.0 hertz (Hz) to avoid the first harmonic. The fundamental frequency of the pedestrian bridge in the lateral direction, shall be greater than 1.3 Hz. If the fundamental frequency cannot satisfy these limitations then the bridge should be proportioned such that either of the following criteria are satisfied:

   a $f \geq 2.86 * \ln(180/W)$

   – or –

   b $W \geq 180 * e^{(-0.35 * f)}$

   Where W is the weight of the bridge in kips and f is the fundamental frequency in the vertical direction in Hz.

2.04 MATERIALS OF CONSTRUCTION

A. Structural Steel:

1. All members of the truss and deck support system shall be fabricated from square or rectangular hollow structural shapes (HSS), with the exception that floor beams may be wide flange shapes. All open ends of end posts and floor support beams shall be capped. Drain holes shall be provided for all sections at the low point of the member that may become filled with water.

2. All bridges shall be fabricated using A847 tube or A588 structural shapes.

3. Minimum nominal thickness of primary hollow structural shapes shall be 1/4". Rolled shapes shall have a minimum thickness of 1/4"

B. Deck Material

1. Decking shall be Trex brand decking. www.trex.com. Material shall be Trex Accents model in a Winchester Grey, Woodland Brown or Saddle color, 2x6 nominal thickness.

2. Deck planks shall be sized to support the loads specified in Section 5.0 of these specifications, and per the wheel distribution in Section 6.6.

C. Fasteners

1. Structural bolts used to field splice, or connect; all main members shall be ASTM A325, in accordance with the *Specification for Structural Joints using ASTM A325 or A490 Bolts.* The nuts for these structural bolts shall be ASTM A563. The Bridge Manufacturer shall determine the finish of the structural bolts. They shall be either Type 3 (Weathering) or Type 1 (Hot-Dipped or Mechanically Galvanized) as specified by the Bridge Manufacturer.

2. Bolts used for the connection of a rub rail shall be ASTM A307 or SAE J429 Grade 2, ¼ inch diameter carriage bolts, zinc plated.

3. Self-drilling fasteners for attachment of the form decking shall be #14 x 1 inch Zinc Plated Hex Washer Head Tek Screws.

4. Power Actuated fasteners shall be Hilti sheet metal nail X-ENP-19 fastener.

5. Other miscellaneous fasteners shall be ASTM A307 zinc plated or galvanized, as determined by the Bridge Manufacturer.

D. Rub Rail and Rail Cover Timber – See section for placement

1. Rub Rail timber planks shall be Ipe wood (Tabebuia spp. -lapacho group), all heartwood (no sapwood), clear (no knots), straight grained, with no worm holes, surfaced 4 sides (S4S) and eased at four edges, and be air dried to no more than 20% moisture content prior to installation. Planks shall be untreated, except ends of planks shall be sealed with "Anchorseal" as manufactured by Mobil CER-M or an equal aqueous wax log sealer. Based on the Forest Products Laboratory value of 27,270 psi for Modulus of Rupture, Modulus of Elasticity of 3,030,000 psi and Maximum Crush Strength of 13,720 psi the following allowable stresses shall apply: Allowable bending stress without modification factors of 3,700 psi; allowable shear without modification factors of 320 psi.

2.05 FINISH

A. **Blast Cleaning:** Exposed surfaces of structural steel shall be blast cleaned in accordance with the Steel Structures Painting Council (SSPC), Surface Preparation Specification No. 7, latest edition, (SSPC-SP7), Brush-Off Blast. Exposed surfaces of steel shall be defined as those surfaces seen from the deck or from the outside and bottom of the structure.

B. **Expansion Joint:** If the gap between the end of the bridge deck and the back wall of the foundation system is 1" or less, then no expansion joint cover is required. If the gap is greater than 1", then the joint shall be covered with a ¼" thick plate which attaches to the bridge and extends over the gap and onto the top of the foundation system back wall. This plate shall have its edges beveled at a 45-degree angle to minimize the potential trip hazard.

2.06 BEARINGS

A. **Steel on Steel:** Expansion and fixed bearings shall be a steel on steel Slide Plate. Size shall be per loads and anticipated movements determined by the bridge manufacturer. Both expansion and fixed bearings shall have slotted holes for ease of installation. Fixed bearings shall have the nuts of the anchor rods tight, whereas the expansion bearings shall have the nuts of the anchor rods finger tight.

B. **Design Temperature Range:** The Design Temperature Range shall be site specific and shall be determined from the Tables in AASHTO Section 3.12.2.2 Temperature Range.

C. **Non-Shrink Grouting:** The bridge shall be supplied with a lower setting plate. This setting plate shall be leveled and shimmed to the proper elevation. The space between the lower surface of the setting plate and the foundation surface shall be filled with a non-shrink grout capable of achieving a minimum compressive strength of 4000 pounds per square inch. The cost of the leveling, shimming and non-shrink grout shall be the responsibility of the Contractor.

D. **Anchor Rods:** Bridge Manufacturer shall design the diameter and grade of anchor rods, based on the shear and tensile strength of the anchor rod material only. All design considerations regarding concrete breakout strength in shear and tension, pullout strength, concrete side-face blowout strength, concrete pry out strength, embedment depth, type of anchorage or any other concrete failure modes are the responsibility of the Foundation Engineer, and shall be shown on the contract plans. All anchor rods shall be galvanized. The foundation engineer shall determine if the anchor rods shall be cast-in-place, drilled/epoxy, or expansion anchors.

2.07 FABRICATION

A. **Welding:** Welding procedures and weld qualification test procedures shall conform to the provisions of AWS D1.1, Structural Welding Code, latest edition. Filler metal shall be in accordance with the applicable AWS Filler Metal Specification, and shall match the corrosion properties of the base metal.

B. **Welders:** Welders shall be qualified for each process and position used while fabricating the bridge. Qualification tests shall be in accordance with AWS D1.1. All weld qualifications and records shall be kept in accordance with the Fabricator's Quality Assurance Manual which has been approved by AISC.

C. **Shop Splices:** Shop splices for main truss members shall be full penetration welds all around the perimeter of the member. These shop splices shall be performed using a full perimeter backing plate. After welding of the shop splices, the weld shall be ground smooth to match the perimeter of the member. No grinding of this weld shall not be permitted, and shall be grounds for rejection of the bridge upon delivery.

D. Bolted Splices

1. For shipping purposes, the bridge may be fabricated in sections. Sections shall be field assembled using bolted connections. No field welding of members shall be allowed.

2. The chord members of the bridge shall be bolted such that all faces of the member are bolted. This is to provide equal force distribution around the perimeter of the member. Bolting in only two faces of an HSS is not allowed. Bolted splices shall be designed and fabricated such that the head of the bolt is the only item exposed. No through-bolting of the member is allowed.

3. The diagonals and brace diagonals shall be bolted utilizing a through-bolt system with plates on the exterior faces of the members. An internal stiffening plate is required to keep the member from crushing during the bolt tightening process.

4. Tightening of the bolts shall be by Turn-of-the-Nut Method. No washers shall be required or furnished by the Bridge Manufacturer.

PART 3 — EXECUTION

3.01 INSTALLING AND LIFTING PROCEDURES

A. The Bridge Manufacturer shall provide standard typical written procedures for lifting and splicing the bridge. All actual methods, equipment and sequence of erection used are the responsibility of the Contractor.

END OF SECTION

SECTION 323000

MISCELLANEOUS SITE IMPROVEMENTS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Provide all labor, materials, equipment, services and transportation required to complete:

1. Benches.
2. Concrete Benches.
3. Trash and recycling receptacles.
4. Bicycle racks.
5. Flagpoles.
6. Decorative metal bollards.
7. Metal bollards.
8. Decorative aggregate bed.
9. Native stone boulders.
10. Flush granite curb.
11. Existing Buddy Bench anchor.

1.03 RELATED WORK

A. The following related work is to be performed under the designated Sections.

1. Painting – Section 09 0007
2. Earthwork - Section 31 2000
3. Finish Grading - Section 31 2219
4. Planting - Section 32 9000
5. Site Concrete - Section 32 1313
6. Site Stone – Section 32 3253

7. Miscellaneous Metals – 055000

8. Electrical – Division 26

1.04 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 013300 – Submittals.

B. Product Data: Manufacturer's current catalogue cuts and specifications and suppliers material certificates for the following:

1. Bench.

a. Manufacturer's cut sheets, paint primer and finish coat paint, touch-up paint and installation bolts.

2. Concrete Benches.

a. Manufacturer's cut sheets, finish color and texture and installation bolts.

3. Bicycle Racks.

a. Manufacturer's cut sheets, paint primer and finish coat paint, touch-up paint and installation bolts.

4. Flagpole.

5. Decorative Metal Bollards.

6. Metal Bollards.

7. Decorative aggregate bed.

8. Native Stone Boulders.

9. Flush Granite Curb.

10. Existing Buddy Bench Anchors.

C. Samples

1. All materials samples and paint colors for the Benches, Concrete Benches, Trash Receptacles and Bicycle Racks.

2. Decorative Aggregate.

D. Shop Drawings

1. Minimum (3/8) inch scale showing dimensions, sizes, thickness, gauges, finishes, joining, attachments and relationships of work to adjoining construction and existing conditions.

a. Trash and Recycling Receptacle.

b. Flagpole.

c. Benches.

d. Concrete Benches.

e. Bicycle Racks.

f. Decorative Metal Bollards.

g. Metal Bollards.

2. Do no final sizing or finishing until shop drawings and samples for that item of work is approved.

1.05 REFERENCES

A. ASTM - American Society for Testing and Materials.

1.06 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.07 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architect's designated representative.

PART 2 MATERIALS

2.01 STRUCTURAL FILL, DENSE GRADED CRUSHED STONE

A. Refer to Section 312000 Earthwork for all requirements.

2.02 CEMENT CONCRETE

A. Cement Concrete for footings shall be the 5000 PSI Mix. Refer to Section 32 1313 Site Concrete for all requirements.

2.03 BENCHES

A. Manufacturer: Provide backed benches, surface mount based on the product named and as shown on the drawings:

1. Vector Seating System by Forms+Surfaces – Basis of Design.

a. Manufacturer Contact: Dan Delongchamp
dan.delongchamp@forms-surfaces.com 617-780-4134
Forms+Surfaces
30 Pine Street
Pittsburgh, PA 15223
phone: 800-451-0410

b. Benches:

1) Six Benches: (6) foot aluminum slat benches with (three) seat backs and (two) cast seat dividers equally spaced.

Comparable manufacturer: Sitecraft 43-02 Ditmars Blvd. 2nd Floor Astoria NY 11105 tel.800.937.0203 http://site-craft.com/contact/.

Comparable manufacturer: equiparc 1001 James-Brodie Street, Saint-Jean-sur-Richelieu QC J2X 0C1 Canada 1 800 363-9264

B. Performance Criteria

1. Materials:

a. Bench frame and seat dividers: aluminum with textured powdercoated finish.

b. Bench slats:

1) Extruded aluminum with textured powdercoated finish.

c. Seat backs: aluminum plate with perforated pattern selected by the landscape architect and textured powdercoated finish.

C. Finishes

1. Bench frame, seat dividers, slats and perforated backs: graffiti resistant polyester powdercoat.

a. Textured polyester powdercoat selected from manufacturers available colors. Final color to be selected by the landscape architect.

1) All metal parts to undergo tri-chrome dipping process to provide highest achievable bond for powdercoated surfaces. Phosphate washing will not be acceptable as the cleaning procedure for metals to be powdercoated.

2) Physical specifications of textured powdercoat to meet or exceed the following:

TEST	STANDARD	TEST PERIOD	RESULT	TEST
Gloss Retention	DIN EN ISO 16474-2	1000H	>90%	Gloss Retention
Condensation Test	DIN EN ISO 6270 CH	1000H	no infiltration, no bubbles	Condensation Test
Salt Spray	DIN EN ISO 9227 AASS	1000H	no infiltration, no bubbles	Salt Spray

D. Dimensions: Refer to drawings for dimensions.

E. Mounting:

1. Stand alone benches to be surface mounted. Provide 304 stainless steel surface mounting hardware with tamper resistant bits with low profile button head tops. Use manufacturer provided epoxy and stainless steel anchors. Required for benches with seat backs.

2.04 CONCRETE BENCHES

A. Acceptable Manufacturers: Provide products which meet or exceed the requirements of these specifications from one of the following manufacturers.

1. (Five) – Twig bench, backless, reinforced cast stone over stainless steel rebar cage, acid-etched finish, shapes as shown on the drawings, (four) standard colors to choose from by the design team, escofet/landscape forms, 800-381-3455.

2. (Five) - Flor reinforced stone benches. Color to be selected from standard color chart by the Architect, manufactured by Landscape Forms, 800-381-3455.

3. (Three) angled left and (three) angled right Milenio reinforced stone benches. Color to be selected from standard color chart by the Architect, manufactured by Landscape Forms, 800-381-3455.

2.05 BICYCLE RACKS

A. Acceptable Manufacturers: Provide products which meet or exceed the requirements of these specifications from one of the following manufacturers.

1. (Eight) - Trio, cast aluminum powder coat aluminum texture, surface mounted with stainless steel anchors as recommended by the manufacturer, color to be selected by Forms + Surfaces 800-451-0410.

2. (Eight) - Emerson, cast aluminum, surface mounted with stainless steel anchors as recommended by the manufacturer, color to be selected Landscape Forms, 800-381-3455.

3. (Eight) – EP 5590, cast aluminum, surface mounted with stainless steel anchors as recommended by the manufacturer, color to be selected from RAL color chart, by Equiparc 800-363-9264.

B. Manufacturing Requirements: Provide all bicycle racks as a complete unit produced by the same manufacturer only including all attachments as shown on the drawings or specified herein.

2.06 TRASH AND RECYCLING RECEPTACLES

A. Acceptable Manufacturers: Provide products which meet or exceed the requirements of these specifications from one of the following manufacturers. Provide all trash receptacles as a complete unit produced by the same manufacturer only including the receptacle, liner and finishes and all attachments as shown on the drawings or specified herein.

B. Provide surface mount attachments to concrete paving and for concrete subbase located below the concrete unit pavers as required by the manufacturer.

1. (Two) Dispatch dual stream litter and recycling receptacles, surface mounted, with F+S optional colors to be selected by the Architect, with 45 gallon ridged plastic liner. Appropriate graphics indicating litter and recycling on each receptacle. Manufactured by Form+Surfaces 800-451-0410.

2. (Four) Chase Park trash receptacle, (24) inch x (40) inch, surface mounted with 36 gallon ridged plastic liner. Aluminum polyester powdercoat. Appropriate graphics indicating (two) trash and (tow) recycling on each receptacle. Color to be selected from standard color chart by the Architect, manufactured by Landscape Forms, 800-381-3455.

3. (Four) Retropolitan – (two) trash receptacle and (two) recycling receptacles, surface mounted, Model RTR-LS-36-EL-SS #4 satin-DT with 36 gallon rigid plastic liner and appropriate graphics indicating litter and recycling on each receptacle manufactured by Creative Pipe Inc, (800) 644-8467.

2.07 FLAGPOLE (2)

A. Acceptable manufacturers: Provide products which meet or exceeds the requirements of this equipment by Pole Tech Co., 800-633-6733, Admiral Flagpoles, Inc. 800-783-7653 or American Flagpoles, 800-368-3090.

B. Manufacturing Requirements: Provide all flagpoles as a complete unit produced by the same manufacturer, including pole fittings, accessories, bases and anchoring devices and all other components as shown on the drawings or specified herein.

1. Provide flagpoles and installations to withstand a wind velocity of 120 MPH when flying a flag of (8) feet x (12) feet.

C. Materials:

1. Poles: Concealed halyard, two piece cone-tapered aluminum flagpole of extruded tubing.

a. Aluminum: Comply with ASTM B 221, alloy 6063-T6, having minimum wall thickness and tensile strength of not less than 30,000 psi. Polish satin brush deep luster finish per AA M32.

b. Pole Description:

Exposed Height: (45) feet exposed

Overall Height: (49) feet

Butt Diameter: (10) inches

Top Diameter: (4) inches

Wall Thickness: .250

c. Pole Mounting: Mounting shall be embedded (Ground Set).

1) Steel foundation sleeve shall be corrugated 16 gage corrugated galvanized steel tube.

2) Steel base plate and ground spike shall be galvanized steel, welded to the sleeve and dimensioned as shown on the drawings.

3) Spun aluminum pole flash collar, finished to match the flagpole shaft and sized to meet the manufacturers requirements for the selected pole sleeve.

4) Sand as required by the manufacturer.

5) (Four) - Steel Wedges: Weld to sleeve at 90-degree angles to the center of the flagpole.

6) (Four)- Hardwood Wedges.

7) Sealant shall be polyurethane joint sealant as specified in Section 03400 Site Concrete.

8) Coordinate installation with precast base by Section 040001 – Masonry.

d. Pole shaft and pole flash color finish shall be the manufacturer's standard finish such as, deep luster finish.

e. Fittings and Accessories

1) Truck shall be a cast aluminum, internal halyard type, revolving, non-fouling.

2) Cast aluminum hood.

3) Halyard shall be concealed internal halyard system with stainless steel cable sized to accommodate the specified maximum flag size, (two) swivel-snaps, counter weight, and retainer ring.

4) Stainless steel winch shall be mounted inside the pole and protected by a locked door.

5) Flag: American Flag – (8) feet x (12) feet.

6) Coordinate installation with precast base by Section 040001 – Masonry.

2.08 DECORATIVE METAL BOLLARD

A. Manufacturer:

1. Manufacturer Contact: dan.elongchamp@forms-surfaces.com 617-780-4134, Forms+Surfaces, 30 Pine Street, Pittsburgh, PA 15223, phone: 800-451-0410, email: sales@forms-surfaces.com , website: www.forms-surfaces.com Provide products which meet or exceed the requirements of these specifications.

2. Comparable product from an approved manufacturer or fabricated by a metal fabricator to the specifications and details provided the specifications and drawings.

B. Stainless steel security core bollards:

1. Stainless Steel Security Bollards:

a. Model number Series LBHLO-603,SAT, NLIT, SEC – (Permanent Mount).

1) Height: (40) inch exposed.

2) Material: 304 Stainless Steel.

3) Column: (6) inch nominal diameter.

4) Escutcheon: spun stainless w/ integral set screw.

5) Mounting: cast in place extra-heavy wall steel security core with welded cross supports. (48) inch Security core minimum (24) inch embed into concrete and minimum (24) inch internal to bollard.

C. Finishes: Satin with factory applied protective clearcoat for fingerprint and resistance to oxidation.

2.09 METAL BOLLARD

A. Galvanized, unpainted.

B. Refer to 055000 – Misc Metal for metal specifications.

C. Refer to the drawings for sizing and installation.

2.10 DECORATIVE AGGREGATE BED

A. Smooth water washed riverstone. Multi-colored stone consisting of grays, beige, burgundy and browns.

B. Size: Decorative Gravel:

1. (3) inch – (four) inch size.

C. Thickness: (8) inches minimum.

D. Filter Fabric: Mirafi # 140.

2.11 NATIVE STONE BOULDERS

A. Local natural New England fieldstone boulders: location and numbers as shown on the drawings, boulders ranging in size from (3 -5) feet in size as shown on the drawings.

2.12 FLUSH GRANITE CURB

A. Refer to Section 321600 for granite curbing material.

B. Refer to the drawings for sizing and installation.

C. Coordinate curbing depth with storm water chambers where the curbing will need to be cut to accommodate curbing depth limitations where the chamber are located under the play area.

2.13 BUDDY BENCH ANCHORS

A. Set of (4) on grade 2-1/4 inch steel L shaped anchors and bolts by Country Casual Teak, countrycasualteak.com or approved equal.

PART 3 EXECUTION

3.01 BENCHES

A. Assembly and installation shall be per the shop drawings, the manufacturer's instructions and as specified herein.

B. Install embedded items into the paving surface and install the bench as per the manufacturer's instructions.

C. Use manufacturer's provided paint for touching up all chips and scratches.

D. Assembly and installation shall be per the manufacturer's instructions and as specified herein.

E. Excavation for footings, backfill and compaction shall be as specified in Section - 312000 Earthwork.

F. Install the concrete footings where required and as specified in Section, Site Concrete – 321313, install steel anchoring brackets and secure legs to brackets.

G. Use manufacturer's provided paint for touching up all chips and scratches.

3.02 CONCRETE BENCHES

A. Install on the surface of the paving in the location directed by the Landscape Architect.

3.03 BICYCLE RACK

A. Installation shall be as shown on the drawings and as specified by the manufacturer an as specified herein.

B. The bicycle rack shall be installed plumb and set to the grade(s).

C. Provide touch up paint as necessary to match the manufacturers.

3.04 FLAGPOLES

A. Installation shall be as shown on the drawings and as specified herein. The goals and flagpoles shall be plumb and set to the grades shown on the drawings.

B. Excavation for footings, backfill, compaction and structural fill shall be as specified in Section – 312000 Earthwork.

C. Install the concrete footing as specified in Section, Site Concrete – 321313.

D. Sand shall be installed in the flagpole sleeve after the flagpole is centered in the sleeve by use of centering wedges to plumb the pole. Install and tamp the sand firmly into the sleeve.

3.05 DECORATIVE BOLLARDS AND METAL BOLLARDS

A. Installation shall be as shown on the drawings and as specified herein.

3.06 DECORATIVE AGGREGATE BED

A. Excavate soil (8) inches below finish grade.

B. Install filter fabric lapping up edges of the adjacent paving, walls or soil 4".

C. Install a minimum of (8) inches of Decorative Aggregate.

3.07 NATIVE STONE BOULDERS

A. Installation shall be as shown on the drawings and as specified herein. Stone to have a maximum exposure of (2) feet above finish grade.

3.08 FLUSH GRANITE CURB

A. Installation shall be as shown on the drawings and as specified herein. The Curbing shall be plumb and set to the grades shown on the drawings.

B. Excavation for footings, backfill, compaction and structural fill shall be as specified in Section – 312000 Earthwork.

3.09 BUDDY BENCH ANCHORS

A. Attach to the bench and to the concrete as required by the anchor manufacturer.

END OF SECTION

SECTION 323100

FENCING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 WORK INCLUDED

A. Provide all labor, materials, equipment, services and transportation required to complete fencing as shown on the Drawings and as specified herein or both.

1.03 RELATED WORK

A. The following related work is to be performed under the designated Sections.

1. Masonry – Section 040001
2. Earthwork - Section 312000
3. Finish Grading – 312219
4. Site Concrete - Section 321313
5. Athletic Surfacing – Section 321800
6. Playground Safety Surfacing – Section 321810
7. Miscellaneous Site Improvements - Section 323000
8. Irrigation – Section 328400

1.04 REFERENCES

A. ASTM American Society for Testing Materials

B. AWS American Welding Society

1.05 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 013300 – Submittals.

B. Product Data: Fence Manufacturer's current catalogue cuts and specifications and suppliers material certificates for the following:

1. Manufacture's current catalog cuts and specifications for the fence type to be used on the job.
2. Confirmation that steel members meet required ASTM.
3. Confirmation that accessories and fastenings meet specified requirements.
4. Manufacturer's Paint.
5. Manufacturer's Touch-up paint.
6. Non Shrink Grout.
7. Chain Link Fencing.
8. Barrier Gates.
9. Alphabet Soup Panel.
10. Split Rail Fence.

C. Samples

1. Chain Link Fence Vinyl Color (Brown) sample.
2. Chain Link Fence aluminized fabric sample.
3. Cedar Fence – (1) foot long rail size.
4. Aluminum Fence color samples.

D. Shop Drawings: Minimum 3/8 inch scale showing dimensions, sizes, thickness, gauges, finishes, joining, attachments and relationship of work to adjoining construction and existing conditions.

1. The Sub-Contractor shall field measure the site conditions and provide necessary grades and layout to construct the fence.
2. Verification: Verify all measurements at the job site. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
3. Coordination: Where concrete, masonry or other materials must be set to exact locations to receive work, furnish assistance and direction necessary to permit other trades to properly locate their work.
4. Setting Diagrams for Welded Connectors, Concrete or Masonry Inserts: Where required to receive work, show exact locations and furnish all such Drawings to the trades responsible for installing the connectors or inserts.

1.06 DELIVERY, STORAGE AND HANDLING

A. Delivery: No materials with defects or scratches on exposed finishes will be accepted.

B. Storage: Protect work at site from damage and from weather until installed and all work has been accepted. Do not remove protective wrappings from shop-painted finishes until installation.

C. Handling: Disassemble units only as necessary for shipping and handling limitations.

D. Replacement: Replace all damaged work at no cost to Owner.

E. Acceptance: Do not install work of this section prior to acceptance by Landscape Architect of area to receive such work.

F. Coordination: Coordinate with the work of other sections to insure the following:

1. Templates and Built-ins: Furnish in a timely manner all anchors, fastenings, sleeves, setting templates and layouts affecting or installed in the work of other trades so that work or progress of work is not delayed. Be responsible for proper location of such items.

2. Sleeving: Verify that all post sleeves to be set in concrete are accurately placed in the forms prior to the pouring of concrete.

1.07 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.08 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architect's designated representative.

PART 2 MATERIALS

2.01 CAST IN PLACE CONCRETE

A. Cement concrete shall conform to Site Concrete 321313.

2.02 CHAIN LINK FENCING (4) FOOT AND (6) FOOT HEIGHT – BROWN COLOR)

A. Chain Link Fence Fabric:

1. Aluminum coated (aluminized) chain link fabric per ASTM A491, to have a minimum aluminum coating of 0.40 oz/ft² (122 g/m²).
2. Sizes:
   a. (4) Foot High Fence and (6) Foot High Fence: Galvanized helically wound and woven to height of as indicated on drawings, (one) inch (25 mm) diamond mesh of 9 gauge core wire with a diameter of (0.148) inch (3.76 mm) and a breakload of 1290 lbs (5740 N).
3. Selvage of fabric knuckled at top and knuckled at bottom.

B. Steel Fence Framing:

1. Steel pipe - Type I: ASTM F 1083, standard weight schedule 40; minimum yield strength of 25,000 psi (170 MPa); sizes as indicated. Hot-dipped galvanized with minimum average 1.8 oz. /ft² (550 g/m²) of coated surface area.
   a. The Steel Fence Framings for the Chain link fencing that is shown as curved at the (two) play areas shall be curved to the radius shown.
2. PVC or polyolefin elastomer coated finish: In accordance with ASTM F1043, apply supplemental color coating of 10-15 mils (0.254 - 0.38 mm) thermally fused in Brown color.
   a. (4) Foot High and (6) Foot Fence Framing Sizes:

End, Corner and	(2 inch) - 2.375” od
Line (intermediate) Post	(2 inch) - 2.375” od
Top and Bottom Rails:	(1-1/4 inches) - 1.66” od
Gate Posts:	(3 inches) - 3.5” od

2.03 CHAIN LINK FENCING (8) FOOT HEIGHT – BROWN COLOR)

A. Chain Link Fence Fabric:

1. Aluminum coated (aluminized) chain link fabric per ASTM A491, to have a minimum aluminum coating of 0.40 oz/ft² (122 g/m²).

2. Sizes:

a. (8) Foot High Fence: Galvanized helically wound and woven to height of as indicated on drawings, (one) inch (25 mm) diamond mesh of 9 gauge core wire with a diameter of (0.148) inch (3.76 mm) and a breakload of 1290 lbs (5740 N).

3. Selvage of fabric knuckled at top and knuckled at bottom.

B. Steel Fence Framing:

1. Steel pipe - Type I: ASTM F 1083, standard weight schedule 40; minimum yield strength of 25,000 psi (170 MPa); sizes as indicated. Hot-dipped galvanized with minimum average 1.8 oz. /ft² (550 g/m²) of coated surface area.

a. The Steel Fence Framings for the Chain link fencing that is shown as curved at the (two) play areas shall be curved to the radius shown.

2. PVC or polyolefin elastomer coated finish: In accordance with ASTM F1043, apply supplemental color coating of 10-15 mils (0.254 - 0.38 mm) thermally fused in Brown color.

a. (8) Foot High Fence Framing Sizes:

End, Corner and	(2 inch) - 2.375” od
Line (intermediate) Post	(2 inch) - 2.375” od
Top and Bottom Rails:	(1-1/4 inches) - 1.66” od
Gate Posts:	(4 inches) - 4.5” od

2.04 BARRIER GATE AND BARRIER GATE KEEP POSTS

A. Gate Post and Gate Keep Posts: 2-7/8 inch OD x 8’-6” length galvanized steel pipe (SS40).

B. Rails: 1-7/8 inch OD galvanized steel pipe (SS40).

C. Accessories:

1. Galvanized acorn style cap.

2. Galvanized 1-3/8 inch eye locks.

3. Dual sealed bearing hinges.

2.05 DECORATIVE PANEL PANELS

A. Fence Panel: Alphabet Soup pattern, (3/16) inch thick powder coated aluminum by Revamp panels, LLC, 509-919-0460. Attached/weld to the Gate Framing as shown on the Shop Drawings.

2.06 CHAIN LINK FENCE FITTINGS

A. Chain link fence accessories: (ASTM F 626) Provide items required to complete fence system. Galvanize each ferrous metal item and finish to match framing.

B. Post caps: Formed steel, cast malleable iron, or aluminum alloy weather tight closure cap for tubular posts. For each line post provide tops to permit passage of top rail. Brown color.

C. Top rail and brace ends: Pressed steel per ASTM F626, for connection of rail and brace to terminal posts. Brown color.

D. Top rail sleeves: (7) inch (178 mm) expansion sleeve with spring, allowing for expansion and contraction of top rail. Brown color.

E. Wire ties and clips: 10 gauge (0.135) inch (3.43 mm)] galvanized steel wire for attachment of fabric to line posts. Double wrap 13 gauge (0.092) inch (2.324 mm)] for rails and braces. Hog ring ties of 12-1/2 gauge (0.0985) inch (2.502 mm)] for attachment of fabric to tension wire. Brown color.

F. Brace and tension (stretcher bar) bands: Pressed steel. Brown color.

G. Tension (stretcher) bars: One piece lengths equal to (2) inch (50 mm) less than full height of fabric with a minimum cross-section of (3/16) inch x (¾) inch (4.76 mm x 19 mm) or equivalent fiberglass rod. Provide tension (stretcher) bars where chain link fabric meets terminal posts. Brown color.

H. Tension wire: Thermally fused PVC or polyolefin elastomer applied to metallic coated steel wire: Per ASTM F 1664 Class 2 b, 7 gauge, and (0.177) inch (4.5 mm) diameter core wire with tensile strength of 75,000 psi (517 MPa). Brown color.

I. Truss rods & tightener: Steel rods with minimum diameter of (5/16) inch (7.9 mm). Capable of withstanding a tension of minimum 2,000 lbs. Brown color.

J. Nuts and bolts are galvanized but not cedar coated. Cans of PVC touch up paint are available to color coat nuts and bolts if desired. Brown color.

2.07 CEDAR RAIL FENCE

A. Natural Cedar Morgan Fence. (3) rails with (6) inch square chamfered top posts Morgan Fence by Walpole Woodworkers or approved equal:

B. Available from the following companies:

1. Malone Fence Company, 978-744-7339, malonefencecompany.com.
2. Walpole Woodworkers, 508-668-2800, walpolewoodworkers.com.
3. Reliable Fence Company, 800-321-9363, reliablefenceboston.com.

PART 3 EXECUTION

3.01 EXAMINATION

A. Condition of Surfaces: Inspect all surfaces to receive the work and report all defects which would interfere with this installation.

B. Acceptance: Starting work implies acceptance of surfaces as satisfactory.

3.02 PREPARATION

A. Layout: Set all work plumb, unless otherwise noted.

B. Fitting: Fit exposed connections accurately together to form tight joints.

3.03 INSTALLATION GENERAL

A. Attachments and Reinforcements

1. Set all railings and similar items shown or required to be set in sleeves or cans with quick setting non-shrink grout or anchor cement.
2. Provide all reinforcements for hardware and other miscellaneous attachments.

B. Fasteners

1. Provide hot dipped galvanized steel all lugs, clips, anchors and miscellaneous fastenings necessary for the complete assembly and installation.

3.04 CHAIN LINK FENCE INSTALLATION

A. Erect chain link fencing only after final grading is complete. Install fence fabric and bolt heads on one side of fence and bolt nuts on the other side. After installation is complete, preen nuts to prevent removal.

1. Level: Install all fence work, including fences over irregular terrain, with posts truly plumb and top of fence fabric and rails truly level, except as indicated otherwise and except at regular slopes and hills, install top of fence fabric and rails to follow slope.

2. Posts Set in Ground: Accurately space posts at approximately (8) feet on center, unless otherwise indicated or required, and excavate neat, circular holes at least four times the diameter of the post and at (4) inches below post bottoms. Set posts at as shown on the drawings and center align posts in hole with (4) inches of concrete beneath posts. Fill holes with concrete and vibrate and consolidate around posts. Maintain true vertical and top alignment and alignment along the fence line. Extend concrete footings to (6) inches below finish grades and slope to shed water away from posts. Align posts and fence fabric to permit paving to continue around fence posts so that concrete fence post footing does not show.

3. Rails: Provide straight and curved top and bottom rails continuously with expansion couplings as recommended by fence manufacturer. Install intermediate rails, where used, flush with face fabric using offset fittings if necessary. Provide intermediate rails for all fences over (6) feet high.

4. Fabric: Thread tension bars through fabric and clamp to fabric at 4 inches on center. Band stretcher bars to end posts at (12) inches on center. Stretch fabric tightly and securely anchor fabric to framing and tension wires leaving about (1) inch clearance above grade. Anchor and tie so that fabric remains in tension after pulling force is released. Form joints of splices in fabric only at posts. Tie fabric to line posts at (12) inches on center, to rails and braces at (24) inches on center, and to tension wires at (24) inches on center with U-shaped tie wires double turned with ends bent into fence for safety.

5. PVC Coated Work: Generally comply with requirements for galvanized work. Take extreme care to prevent removal of or damage to PVC coatings. Touch-up all cut and abraded surfaces with PVC tough-up paint to prevent corrosion and to make tough-up invisible.

3.05 BARRIER GATE AND BARRIER GATE KEEP POSTS

A. Install as shown on the drawings and on the approved shop drawings.

3.06 SPLIT RAIL FENCE

A. Install as shown on the shop drawings and as recommended by the manufacturer.

3.07 REPAIR AND PROTECTION

A. Repair minor damage to eliminate all evidence of repair. Remove and replace work that cannot be successfully repaired. Protect work from damage.

END OF SECTION

SECTION 328400

IRRIGATION SYSTEM

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Include GENERAL CONDITIONS and applicable parts of Division 1 as part of this Section.

B. Coordinate work of this Section with trades responsible for their installation. Refer to respective drawings pertaining to other work.

1.02 WORK TO BE DONE

A. Coordinate work of this Section with underground utilities and with trades responsible for their installation. Refer to respective drawings pertaining to other work.

B. Work to be done includes furnishing labor, materials, equipment and services required to complete the irrigation work indicated on the drawings, as specified herein, or both.

C. Point of connection shall be a 2-inch water supply from the school where indicated on the drawings.

D. Electrical point of connection shall be 120-volt, 20-amp, hard wired electrical circuit for the irrigation controller in the school mechanical room.

E. Drawings and specifications must be interpreted and are intended to complement each other. Furnish and install parts which may be required by the drawings and omitted by the specifications, or vice versa, just as though required by both. Should there appear to be discrepancies or question of intent, the matter shall be referred to the Owner's Representative for decision, and his interpretation shall be final, conclusive and binding.

F. Necessary changes to the drawings to avoid any obstacles shall be made with the approval of the Owner's Representative.

G. Excavation, backfilling and bedding materials, together with the testing of the completed installation shall be included in this work.

H. Work shall be constructed and finished in every respect in a good, workmanlike and substantial manner, to the full intent and meaning of the drawings and specifications. Parts necessary for the proper and complete execution of the Work, whether the same may have been specifically mentioned or not, or indicated on the drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.

I. Record drawing as well as Operating & Maintenance Manual generation, in accordance to these specifications shall be included in this work.

1.03 SCOPE

A. Irrigation system shown on the drawings and described within these specifications represents a single controller, landscape irrigation system supplied from potable water source. The system is designed for 60 gallons per minute 65-psi dynamic pressure.

1.04 RELATED WORK

A. Carefully examine the Contract Documents for requirements that affect the Work of this Section.

1. Earthwork: Division 312000
2. Planting: Section 329000
3. Site Improvements: Section 323000
4. Electrical Power Supply: Division 26
5. Plumbing: Division 22

1.05 ORDINANCES, PERMITS AND FEES

A. Work under this Section shall comply with ordinances and regulations of authorities having jurisdiction.

B. Permits, tests and certifications required for the execution of Work under this Section shall be obtained and paid for.

C. Furnish copies of permits, certifications and approval notices to the Owner's Representative prior to requesting payment.

1.06 EXAMINATION OF CONDITIONS

A. Be fully informed of existing conditions on the site before submitting bid, and be fully responsible for carrying out work required to fully and properly execute the Work of the Contract, regardless of the conditions encountered in the actual Work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed, except those conditions described in the GENERAL CONDITIONS.

1.07 QUALITY ASSURANCE

A. Installer: A firm which has at least five (5) years' experience in work of the type (athletic) and size required by this Section and which is acceptable to the Owner's Representative.

B. References: Supply five references for work of this type and size with the bid including names and phone numbers of contact person(s).

C. Applicable requirements of accepted Standards and Codes shall apply to the Work of this Section and shall be so labeled or listed:

1. American Society for Testing & Materials (ASTM)
    a. ASTM: D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
    b. ASTM: D1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and Cl200.
    c. ASTM: D2464 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
    d. ASTM: D2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
    e. ASTM: D2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe Systems.
    f. ASTM: B43-98 Brass pipe.
    g. ASTM: D2737-99 Polyethylene (PE) Pressure rated tube.
2. National Standard Plumbing Code (NSPC)
3. National Electric Code (NEC)
4. National Sanitary Foundation (NSF)
5. American Society of Agricultural and Biological Engineers (ASABE)
6. Underwriters Laboratories, Inc. (UL)
7. Occupational Safety and Health Administration (OSHA)
8. American Society of Irrigation Consultants (ASIC)

1.08 TESTS

A. Observation: Owner’s Representative will be on site at various times to ensure the system is being installed according to the specifications and drawings.

B. Coverage Test: After completion of the system, test the operation of entire system and adjust sprinklers as directed by the Owner's Representative. Demonstrate to the Owner's Representative that irrigated areas are being adequately covered. Furnish and install materials required to correct inadequacies of coverage due to deviations from the drawings or where the system is obviously inadequate or inappropriate. (See Part 3 - Execution).

C. Owner’s Representative shall be notified 7 days in advance for observations.

1.09 PRODUCT SUBMITTALS

A. Provide copies of product specification sheets on all proposed equipment to be installed to the Owner's Representative for approval prior to the start of work, in accordance with the parameters of Division-1. Work on the irrigation system may not commence until product sheets are submitted and approved. Submittals shall be marked up to show proper nozzles, sizes, flows, etc. Equipment to be included:

1. Sprinklers and Nozzles
2. Valves: Manual and Automatic
3. Controller
4. Decoders
5. Lightning Arrestors
6. Valve Boxes
7. Copper Pipe and Fittings
8. Polyethylene Pipe and Fittings
9. PVC Pipe and Fittings
10. Primer and Cement
11. Sleeving Pipe
12. Wire and Connectors
13. Wire Conduit
14. Quick Coupling Valves
15. Rain Sensor
16. Master Valve
17. Flow Meter
18. Soil Moisture Sensors
19. Grounding Equipment
20. Identification Tags
21. Miscellaneous Materials

B. Project Record Documents:

1. Provide and keep up-to-date a complete redlined record set of drawings of the system as the project proceeds. Drawings shall be corrected daily, showing every change from the original drawings and specifications. Record drawings shall specify and exactly locate sprinkler type; pop up height and nozzle for each sprinkler installed. Each valve box location to be referenced by distance from a minimum of two permanent locations. Controllers, weather/rain sensors, moisture sensors, quick coupling valves and other equipment shall be indicated on the drawings. Wire routing, wire size and splices shall be indicated. Mainline pipe, lateral pipe and wire route shall have three (3) distinctly different graphic symbols (line types). This redlined record set of drawings shall be kept at job site and shall be used only as a record set.

2. Make neat and legible notations on this record set of drawings daily as the Work proceeds, showing the Work as actually installed. For example, should a piece of equipment be installed in a location that does not match the plan, indicate that equipment in a graphic manner in the location of installation and so as to match the original symbols as indicated in the irrigation legend. Should the equipment be different from that specified, indicate with a new graphic symbol both on the drawings and the irrigation legend. The relocated equipment dimensions and northing and easting coordinates should then be transferred to the appropriate drawing in this record set of drawings at the proper time.

3. On or before the date of final field observation, deliver corrected and completed AutoCAD computer plots of “record drawings” on vellum and AutoCAD electronic files on disk to Owner’s Representative as part of contract closeout. Delivery of plots will not relieve the responsibility of furnishing required information that may have been omitted from the prints. Record drawings shall not be marked up design drawings. Record drawings shall be on Contractors own title block with installed, not proposed irrigation information.

1.10 DELIVERY, STORAGE AND HANDLING

A. Store and handle materials in compliance with manufacturer instructions and recommendations. Protect from possible damage. Minimize on-site storage.

1.11 GUARANTEE

A. Obtain in the Owner's name the standard written manufacturer's guarantee of materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. These guarantees shall be in addition to, and not in lieu of, other liabilities that the Company performing the work under contract may have by law.

B. In addition to the manufacturers guarantees, the new irrigation equipment shall be warrantied, both parts and labor for a period of one (1) year from the date of acceptance by the Owner.

C. As part of the one-year warranty the first year-end winterization and spring start-up for the new irrigation system shall be performed.

D. Should any problems develop within the warranty period because of inferior or faulty materials or workmanship, they shall be corrected to the satisfaction of the Owner’s Representative at no additional expense to the Owner.

E. A written warranty showing date of completion and period of warranty shall be supplied upon completion of the project.

1.12 COORDINATION

A. Work shall be coordinated closely with the Owner's Representative to avoid misunderstandings and to efficiently bring the project to completion. Owner's Representative shall be notified as to the start of work, progression and completion, as well as any changes to the drawings before the change is made. Coordinate work with those of other trades.

B. Be responsible and pay for damage to other work caused by work or workmen. Repair such damage as directed by the Owner's Representative.

1.13 MAINTENANCE AND OPERATING INSTRUCTIONS

A. Include in Bid an allowance for four (4) hours of instruction of Owner and/or Owner's personnel upon completion of check/test/start-up/adjust operations by a competent operator (Owner's Representative office shall be notified at least one (1) week in advance of check/test/start-up/adjust operations).

B. Upon completion of work and prior to application for acceptance and final payment, a minimum of three (3), three ring, hard cover binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE AMESBURY ELEMENTARY SCHOOL IRRIGATION SYSTEM, shall be submitted to the Owner's Representative office. After review and approval, the copies will be forwarded to the Owner. Included in the Maintenance and Operating binders shall be:

1. Table of Contents
2. Written description of Irrigation System.
3. System drawing:
    a. One (1) copy of the original irrigation plan;
    b. One (1) copy of the Record Drawing;
    c. One (1) reproducible of the Record Drawing;
    d. One (1) copy of the controller valve system wiring diagram.
4. Listing of Manufacturers.
5. Manufacturers' data where multiple model, type and size listings are included; clearly and conspicuously indicating those that are pertinent to this installation.
    a. "APPROVED" submittals of irrigation equipment;
    b. Operation: User's Manuals
    c. Maintenance: including complete troubleshooting charts.
    d. Parts list.
    e. Names, addresses and telephone numbers of recommended repair and service companies.
6. A copy of the suggested "System Operating Schedule" which shall call out the controller program required (zone run time in minutes per day and days per week) in order to provide the desired amount of water to each

area under "no-rain" conditions.

7. Winterization and spring start-up procedures.

8. Guarantee data.

1.14 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.15 PROCEDURE

A. Notify public utility owners concerned of the time and location of work that may affect them. Cooperate and coordinate with them in the protection and/or repairs of any utilities.

B. Provide and install temporary support, adequate protection and maintenance of structures, drains, sewers and other obstructions encountered. Where grade or alignment is obstructed, the obstruction shall be permanently supported, relocated, removed or reconstructed as directed by the Owner's Representative.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of the system. Material overages at the completion of the installation shall be removed from the site.

B. Material substitutions from the irrigation products described in these specifications and shown on the drawings shall be made without prior approval and acceptance from the Owner's Representative.

2.02 COPPER PIPE AND FITTINGS

A. Copper pipe shall be Type K, hard tempered ASTM B88.

B. Copper fitting shall be wrot copper, solder joint type in accordance with ASTM B828-00.

C. Joints shall be soldered with silver solder ASTM B32, Grade 95TA up to 250 degree using non-corrosive flux.

D. Supply only pipes and fittings that are marked by the manufacturer with the appropriate ASTM designations and pressure ratings and are free from cracks, wrinkles, blisters, dents or other damage.

2.03 PVC IRRIGATION PIPE

A. Pipe shall bear the following markings: Manufacturer's name, nominal pipe size, schedule or class, pressure rating in psi, and date of extrusion.

B. Mainline pipe and 1-1/2 and 2-inch lateral pipe shall be PVC, Class 200, Type 1120, SDR 21, Solvent-Weld PVC, conforming to ASTM No. D2241 as manufactured by Ipex, JM Eagle, Silverline or equal.

2.04 PVC PIPE SLEEVES

A. Pipe sleeves beneath non-soil areas shall be PVC, Class 160 water pipe as manufactured by Ipex, National, JM Eagle or equal. Sleeve size shall be as indicated on the drawings. Minimum sleeve size to be 3-inch.

2.05 PVC IRRIGATION FITTINGS

A. Fittings for solvent weld PVC pipe, 2-1/2 inch and smaller in size, shall be Schedule 40 solvent weld PVC fittings as manufactured by Dura, Lasco, Spears or equal.

B. Fittings shall bear manufacturer's name or trademark, material designation, size, and applicable I.P.S. schedule.

C. PVC threaded connections in and out of valves shall be made using Schedule 80 toe nipples and Schedule 40 couplers or socket fittings. Schedule 40 threads will not be approved for installation.

D. PVC solvent shall be NSF approved, for Type I and Type II PVC pipe, and Schedule 40 and 80 fittings. Cement is to meet ASTM D2564 and FF493 for potable water pipes. Cement shall be medium set not fast (no wet and dry or hot). PVC solvent cement shall be Rectorseal Gold, IPS Weld-ON 711, Oatey Heavy Duty Cement or equal, and shall be used in conjunction with the appropriate primer. Primer shall be NSF approved, and formulated for PVC and CPVC pipe applications. Primer is to meet ASTM F 656. Primer shall be Rectorseal Jim PR-2, IPS Weld-ON P-70, Oatey Primer for PVC and CPVC, or equal. Clear primers and cements are no acceptable.

E. Nipples to be schedule 80 PVC.

2.06 POLYETHYLENE PIPE

A. Lateral piping 1-1/4 and 1-inch in size shall be installed with polyethylene (PE-3408) pipe, SDR 15, Class 100, Type III, Grade 3, Class C conforming to ASTM D2239, with a minimum pressure rating of 100 psi as manufactured by Oil Creek or equal.

2.07 POLYETHYLENE IRRIGATION FITTINGS

A. Fittings for polyethylene pipe shall be insert PVC or Nylon type fittings. Fittings shall conform to NSF standards and be attached with two (2) offset dog-eared stainless-steel clamps. Clamps shall be as manufactured by Oetiker or approved equal.

B. Supply only pipes and fittings that are marked by the manufacturer with the appropriate ASTM designations and pressure ratings and are free from cracks, wrinkles, blisters, dents or other damage.

C. Fittings shall be per ASTM D2609 as manufactured by Dura, Lasco or Spears.

2.08 WIRE CONDUIT

A. Conduit for wiring beneath non-soil areas shall be PVC, SCH-40 conduit with solvent-weld joints, as manufactured by Carlon, Cresline, JMM or equal.

B. Sweep ells shall be standard electrical type PVC schedule 40 long sweep elbows. Cap sweep ell with tri-plug with the ring for securing nylon pull rope.

C. Conduit for above ground wiring to rain shut-off or controller shall be schedule 40 rigid conduits.

2.09 SPRAY SPRINKLERS

A. Full and part circle pop up spray sprinklers shall be pressure regulating (30-psi), plastic construction with ratcheting riser, removable nozzle and check valve. Pop-up height shall be 6 inches for turf where indicated on the drawings.

B. Nozzle size shall be as indicated on the drawing and in the legend. VAN nozzles shall only be used where a fixed arc nozzle is not available. Fixed arc nozzles shall be Hunter MPR or equal. VAN nozzles shall be Rain Bird HE-VAN or equal.

C. Sprinkler shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Hunter Industries, model PROS-06/12-PRS30-CV, Rain Bird 1806/1812-SAM-PRS or approved equal.

2.10 MPROTATOR SPRINKLERS

A. Full and part circle pop up spray sprinklers with multi-stream rotary nozzles shall be pressure regulating (40/45-psi), plastic construction with ratcheting riser, removable nozzle and check valve. Nozzle size shall be as indicated on the drawing and in the legend. Pop-up height shall be 6 inches for turf where indicated on the drawings.

B. Multi-stream rotary nozzles shall be manufactured by Hunter MP3000 for 25-foot spacing, MP2000 for 18-foot spacing and MPCORNER for 14-foot spacing or equal where indicated on the drawings.

C. Sprinkler shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Hunter Industries model PROS-06/12-PRS40, Rain Bird 1806/1812-SAM-P45 or approved equal.

2.11 SMALL/MEDIUM ROTARY SPRINKLERS

A. Small/medium rotary sprinklers shall be gear-driven, rotary type sprinklers, designed for in-ground installation with integral check valves and in-riser flow shut-off capability. Sprinkler shall be capable of covering a 25-44-foot radius and flow range of 0.9-7.0 gpm at 50-55 pounds per square inch of pressure. Sprinklers shall have a one hundred percent warranty for two years' minimum against defects in workmanship.

B. Nozzle assembly shall elevate minimum four inches when in operation and retraction shall be achieved by a stainless-steel spring. Riser assembly shall be plastic. A nozzle wiper seal shall be included in the sprinkler for continuous operation under the presence of sand and other foreign material.

C. Sprinkler parts shall be removable through the top of the unit through the removal of a heavy-duty threaded cap. The sprinkler shall have a three quarter-inch (3/4") IPS water connection on the bottom of the sprinkler.

D. Sprinklers shall be manufactured by Hunter Industries model I20-04, Rain Bird 5004-Plus.

E. Approved Performance Chart (25' Spacing):

Model	Pressure	Arc	Nozzle	Flow	Radius
Hunter I20-04	50psi	90 Deg.	0.75SR	0.75	25'

Hunter I20-04	50 psi	180 Deg.	1.5SR	1.5	25’
Hunter I20-04	50 psi	360 Deg.	3.0SR	3.0	25’

F. Approved Performance Chart (35’ Spacing):

Model	Pressure	Arc	Nozzle	Flow	Radius
Hunter I20-04	50 psi	90 Deg.	2.0	2.0	38’
Hunter I20-04	50 psi	180 Deg.	4.0	4.2	41’
Hunter I20-04	50 psi	360 Deg.	8.0	6.8	44’

2.12 ELECTRIC CONTROL VALVES

A. Electric control valves shall be one, one and one-half and two-inch remote control, diaphragm type, fiberglass or reinforced nylon body plastic valves with manual flow control, manual bleed screw, dirty water filter and 200 psi pressure rating.

B. Valves shall be manufactured by Rain Bird model PEB, Hunter Industries model ICV or equal.

2.13 VALVE BOXES

A. Valve boxes shall be manufactured from unformed resin with a tensile strength of 3,100-5,500 psi conforming to ASTM D638. Boxes shall be green or black in color.

B. Valve boxes for single 1-inch electric valves, isolation valves, wire splices and quick coupling valves shall be 10-inch round valve boxes with metal detection, T-top lids and bolt down covers. Splice boxes shall have gray lids.

C. Valve boxes for single 1-1/2-inch and 2-inch electric valves, dual 1-inch and 1-1/2-inch valves, master valve and flow sensor shall be 12-inch standard valve boxes with metal detection, T-top lids and bolt down covers. When multiple 1-inch or 1-1/2-inch electric valves are installed in the same area, they are to be installed no more than two (2) valves per box in a 12-inch standard box.

D. Valve boxes for MPRotator zones and dual 2-inch valves shall be 18-inch jumbo valve boxes with metal detection, T-top lids and bolt down covers. When multiple 2-inch electric valves are installed in the same area, they are to be installed no more than two (2) valves per box in an 18-inch standard box.

E. Valve box extensions shall be provided and installed as required for proper box depth. Valve box extensions shall be made by the same manufacturer as the box.

F. Valve boxes shall be manufactured by Dura Plastics, Highline Products or Olde Castle Specification Grade.

G. Valve covers for ground rods and plates shall be 4-inch, green grated covers with detection consisting of a #10 washer and screw installed on the bottom side of the cover. Cover shall be installed on a 6 inch or 18-inch length of 4-inch perforated drainage pipe as manufactured by ADS or NDS.

2.14 AUTOMATIC CONTROLLER

A. Controller shall be manufactured by Baseline Systems, model 3200X or equal, installed per manufacturer's specifications, and as specified herein.

1. Controller shall be able to operate:

a. Up to 100 zones along a two-wire path and/or a conventional wire path (Expanded), 50 normally.

b. Up to 20 moisture sensors (Expanded), 10 normally.

c. 20 separate programs (Expanded), 10 normally.

d. Support one POC (flow meter, master valve, pump start) Expandable to 3 POC

e. Direct wire to internet through Ethernet port and use "Live View" to manage your controller anywhere.

f. Concurrently operate up to 15 AC solenoids along two wire path or 100 DC latching solenoids.'

g. Support 110 devices on a two-wire path.

h. Support two-way communications with two-wire decoders.

i. Eight start times per program.

j. Support up to seven separately normally open or normally closed pause or event devices.

k. Execute a high flow or low flow shutdown based on total system flow or on flow per flow meter.

l. Detects and repairs address conflicts for devices that are connected to the two-wire path from the controller.

B. Controller shall be capable of storing irrigation schedules, monitoring and managing flow without a Central Computer (i.e. if the Central Computer is turned off, removed, or if communication from/to the Central Computer fails, the field controller will continue to perform moisture and flow management functions). The controller shall display on-screen instructions making it easier for a user to operate the controller.

1. Programmable features include:

a. Eight start times per program in 10-minute increments

b. Run time for zones from 1 second to 18 hours in one second increments

c. Day intervals in even, odd, or odd days excluding the31st

d. Create a custom 7-day calendar, and historical calendar with customizable half months

e. Program unique cycle soak times for each program. Soak times can be programmed between 0 minutes and 18 hours.

f. Specify hours during each day of the week when or when not, water can be applied in one-hour increments in a 24-hour period.

g. Assign start, stop and pause irrigation modes to each program, including time based, event based and soil moisture sensor-based behaviors.

h. Manually enter a design flow for each zone with or without an installed flow meter.

i. Automatically calibrate soil moisture thresholds and make irrigation decisions based on those thresholds.

j. Adjust seasonal water budget from 10% to 200% by program.

k. Schedule up to 8 future event dates when watering will not occur.

l. Manually operate one zone, or all zones of a program, with programmable runtimes, delay before starting first zone, and time between zones.

m. Search and define all devices connected to the two-wire and list them according to device type and serial number.

n. Back up all programming and historical data with a USB flash drive

o. Establish three levels of local and remote PIN protection: status and stop, manual runs and full programming access.

p. Configure pipe stabilization time for flow management.

C. Controller shall be able to send alerts to Live View or central software at an offsite location utilizing supported devices. Alerts shall be processed at both the field controller location and/or the Central Computer location (requires communication module). Ethernet is built in for Live View but can be used for central control with software. Communication options for central control shall be as follows:

1. Cellular modem
2. Wi-Fi
3. Ethernet Radio
4. Long Haul Ethernet Wired Communication

D. Controller shall be able to provide real time soil moisture measurements and watering feedback to the user. It includes integrated tools and software that self-diagnose problems and generate alerts and messages, and then displays the messages on the screen and remotely. It displays on screen total runtime and water used for the last two days, actual or estimated flow values, 7-day scalable soil moisture graph with 12 reading per day. It displays all pause and stop conditions in message screens. One message will be displayed for each condition and each message can be individually removed. It further displays high flow alerts, low flow alerts, pause messages and conditions, rain delays, wire faults and other operating conditions.

E. Controller equipped with 10 levels of surge protection; 5 levels built into the controller boards with a minimum surge response time of 1 picosecond.

2.15 DECODERS

A. Decoders shall be installed between the controller and the electric control valves to provide the 24-volt power supply for individual valves. Decoders shall be available in 1, 2 or 4-station devices. Decoder shall have a unique serial number and controller-assigned address to identify it in the network.

B. Decoder shall be manufactured by Baseline Systems, model biLine or equal.

2.16 SOIL MOISTURE SENSORS

A. Soil moisture sensors shall provide the following:

1. Measures soil moisture using patented modified TDT technology.
2. Sensor is self- calibrating for all soil types and conditions.
3. Moisture range measurement from 5% moisture to fully saturated soil (45%).
4. Measures soil temperature.
5. Moisture readings are consistent in salty conditions.

B. Sensor shall be completely sealed and shall be resistant to power surges, shock, freezing, heat, salts and fertilizers.

C. Sensor shall have the following accuracy and repeatability:

1. Range: 5% to 45% volumetric (fully saturated)
2. Raw Sensor Resolution: 0.01% volumetric
3. Volumetric Moisture Accuracy: +/- 0.1%
4. Volumetric Calibration: +/- 2% of calibrated sample
5. Soil Temperature: +/- 2C/3.6F

D. Sensor shall be 24 to 28 VAC.

E. Sensor shall be manufactured by Baseline Systems or equal.

2.17 FLOW SENSOR

A. Flow sensor shall be provided and installed in accordance with manufacturer's requirements to maintain accuracy. Refer to drawings for location. Flow sensor for irrigation controller interfacing shall be 2-inch, with 150 psi pressure rating. Sensor shall have flow range of 2.8 to 170 gpm and be installed in a PVC solvent weld tee. Output shall be two wire standard pulse. Flow sensor shall be as manufactured by Creative Sensor Technologies, model CSI-FS1-T20-001.

2.18 NORMALLY OPEN MASTER VALVE

A. Normally open master control valve shall be in 2-inch in size. Valve shall provide dirty water protection and no minimum flow feature. The valve shall be designed to operate with no minimum flow rate.

B. Valve shall come with two-piece upper diaphragm and lower seat assembly. Valve shall operate within a pressure range of 20 psi-200 psi and have an in-rush current of 0.45 amps and a holding current of 0.30 amps at 24VAC.

C. Valve shall be designed with removable filter and metering rod assembly and non-continuous flow through the solenoid. Rubber parts shall be EPDM rubber parts.

D. Normally open master valves shall be manufactured by Buckner/Superior, Storm Manufacturing Group, Inc., model 3300200-RW or equal.

2.19 WIRE

A. Valve control wire from the controller to the valve module shall be through two-wire. Wiring shall be polyethylene double-jacketed or UF-B UL PVC double-jacketed two-conductor solid copper designed for direct burial systems. Wire connections shall be DBR/Y-6 or equivalent on the wire side of the valve module and shall utilize DBR/Y-6 or equivalent on the valve side. Connections shall be installed as per their manufacturers' instructions. Wire shall be manufactured by Paige Electric P7072D (maxi wire) or equal. Wire gauge shall be AWG #14.

B. Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.

C. In ground wire connections shall be UL listed (486D), manufactured by Paige, 3M, model DBR/Y-6 splice kits or equal. Wire splices shall be made in valve boxes, electrical junction boxes, at the controller or at valves. Connections shall be installed as per their manufacturers' instructions.

D. Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.

E. Wiring shall be in strict accordance with national, state and local electrical codes.

2.20 SURGE ARRESTERS

A. Surge arresters shall be installed on two-wire communication path where indicated on the drawings and as per manufacturers requirements. The unit shall have low clamping level and high current handling capabilities for protection of sensitive electronic devices. Surge arrestor shall be manufactured by Baseline Systems or equal.

2.21 QUICK COUPLING VALVES

A. Valve body shall be of cast brass construction with a working pressure of 125 psi. Valve seat disc plunger body shall be spring loaded so that the valve is normally closed under conditions when the key is not inserted.

B. Top of the valve body receiving the key shall be equipped with ACME threads and smooth face to allow the key to open and close the valve slowly. The quick coupling valve shall be equipped with a vinyl cover.

C. Valve body construction shall be such that the coupler seal washer may be removed from the top for cleaning or replacement without disassembling any other parts of the valve.

D. Keys shall be ACME with 1-inch male thread and 3/4-inch female thread at the top.

E. Quick coupling valves, keys and swivels shall be manufactured by Toro models 100-ATLVC, 100-AK and 075-MHS, Hunter Industries, model HQ-44RC-AW, HK-44A and HS-1 or equal.

2.22 ISOLATION VALVES

A. Isolation valves shall be gate type, of bronze construction, US Manufacture, 200 WOG with bronze cross handle and 200 psi rating. Gate valves to be as manufactured by Nibco model 113-K, Apollo model 102T or equal.

2.23 SWING JOINTS

A. ½ and ¾ inch sprinklers shall be installed on swing pipe assemblies, minimum length 12 inches and maximum length of 18 inches.

B. Swing pipe operating pressure shall be up to 80 psi with an inside diameter of 0.49 inches, manufactured of low-density polyethylene material meeting ASTM D2104, D2239 and D2737. Swing joint swing pipe and fittings shall be manufactured by Hunter Industries, Irritrol, Rain Bird or equal.

C. Quick coupling valves to be installed on 1-inch prefabricated PVC unitized swing joint assemblies with double O-ring seals, minimum 315 psi rating and minimum length of 12 inches with brass insert and stabilizer (unless stabilizer is an integral part of the quick coupling valve). Prefabricated PVC swing joints shall be as manufactured by Dura, Lasco or Spears.

2.24 AUTOMATIC RAIN/WEATHER SENSOR

A. Rain/weather sensor shall be plastic in construction with adjustable interruption point, 1/2-inch IPS threads and stainless-steel vandal resistant guard. Rain/weather sensor shall be manufactured by Hunter Industries, Irritrol, Rain Bird or equal.

2.25 IDENTIFICATION TAGS

A. Valves shall have ID tags attached. ID tags shall be manufactured from Polyurethane Behr Desopan. Provide one tag for each electric valve. Use one maxi size tag for electric control valve. Each tag shall provide valve and station ID information.

B. Tags shall be as manufactured by Paige Electric, T. Christy Enterprises or equal.

2.26 COMMUNICATION PATH GROUNDING

A. Two-wire communication path shall be grounded at 600-foot maximum intervals, at every termination of a part of the wire path to a surge arrestor decoder where indicated on the drawings, and 50 feet from the controller. Each surge arrestor shall be connected to a 5/8-inch diameter x 8-foot long copper clad grounding rod and 4-inch x 36-inch grounding plate with minimum #10 AWG, solid, bare copper wire. Minimum 8-foot separation between rod and other equipment. Connections to rods shall be with exothermic connectors as specified. Each grounding rod is to be covered by a 4-inch round, grated top, plastic valve cover with metal detection and six inches of 4-inch drainage pipe. Plate shall be installed at a 36-inch depth with 25 lbs. of ground enhancement material spread evenly below the plate and 25 lbs. spread evenly above the plate. Plates shall be covered with 4-inch plastic grated cover with detection and minimum 36 inches of 4-inch drainage pipe. Ground rods and plates shall be UL listed.

2.27 CONTROLLER GROUNDING

A. Controller installed inside school mechanical room shall be installed with an insulated grounding strap connected to a metal water pipe.

B. Ground strap shall be 1-inch wide by 0.015-inch-thick with punched holes. Length and hole sizes shall be to NEC requirements.

C. Ground strap shall be as manufactured by ABL Electronic Supplies Inc., model GSI-8.

2.28 CRUSHED STONE

A. 1/2-inch crushed stone shall be washed at the source facility to remove fine-grained soils and shall be well graded within the following limits:

Sieve Size (ASTM D422)	Percent Passing by Weight
3/4 inch	100
1/2 inch	90-100
3/8 inch	0-20
No. 4	0-5

2.29 SAND

A. Shall consist of well-graded natural sand, free from organic, other weak or compressible materials, or frozen materials, conforming to the following gradation:

Sieve No.	Percent Passing by Weight
#8	100
#50	15-40
#100	2-10
#200	0-5

2.30 SPARE PARTS

A. Supply the following tools and equipment to the Owner's Representative before final observation:

1. Two (2) wrenches or keys for disassembling and adjusting each type of sprinkler provided.
2. Four (4) quick coupler key assemblies.

B. Before final observation can occur, written evidence that the Owner's Representative has received the tools and equipment must be shown.

PART 3 EXECUTION

3.01 GENERAL

A. Before work is commenced, hold a conference with the Owner's Representative to discuss general details of the Work.

B. Examine Contract Documents applying to this Section noting any discrepancies and bringing the same to the attention of the Owner's Representative for timely resolution.

C. Work indicated on drawings shall be provided whether or not specifically mentioned in the specifications.

D. If there are ambiguities between drawings and specifications, and specific interpretation or clarification is not issued prior to bidding, the interpretation or clarification will be made only by Owner's Representative, and compliance with the decisions shall be required. In the event the installation contradicts the directions given, the installation shall be corrected at no additional cost to the Owner.

E. Verify dimensions and grades at job site before work is commenced. Do not proceed with installation of the irrigation system when it is apparent that obstructions or grade differences exist or if conflicts in construction details, legend or specific notes are discovered. Such obstructions, conflicts, or discrepancies shall be brought to the attention of the Owner's Representative.

F. Make field measurements necessary for the work noting the relationship of the irrigation work to the other trades. Coordinate with other trades. Project shall be laid out essentially as indicated on the Irrigation Plans. Major changes shall be reviewed with the Owner's Representative prior to proceeding.

G. Layout of sprinkler lines indicated on drawings is diagrammatic. Location of sprinkler equipment is contingent upon and subject to integration with other underground utilities. Employ data contained in the Contract Documents and verify this information at the construction site to confirm the manner by which it relates to the installation.

H. Coordinate installation of irrigation materials, including pipe, to avoid conflict with trees, shrubs or other plantings.

I. During progress of work, a competent superintendent and assistants necessary shall be on site and shall be satisfactory to the Owner's Representative. The superintendent shall not be changed, except with the consent of the Owner's Representative, unless that person proves unsatisfactory and ceases to be employed. Directions given to the superintendent shall be binding.

J. Protect existing paving/pavers, structures, walls, footings, etc. from damage. Inadvertent damage to the work of another trade shall be reported at once.

3.02 PIPE AND FITTINGS INSTALLATION

A. Using proper equipment, excavate a straight (vertical) and true trench to a depth of 2-inch of pipe invert elevation.

B. Loam or topsoil encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the lines and depths as shown on the drawings and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.

C. Pipe shall be laid on undisturbed trench bottom provided suitable base is available - no rock; if not, excavate to 2-inch below pipe invert and provide and install sand base or crushed stone upon which to lay pipe.

D. Backfilling shall be accomplished as follows: backfill material shall contain no foreign matter and no rock. Carefully place material around pipe and wire and tamp in place. Remainder of backfill shall be laid-up in 6-inch (maximum) lifts and tamped to compaction with mechanical equipment. Compact backfill in trenches to dry density equal to the adjacent undisturbed soil and conform to adjacent grades without dips, sunken area, humps, or other irregularities. Frozen material shall not be used for backfill.

E. Make solvent-weld joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of primer or solvent, and wiping off excess solvent from each connection. Allow welded joints at least 15 minutes set-up/curing time before moving or handling. When the temperature is above 80º F, allow connections to set minimum 24 hours before pulling or pressure is applied to the system. When temperature is below 80º F, follow manufacturer’s recommendations. Provide and install for expansion and contraction as recommended. Wire shall be laid in same trench as mainline and at pipe invert (see Wire Installation).

F. Mainline pipe shall have minimum 22 inches of COVER (excavate to invert as required by pipe size). Lateral pipe shall have minimum 16 inches or COVER for PVC and 12 inches of COVER for polyethylene (excavate to invert as required by pipe size).

G. Cut plastic pipe with handsaw or pipe-cutting tool, removing burrs at cut ends. Pipe cuts are to be square and true. Bevel cut end as required to conform to Manufacturer's specifications.

H. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. At times, when installation of the pipe is not in progress, the open end(s) of the pipe shall be closed by a watertight plug or other means. Pipe which cannot temporarily be joined, shall be sealed to make as watertight as possible. This provision shall apply during the lunch hour as well as overnight. Pipe not to be installed that day shall not be laid out. Should water enter the trench during or after installation of the pipe, no additional pipe may be installed or backfilled until water is removed from the trench. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 40º F or below. Pipe installed at temperatures below 40º F shall be removed and replaced at no cost to the Owner. PVC pipe shall be snaked in the trench to accommodate for expansion and contraction due to changes in temperature.

I. Maintain 6-inch minimum clearance between sprinkler lines and lines of other trades. Do not install sprinkler lines directly above another line of any kind.

J. Maintain 1-inch minimum between lines which cross at angles of 45 to 90 degrees.

K. Throughout the guarantee period refill any trenches that have settled due to incomplete compaction.

L. Pulling of pipe will be allowed provided soil is suitable and specified depth of bury can be maintained.

3.03 ELECTRICAL WIRE CONDUIT INSTALLATION

A. Electrical conduit shall be installed in non-soil areas, as well as for above ground wiring where wire passes under or through walls, walks and paving/pavers to controller and rain/weather sensor.

B. Conduit shall extend 18 inches beyond edges of walls and pavement/pavers.

3.04 ISOLATION VALVE INSTALLATION

A. Install isolation valves per details where indicated on the drawings. Install isolation valves on a level crushed stone base so that they can be easily opened or closed with the appropriate valve wrench. Install specified valve box over each isolation valve.

B. Check and tighten valve bonnet packing before valve box and backfill installation.

3.05 VALVE BOX INSTALLATION

A. Furnish and install a valve access box for each electric valve, quick coupling valve, isolation valve, master valve, flow sensor and wire splice.

B. Valve access boxes shall be installed on a minimum 4-inch crushed stone base. Finish elevation of boxes shall be at grade. Supply crushed stone and install before valve box. Crushed stone shall not be poured into previously installed valve boxes.

C. Valve boxes shall be installed neatly. Boxes shall be parallel or perpendicular to hardscape edges and equidistance to other valve boxes installed in the same location. A sufficient amount of turf shall remain in place between each valve box and between valve boxes and hardscapes

D. Valve box extensions shall be provided as required on valve boxes in order to install valve box covers at grade.

E. Bricks, stones, etc. shall not be used to support valve boxes. Install isolation valves per detail where indicated on the drawings. Install isolation valves on a level crushed stone base so that they can be easily opened or closed with the appropriate valve wrench. Install specified valve box over each isolation valve.

F. Check and tighten valve bonnet packing before valve box and backfill installation.

3.06 24 VOLT CONTROL VALVE INSTALLATION

A. Control valves shall be installed on a level crushed stone base. Grade of bases shall be consistent throughout the project so that finish grades fall within the limits of work. Valves shall be set plumb with adjusting handle and bolts, screws and wiring accessible through the valve box opening. Valves shall be set in a plumb position with 24-inch minimum maintenance clearance from other equipment.

B. Install at sufficient depth to provide more than 6-inch, nor less than 4-inch cover from top of valve to finish grade.

C. Adjust zone valve operation after installation using flow control device on valve.

3.07 WIRING INSTALLATION

A. Sufficient slack for expansion and contraction shall be maintained and wiring shall at no point be installed tightly. Provide and install an additional 8 inches to 12 inches slack at changes of direction. Wiring in valve boxes shall be a sufficient length to allow the valve solenoid, decoder, splice and connections to be brought above grade for servicing. This additional slack shall be coiled for neatness in the valve box.

B. Wire shall be laid in trenches and shall be carefully backfilled to avoid any damage to the wire insulation or wire conductors themselves. In areas of unsuitable material, the trench shall have a 2 inches layer of sand or stone dust on the bottom before the wires are laid into the trench and backfilled. The wires shall have a minimum of 22 inches of cover (See Detail). Wire not to be installed that day shall not be laid out.

C. An expansion curl shall be provided and installed within 6 inches of each wire connection to a solenoid or decoder on the single #14 wire – do not curl two-wire communication cable. Expansion curls can be formed by wrapping five (5) turns of wire around a 1-inch diameter or larger pipe and then withdrawing the pipe.

D. Service wiring in connection with drawings and local codes for low voltage service. In-ground wire connections shall be waterproofed splice kits. Splices shall be made in valve boxes (wire runs requiring splices between valve locations shall be provided and installed in splice box-valve box shall be used). Splice locations shall be shown on the record drawings.

E. Provide a complete wiring diagram showing wire routing for the connections between the controller and valves. See section one for the inclusion of wiring diagram in operation and maintenance manuals.

F. Two-wire communication cable shall be installed along mainline path and indicated on the record drawings.

3.08 CONTROLLER INSTALLATION

A. Install controller on school mechanical room wall in specified location, per detail. Wire communication cable into controller and set proper programs.

B. Install minimum one (1), 1-1/2-inch PVC conduit as required for communication wiring. Install minimum one (1), 1-1/2-inch PVC conduit for #6 bare copper wire. Install minimum one (1), 1-inch conduit for 120-volt power cable. Install minimum one (1), 1/2-inch conduit for rain/weather sensor wiring.

C. Wire controller to electrical supply furnished and installed to the controller location.

D. Keys shall be turned over to Owner's Representative.

E. Ground controller per electrical codes and specifications.

3.09 FLOW SENSOR INSTALLATION

A. Flow sensor shall be installed in mainline pipe where indicated on the drawings in standard 12-inch rectangular valve box downstream of the master valve. Wire flow meter to controller two-wire path with decoder per manufacturers requirements. (See plan and details.)

3.10 MASTER VALVE INSTALLATION

A. Master valve shall be installed in a 12-inch rectangular valve box on the exterior PVC mainline pipe where indicated on the drawings downstream of the quick coupler and isolation valve. See plan and details.)

3.11 GROUNDING INSTALLATION

A. Grounding rods shall be driven into the ground their full length 8-foot from surge arrestors and connected via exothermic connections to #10 solid, bare copper wire. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 8 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire. The top of the ground rods shall be driven below the ground surface. A 4-inch grated cover as specified, set a minimum of 1-inch below grade, shall be placed over the ground rods and exothermic connection for periodic maintenance. Covers shall be installed on a minimum of 6 inches of 4-inch corrugated polyethylene, perforated drainage pipe. Plates shall be installed 36 inches below grade with 25 lbs. of ground enhancement material spread evenly below the plate and 25 lbs. of ground enhancement material spread evenly above the plate in accordance with the manufacturer's requirements. Plates shall also be covered with a 4-inch grated cover as specified, set a minimum of 1-inch below grade, to facilitate drainage onto the plates. Covers shall be installed on a minimum of 36 inches of corrugated polyethylene, perforated drainage pipe.

B. When tested, grounding grid shall have an earth resistance no greater than 10 ohms. If earth resistance is greater than 10 ohms, additional grounding rods and/or plates and enhancement material shall be added to system until desired test results have been meet.

3.12 RAIN/WEATHER SENSOR INSTALLATION

A. Install rain/weather sensor on school roof eave.

B. Install rain/weather sensor wiring within 1/2-inch conduit where exposed. Above ground wires shall be installed in conduits.

3.13 SPRINKLER INSTALLATION

A. ½ and ¾ inch sprinklers shall be installed flush (perpendicular) to grade on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

B. Sprinklers shall not exceed maximum spacing indicated

C. Adjust sprinkler zone after installation using flow control device on valve.

3.14 QUICK COUPLING VALVE INSTALLATION

A. Provide and install quick coupling valves where indicated on the drawings.

B. Quick coupling valves to be mounted on 1-inch prefabricated PVC unitized swing joint assemblies with integral O-rings, minimum length 12 inches with brass insert and stabilizer as per details.

3.15 CHECK/TEST/START-UP/ADJUST

A. Flushing:

1. After pipe, valves, sprinkler bodies, pipes and risers are in place and connected, but prior to installation of sprinkler internals, open the control valves and flush out the system under a full head of water.

2. Sprinkler internals, and riser nozzles shall be installed only after flushing of the system has been accomplished to the full satisfaction of the Owner's Representative.

3. Flush the entire system after installation is complete and service any clogged equipment for thirty (30) days after substantial completion of the irrigation system.

B. Testing:

1. Leakage test: test lines for leaks under operating pressure. Repair leaks and re-test.

2. Coverage test: perform a coverage test in the presence of the Owner's Representative (notify Owner's Representative at least seven (7) days in advance of scheduled coverage test). Representative will determine if the water coverage is complete and adequate. Readjust sprinklers and sprinkler locations as necessary or directed to achieve proper coverage.

3. Testing shall be at no additional expense to the Owner.

3.16 CLEANING AND ADJUSTING

A. At the completion of the work, parts of the installation shall be thoroughly cleaned. Equipment, pipe, valves and fittings shall be cleaned of grease, metal cuttings and sludge which may have accumulated by the operation of the system for testing.

B. Adjust sprinklers, valve boxes and quick coupling valves to grade as required, so that they will not be damaged by maintenance operations.

C. Continue sprinkler coverage adjustment as required by settlement, etc., throughout the guarantee period.

D. Each control zone shall be operated for a minimum of 5 minutes and sprinklers checked for consistency of delivering water. Adjustments shall be made to sprinklers that are not consistent to the point that they match the manufacturer's standards. Sprinklers, valves, timing devices or other mechanical or electrical components, which fail to meet these standards, shall be rejected, replaced and tested until they meet the manufacturer's standards.

3.17 ACCEPTANCE AND OPERATION BY OWNER

A. Upon completion of the work and acceptance by the Owner, train the Owner's Personnel in the operation of the system (provide minimum 7-day written notice in advance of test). Furnish, in addition to the record drawings and operational manuals, copies of available specification sheets and catalog sheets to the Owner's personnel responsible for the operation of the irrigation system. Guarantee parts and labor for a minimum period of one (1) year from date of acceptance.

3.18 CLEAN UP

A. Upon completion of installation work remove leftover materials and equipment from the site in a safe and legal manner.

B. Remove debris resulting from work of this section.

C. Regrade, lightly compact, and replant around sprinklers where necessary to maintain proper vertical positioning in relation to established grade.

D. Fill depressions and eroded channels with sufficient soil mix to adjust grade to ensure proper drainage. Compact lightly, and replant filled areas in accord with drawings requirements.

END OF SECTION

SECTION 329000

PLANTING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Provide all labor, materials, equipment, services and transportation required to complete planting work as shown on the Drawings and as specified herein or both.

1.03 RELATED WORK

A. The following Related Work to be performed under the designated Sections:

1. Earthwork - Section 312000
2. Landscape Maintenance - Section 310125
3. Finish Grading - Section 312219
4. Irrigation System – Section 328400
5. Soil Preparation - Section 329113
6. Landscape Subdrainage – Section 334610

1.04 REFERENCES

A. "American Standard for Nursery Stock", 1986 Edition, American Association of Nurserymen, Inc.

1. The Contractor shall have a copy of this with him for all nursery visits and on site at all times.

B. "Hortus III", 1976 Edition, Bailey Hortorium, Cornell University.

C. "Arboriculture", Harris, R.W., Prentice Hall, Inc., New Jersey, 2004.

D. Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

E. Massachusetts Pesticide Control Act (MPCA, Chapter 132B of the Massachusetts General Laws). Chapter 333 of the Code of Massachusetts Regulations (333 CMR).

F. ASA: American Society of Agronomy.

G. Recommended Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeastern Regional Publication No. 493.

H. American Society for Material Testing (ASTM

1.05 DEFINITIONS

A. Subgrade: Soil materials levels resulting from the approved rough grading work.

B. Existing Subsoil: Soils that exist on the site below the existing topsoil in the lawns and planting areas.

C. Amended Lawn and Plant Topsoil: Approved Mix of Base Loam, Coarse Sand and Compost as required by the soil test reports. Refer the Soil Preparation 329113.

1.06 SUBMITTALS

A. Submit the following in accordance with the provisions of Section 013300 – Submittals.

B. Plant Materials Review

1. Plant List: Submit a complete list of all plant materials from the Contract Documents plant list including:

a. Botanical name and common name.

b. Size and quantity.

c. Location of growing grounds or nursery.

d. Name of the nursery, phone number, address, and contact person.

e. Quantity of trees that are available to select from. The reviewer will need to review a larger quantity of trees to select the required quantity for the project.

2. Photographic Submittal:

a. Submit color photographic prints of each plant proposed. A scale element or person of a known height shall appear in each photograph.

1) Each photograph shall include the botanical name, common name and caliper inches for trees and height, spread and container size for shrubs, grasses, groundcovers, vines and perennials.

3. Substitutions: If substitutions need to be considered the Contractor should supply the following information:

a. The names, contact person and phone number from a minimum of (5) nurseries contacted to secure the plant(s).

1) The search should not be limited to Massachusetts.

b. Submit the following for plant substitutions:

1) Botanical name and common name of the plant that is unable to be located: Description of the plant habit, mature height and spread. Salt tolerance, sun/shade tolerance and wet/moist soil tolerance.

2) Botanical name and common name of the plant proposed for substitution: Description of the plant habit, mature height and spread. Salt tolerance, sun/shade tolerance and wet/moist soil tolerance.

a) Botanical name and common name.

b) Size and quantity.

c) Location of growing grounds or nursery.

d) Name of the nursery, phone number, address, and contact person.

3) Photographic submittal. Refer to 1.06 Submittals.

4. Field Collected Plant Material: If some plant materials are only available from non-nursery sources, the Landscape Architect will consider whether these plants can be used in the work. The Contractor shall submit written data, the same as for Unavailable Material, listing all nurseries and sources contacted.

a. All conditions specified under Substitutions shall apply.

b. If the Landscape Architect elects to consider these plants, all requirements for nursery grown plants shall apply.

5. The Landscape Architect, based upon the review of the plant photograph submission(s), will determine if the plants are acceptable for field review at the nursery.

a. The Landscape Architect reserves the right to provisionally accept the plant material from the photograph without inspection at the nursery.

1) If these provisionally accepted plants do not meet the requirements of this specification, in the opinion of the Landscape Architect, when the plants are reviewed on site prior to planting, the Contractor shall remove them from the site at no additional cost to the Owner and immediately find replacement plants which meet the requirements of the Specifications. The Contractor shall then arrange for plant review as specified.

b. The Landscape Architect may field review and tag all acceptable proposed plant materials at the nursery. Such approval shall not limit the Landscape Architect's right of inspection and rejection of any plants at any time during the progress of the work which do not meet the requirements of the Specifications.

6. Nursery Inspection: The Contractor shall accompany the Landscape Architect to all reviews of plant materials at the nursery. The Landscape Architect may review and tag plants at place of growth and upon delivery to the site for conformity to the Specifications.

   a. The Landscape Architect's acceptance of the plants at this time shall not limit the right of inspection and rejection of any plants at any time during the progress of the work which do not meet the requirements of the Specifications.

   b. The Contractor shall have a copy(s) of the approved Plant List at the Nursery to give to each Nursery from which plant material is purchased.

   c. If the plant material at the nursery(s) in found to be unacceptable in the opinion of the Landscape Architect, the Contractor shall at their expense find the required plants, submit the required plants list and photographs and arrange for the Landscape Architect’s review of the plant material.

      1) This sequence of plant finding, review and approval or rejection and review for approval shall continue until all plants have been accepted by the Landscape Architect.

   d. The Contractor shall be solely responsible for the purchase of the accepted plant materials from the supplier or nursery.

7. Special Conditions: The above provisions shall not relieve Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

C. Product Data: Manufacturer's current catalog cuts and specifications of the following:

1. Mulch
2. Top dress fertilizer
3. Fertilizer tablets.
4. Anti-desiccant.
5. Protective coverings.

D. Tree Staking: Provide Tree Staking if the contractor or Landscape Architect determines that tree staking is necessary to maintain any of the trees straight and plumb.

1. Submit tree staking details and materials for review and approval.

E. Samples

1. Mulch: (One) pint.

F. Certificates

1. Written Certification from the Grower and Contractor that the plants are true to species and variety.

G. Tests

1. Plant Pit Percolation Tests: Refer to 3.02 Plant Percolation Testing of these specifications.

1.07 PLANT DIGGING AT THE NURSERY

A. All overburden soil, if any is present, shall be removed from all tree and shrub rootballs prior to digging.

1. The depth of this overburden soil shall be determined by excavating down at the plants trunk(s) until the root flare is exposed.

a. The root crown (flare) is the point at which the roots begin to flare out from each plants trunk(s)

b. The Contractor shall not accept any plants for shipping which have not had all overburden soil removed and root balls of the incorrect sizes.

c. The Landscape Architect will reject any plants which have overburden soil unremoved and rootball(s) of incorrect sizes.

d. The rejected plants shall be immediately replaced by the Contractor with matching specified plants at no additional cost to the Owner.

B. Field Dug Stock:

1. Dig B&B plants with firm, natural balls of earth of diameter not less than that recommended by the American Standard for Nursery Stock, and of sufficient depth to include the fibrous and feeding roots. Wrap and tie as required to prevent all cracking or loss of soil from routable.

C. The Contractor shall inspect all plants at the Nursery after digging and prior to shipping and shall determine that they meet all the requirements of these Specifications and reject any that do not.

1.08 DELIVERY, STORAGE, AND HANDLING OF PLANT MATERIALS

A. Delivery: Deliver, store and handle materials to the site in such a way that they will not be damaged. Do not deliver to the site disease-infected plant materials.

B. Labeling: Provide legible waterproof labels for all plants and attach them at the nursery. The labels shall have the correct genus and species and Common Name and the name of the grower or nursery form, which it was purchased.

C. Certificates of Inspection: As required by law for transportation of each shipment of plants along with invoice.

D. Storage: Protect all plants from sun during summer months with temperatures above 75 degrees F. Keep plants that cannot be planted immediately upon delivery in the shade, well protected and well-watered.

E. Handling

1. Do not lift or handle plants by tops, stems or trunk at any time. Do not pull or bend or handle plants with wire (except wrapped rootball of field dug plants).
2. Lift plants by supporting rootball bottom or container bottom.
3. Do not throw or drop any plants from trucks or other equipment.
4. Any damaged plants including plants with broken balls or cracked containers shall be rejected and immediately replaced with matching plants.

F. Anti-Desiccant: At Contractor's option, and immediately before transporting, spray deciduous plant materials in full leaf or evergreens with anti-desiccant. Apply an adequate film over trunks, branches, twigs and foliage.

1.09 SEQUENCING AND SCHEDULING

A. Acceptance: Do not install plant materials prior to acceptance of finish grades.

B. Coordination: Coordinate with work of other sections to insure the following sequence of events:

1. Pruning: Do not prune plant materials until after installation. Refer to Section 310125 - Landscape Maintenance for time of pruning, pruning requirements, and review at the time of pruning by the Landscape Architect.

C. Planting Seasons: All plant material shall be planted during the Spring or Fall planting season as indicated below. No planting shall be performed in frozen ground or when snow covers the ground. The Landscape Architect may suspend work when soil or weather conditions are unsuitable for planting operations.

1. Balled and Burlapped and Container Material - Deciduous and Evergreen (Except Pines):

   Spring: March 1 to June 15

   Fall: September 1 to November 15

2. Pines (Pinus Species):

   Spring: April 1 to May 15

   Fall: August 1 to October 15

3. If special conditions exist which may warrant a variance in the above conditions or dates, a written request shall be submitted to the Landscape Architect stating the conditions and proposed variance. Permission for the variance shall be given if in the opinion of the Landscape Architect if the variance is warranted.

1.10 INSPECTION

A. The Landscape Architect reserves the right to inspect the plants upon delivery to the site and reject any shipment if it does not meet the Landscape Architect's expectations.

1.11 SEQUENCE OF REVIEW, MAINTENANCE AND ACCEPTANCE

A. The Preliminary Review, 90 Day Maintenance Period, 90 Day Maintenance Period Suspension and Acceptance of the 90 Day Maintenance Period shall correspond and track simultaneously with the Lawns and Grasses.

B. Preliminary Review: Refer to 310125 Landscape Maintenance.

C. 90 Day Maintenance Period: Refer to 310125 Landscape Maintenance to begin the 90 Day Maintenance Period.

D. 90 Day Maintenance Period Suspension: Refer to 310125 Landscape Maintenance for suspension and extension into the following year during the months of December through the end of March.

E. The Time Period: Warrant that Plants shall be in a healthy and flourishing condition of active growth until acceptance by the Landscape Architect of the 90 Day Maintenance Period.

   1. Refer to Section 310125 Landscape Maintenance for plant maintenance requirements until and during the 90 Day Maintenance Period.

F. Exceptions: Contractor shall not be held responsible for failures due to damage by Owner, vandalism, or Acts of God during Warranty Period. Report such conditions in writing.

1.12 MAINTENANCE AND PROTECTION OF PLANTS UNTIL THEIR ACCEPTANCE AT THE PRELIMINARY REVIEW

A. Maintenance shall begin immediately after the installation of each plant.

1. Refer to Section 310125 Landscape Maintenance for requirements.

1.13 90 DAY MAINTENANCE PERIOD AND FINAL ACCEPTANCE

A. Refer to Section 310125 Landscape Maintenance for these requirements.

1.14 WARRANTY

A. Warrant that all plants (except annuals) planted under this Contract shall be healthy and in flourishing condition of active growth (one) year after the date of Acceptance of the 90 Day Maintenance.

B. Correct Species: Warrant that all plant materials are true to species and variety.

C. Delays: Delays caused by the Contractor in completing planting operations which extend the planting into more than one planting season shall extend the Warranty Period correspondingly.

D. Condition of Plants: Plants shall be free of dead or dying branches and branch tips, with foliage of normal density, size and color.

E. Replacements: As soon as weather conditions permit, replace, without cost to Owner all dead plants and all plants not in a vigorous, thriving condition, as determined by Landscape Architect during and at the end of Warranty Period.

F. Replacement Plants shall be the same genus, species, size and quality as the approved plants.

G. Exclusions: Contractor shall not be held responsible for failures due to neglect by Owner, vandalism, and acts of God, during Warranty Period. Report such conditions in writing to the Landscape Architect.

1.15 REPLACEMENTS

A. Failed Materials

1. Replace at no cost to the Owner all plant materials exhibiting conditions which are determined as unacceptable by the landscape architect.
2. Replacements shall be the same species. Apply all requirements of this Specification and drawings to replacements.
3. Contractor shall be held responsible for a maximum of (one) replacement for each failed tree, shrub and vine, and same area of groundcover planting after final acceptance during warranty period.

B. Incorrect Materials

1. During Warranty Period, replace at no cost to Owner plants revealed as being untrue to name and species.

2. Provide replacements of a size and quality to match the planted materials at the time the mistake is discovered.

1.16 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.17 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architect's designated representative.

PART 2 PRODUCTS

2.01 MATERIALS

A. Plant Materials

1. Verify that all container stock (excluding annuals) has been grown in the containers in which delivered for at least one growing season, but not over (two) years.
2. Growing Conditions: Plants shall be nursery-grown in accordance with good horticultural practices under climatic conditions similar to those of project for at least two years unless otherwise specifically authorized.
3. Appearance: Trees and shrubs shall be exceptionally heavy, symmetrical (as applicable to the species), tightly knit, and so trained or favored in development and appearance as to be superior in form for their species, with regard to number of branches, compactness and symmetry and other applicable standards specified in the American Standard for Nursery Stock for the species and size of plants in the Contract.
4. Vigor: Plants shall be sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall be free of disease, insect pests, eggs, or larvae. They shall have healthy, well-developed root systems.

B. Condition of Root System: Samples must prove to be completely free of circling, kinked or girdling trunk surface and center roots and as applicable show no evidence of a pot-bound condition.

C. Root Flare Exposure: Refer to 1.07 Plant Digging at the Nursery of these specifications.

D. Measurements

1. Refer to the American Standards for Nursery Stock for applicable standards not specified herein.
2. General: Take caliper measurement at a point on the trunk 6 in. above natural ground line for trees up to (4) inches in caliper (and at a point (12) inches above the natural ground line for trees over (4) inches in caliper.)
    a. Measure foliage across mean foliage dimension when branches are in their normal upright position. Foliage origin along main trunk shall be measured from soil line.
    b. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Properly trimmed plants shall measure the same in any direction. If a plant is unevenly grown, it shall be classified in the size category of the smallest dimension.

3. Size Range: If a range of size is given, do not use plant materials less than the minimum size. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required. Plants that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected.

4. Substitutions

   a. Refer to SUBMITTALS of this Section - 329000 Planting, for Substitution requirements.

E. Unacceptable Trees: Trees having such items, as but not limited to, the following will be rejected:

1. Nonconformance to the specifications.
2. Non-Exposure of the Root Flare.
3. Damaged or crooked leaders or other damage.
4. Main leader headed back.
5. Abrasions of the bark, sunscalds, disfiguring knots, or fresh cuts of limbs over (3/4) inch diameter which have not completely callused.
6. Plant disease, nutrient or other stress.

F. Pruning: Do not prune plants until after installation. See Section 310125 - Landscape Maintenance for time of pruning, pruning requirements, and review at the time of pruning by the Landscape Architect.

G. Refer to Item 1.07 PLANT DIGGING AT THE NURSERY of this Section - 329000 Planting for other applicable plant material requirements.

2.02 PLANTING SOIL BACKFILL MIX

A. Amended Lawn and Plant Topsoil: See Section 329113 - Soil Preparation.

2.03 ACCESSORIES

A. Pine Bark Mulch

1. Pine bark mulch shall be derived from evergreen tree bark aged a minimum of (6) months and no more than (18) months. The bark shall be shredded so that the resulting pieces are no more than (1/4) inch thick and no longer than (3) inches. The mulch shall be free of stringy materials and shall not contain an excess of fine particles. The mulch shall be dark brown in color, free of leaves, twigs, sod, weeds, shavings, and other foreign materials which are injurious to healthy plant growth.

B. Water

1. Clean, fresh and potable.
2. Transport as required.

C. Anti-Desiccant: (Used for retarding excessive loss of plant moisture and inhibiting wilt)

1. Type: Sprayable, water-soluble vinyl-vinyledine complex which produces a moisture-retarding barrier not removable by rain or snow.
2. Products

a. Transfilm by P.B.I./Gordon Corporation, gordansprofessional.com.

b. Wilt-Pruf by Wilt-Pruf Products, Inc., Wiltpruf.com.

c. Leafshield Anti-Transparent by Aquatrols, aquatrols.com

D. Commercial Fertilizer Tablets

1. Type: Slow release fertilizer tablets.
2. Products:

a. Agriform 21 gram tablets, 20-10-5 (N-P-K) by Scotts, scotts.com.

b. AgSafe 21 gram tablets, 20-10-5 (N-P-K) by AgriTab Corporation, agritab.com.

2.04 PROTECTIVE COVERINGS

A. Product: Refer to Section 312500 – Erosion and Sedimentation Control.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions

1. Finish Grades: Finish grades for planting areas shall have been established in another Section. Verify that all grades are within (1) inch plus or minus of required finish grade.
2. Soil Preparation: Do not commence planting work prior to completion and acceptance of subgrade scarification and soil preparation. See Section 329113 Soil Preparation.
3. Irrigation System: Do not commence planting work prior to completion and acceptance of the Irrigation System. See Section 328400.

3.02 PLANT PERCOLATION TESTING

A. Plant pit percolation testing is to be completed before the plants are laid out.

B. Number of Percolation Tests: Minimum of (10) tests in locations determined by the Landscape Architect.

C. Testing Procedure

1. Restrictions: Do not perform tests of a rainy day (or during freezing weather) of when the ground is frozen or the soil is saturated with water.
2. Dig test pit the size specified for each tree pit. Legibly calibrate a stake at (1) inch intervals into the bottom of the pit.
3. Fill the test pit with water to within (1) foot of the finish grade. Immediately record the water level on the stake.
4. After (3) hours, record the water level again. Repeat recording of the water level once each hour for the succeeding (5) hours.
5. Water level drop ratings:
   a. Acceptable rate = (2) inches /hour or more
   b. Marginal rate = (1 to 2) inches/ hour
   c. Unacceptable rate = Less than (1) inch / hour
6. Test all plant pits twice in succession.
7. Written test results
   a. Submit a Plant Pit Percolation Test Submittal, with dates recorded that includes a key plan of the test locations that lists the water levels for each test pit recorded as required above. Indicate which pits are Acceptable, Marginal or Unacceptable.

b. Indicate which, if any, test pits contain water after a (24) hour period.

D. Unacceptable Rate Options:

1. Relocate the plants to an area of marginal to acceptable percolation rates on the project site as directed by the Landscape Architect at no cost.

2. Deliver the plants to a location in the town at no cost to the Owner. The town staff will be responsible for the care and planting of the plants. There will be no warranty for these plants.

3. If it is determined that the plants should remain in the location as shown on the plan the Landscape Architect will prepare underdrainage plans and details for pricing by the contractor. The contractor shall prepare an estimate for the underdrainage work for consideration of approval by the Owner.

3.03 PLANT LAYOUT

A. Tree Layout: Lay out trees at locations shown on Drawings. Use (4) foot wood grade stakes with the common name or abbreviation labeled on each stake. Pound stakes into the ground with a hammer.

B. Plant Bed Layout: Layout all plants to the spacing indicated on the plant list in the plant beds where shown on the drawings.

3.04 REVIEW OF TREE AND PLANT BED LAYOUT

A. Locations of the Contractor's stakes and plant bed layout will be checked in the field by the Landscape Architect with the Contractor and will be adjusted by with the Contractor to the Landscape Architects satisfaction.

3.05 PLANT BED AND TREE PIT PREPARATION

A. Refer to the drawings for the planting details

B. Prepare the plant pits to the width and depth indicated in the specifications.

C. Digging Plant Pits: Dig tree pits and scarify all sides of the tree pit after excavation - see drawings and below. Do not use an auger or tree spade.

1. Scarify the sides of the plant pit, thoroughly breaking up the surface and to eliminate ‘glazed’ and compacted soil.

D. Containerized Plant Pits: Excavate round plant pits as follows unless shown otherwise on the Drawings:

	Width	Depth
Canned Shrubs	Can + (12) inches	Can

E. Ball and Burlap Plant Pits: Excavate round plant pits as follows unless shown otherwise on the Drawings:

	Width	Depth
Trees	Ball + (24) inches	Ball
Shrubs	Ball + (12) inches	Ball

F. Confirm the depth of the plant pit and add plant backfill mix to the bottom of the plant pit. Foot or hand tamp to compact the backfill to the required elevation.

3.06 OBSTRUCTIONS IN PLANT PIT(S) OR PLANTING BED(S)

A. Obstructions: If rock, underground construction work, main tree roots or other obstructions are encountered in the excavation of the plant pits which may not be able to be removed or are the work of others, the Contractor shall stop digging that pit or bed and immediately contact the Landscape Architect with a full written explanation of the nature of the obstruction.

1. The Landscape Architect will determine if the object(s) encountered are such that they can be removed.

a. If the Landscape Architect determines that the object(s) could be removed, the Contractor shall submit a proposal for the Landscape Architects and the Owner's review and consideration for approval for the cost of the object(s) removal prior to doing any work.

b. If the Landscape Architect determines an Alternative location for the plants, the Contractor shall submit the costs for the plant pit or plant bed work necessary to be done in the Alternative location for consideration for approval by the Landscape Architect and Owner.

c. If the object cannot be removed or the plants cannot be moved to an Alternate location the contractor shall deliver the plants to a location in the town at no additional cost. The Town will be responsible for the care and planting of the plants. There will be no warranty for these plants.

3.07 PLANT HANDLING

A. Balled and Burlapped Plants: Lift and carry by bottom of the root ball. Do not remove wrapping until plant is set in plant pit. Cut all wire and peel wire and wrapping away from upper (1/3) of rootball prior to backfilling.

1. Plastic or otherwise indecomposable burlap or other undecompostable root ball covering materials shall not be used.

B. Container and Potted Plants: Tip container to horizontal orientation and shake carefully to remove the root mass and the plant. Lightly hand scarify the sides and bottom of the root mass. Support rootball and the root mass during installation to prevent cracking or shedding of soil.

3.08 PLANT INSTALLATION AND BACKFILL

A. Refer to the Construction Drawings and Details for the plant installation requirements.

B. Overburden of soil on the root crown (flare) is to be removed before the plants are dug at the nursery. If the root flare is not exposed the contractor is to remove the soil overburden to expose the root flare. If there is more than (2) inches of soil that needs to be removed from the top of the rootball to expose the root flare the Landscape Architect can direct the contractor to remove and replace the plant at no cost to the owner.

C. Handling and De-potting of Plant Materials

1. Damage: Avoid damage to containerized root masses and rootballs. If rootball or containerized root mass is cracked or broken or the trunk loose in the ball or container during handling and de-potting, plant will be rejected. Do not remove plant from container prior to completion of plant pit preparation.

2. Containerized Plants

a. Canned Shrubs: Metal Containers: Cut can on two sides with accepted cutting tool. Do not use a spade.

b. Plastic Containers: Tip container to horizontal orientation and shake carefully to remove the root mass and the plant. Support rootball and the root mass during installation to prevent cracking or shedding of soil.

3. Balled and Burlapped Plants: Lift and carry by bottom of the root ball or containerized root mass only. Do not remove wrapping until plant is set in plant pit. Cut all wire and peel wire and wrapping away from upper 1/3 of rootball prior to backfilling.

a. Plastic or otherwise indecomposable burlap or other undecompostable root ball covering materials shall not be used.

D. Installation

1. Refer to the Drawings for the planting details and locations for the plants.
2. Containerized Root Mass Scarification
    a. After removing plant and its containerized root mass from the container, scarify the sides of the rootball to a depth of 1 in. at four to six equally-spaced locations around the perimeter of the root mass or at (12) inch intervals on sides of boxed materials. Cut and remove circling roots over (3/8) inch diameter.
    b. Shrub and Vine Pit Depths: Confirm the depth of each shrub and vine pit by setting the root crown (1) inch above the finish grade as shown on the Drawings.
        1) If any pits are over excavated, add and foot or hand tamp compact backfill mix at the bottom of the pit or bed to correct the level of over excavation.
3. Plant Pit Side Scarification: Scarify sides of plant pit, thoroughly breaking up surfaces and eliminating "glazed" areas.
4. Plant Positioning: Position the plant in the planting bed and or pit as shown on the Drawings maintaining a plumb condition throughout all planting operations.
5. Plant Pit Depths
    a. Shrub, Grasses, Perennial and Vine Pit Depths: Confirm the depth of each shrub and vine pit by setting the root crown 1- inch above the finish grade as shown on the Drawings.
        1) If any pits are over excavated, add and foot or hand tamp compact backfill mix at the bottom of the pit or bed to correct the level of over excavation.
    b. Confirm the depth of each tree pit and if any are over excavated install the Tree Pit Leveling Mound. Backfilling with any other material to correct the excavation depth shall not be acceptable.
        1) Install the topsoil as the leveling mound as shown on the Drawings and Compact the fill to 85 % density.
6. Plant Positioning: Position as shown on the Drawings. Backfill plant pit to allow setting crown of tree (2) inches above new finish grade and crown of shrub 1 in. above finish grade. Maintain throughout all planting operations.
    a. Plant Pit or Bed Backfilling
        1) Use Amended Lawn and Plant Topsoil to backfill on-grade plant pits as shown on Drawings. Brace each plant plumb and rigidly in position until the backfill mix has been tamped solidly around the ball and roots.

a) Shrub pits that are underdrained shall have a compacted backfill mix layer installed over the entire shrub bed as shown on the Drawings.

2) When plant pits and plant beds have been backfilled approximately (2/3) full, water thoroughly and saturate rootball or containerized root mass, before installing remainder of the backfill mix to top of pit, eliminating all air pockets. The compaction method shall be the same as described above in the previous item.

a) The Contractor shall exercise particular care to be certain that no backfill mix is placed on top of the rootball or containerized root mass. Also see planting details for incorporation of items noted there.

b) Addition of Slow-Release Fertilizer Tablets: When the plant pits and beds are backfilled to 2/3's of their depth. Locate the number of tablets per plant as recommended below, unless stated otherwise by the approved tablet manufacturer, and place the number of tablets required adjacent to each plant's rootball or container root mass for the specified trees, shrubs, and vines as scheduled below:

Container Stock

(1) gallon can – (2) tablets

(5) gallon can – (4) tablets

B & B stock:

(1) tablet per (½) inch caliper or

(1) foot of height, whichever is less

3) Continue backfilling plant pits and beds to their full depth with backfill mix.

4) Watering Basin: Form a circular saucer around each tree, shrub, and vine of backfill mix as shown on the Drawings.

5) All Plants shall be plumb after the backfill mix has been installed.

E. Watering: Immediately water all plants after completion of planting operations.

3.09 PLANT PRUNING

A. See Section 310125 - Landscape Maintenance.

1. All pruning shall be done at the time of the Preliminary review unless otherwise requested by the Landscape Architect.

3.10 TREE STAKING

A. Trees shall be staked at no cost to the Owner if it is determined by the Contractor and Landscape Architect that staking is necessary to maintain the trees straight and plumb.

1. Refer to the approved submittal for materials and details.

B. Install a layer of mulch over all shrub and annual beds or areas and also all tree and shrub watering basins and beds to the depth(s) and where as shown on the Drawings.

3.11 PROTECTIVE COVERINGS

A. Install jute mesh as specified in Section 312500 – Erosion Control on slopes over 3:1.

3.12 MAINTENANCE AND PROTECTION OF NEW PLANTING, AND MATERIALS UNTIL ACCEPTANCE OF THE PRELIMINARY REVIEW

A. See Section 310125 - Landscape Maintenance.

1. This Maintenance shall begin immediately after each plant and or material is installed.

3.13 CLEANUP

A. After completion of all work, all debris, rubbish and surplus materials shall be removed from the site. The site shall be left clean to the satisfaction of the Landscape Architect.

END OF SECTION

SECTION 329113

SOIL PREPARATION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Section Includes: This Section specifies administrative and procedural requirements for planting soils shown on the Drawings and specified herein or both.

1.03 RELATED WORK

A. The following related work is to be performed under the designated Sections.

1. Subsurface Exploration – Section 023000
2. Site Preparation – Section 311000
3. Landscape Maintenance – Section 310125
4. Finish Grading – Section 312219
5. Earthwork – Section 312000
6. Erosion and Sedimentation Control – 312500
7. Bituminous Concrete Paving – Section 321800
8. Infield Surfacing – Section 321823
9. Site Concrete – Section 321313
10. Miscellaneous Site Improvements – Section 323000
11. Fencing – Section 323100
12. Planting – Section 329000
13. Lawns and Grasses – Section 329200
14. Storm Drainage – Section 334000

1.04 REFERENCES

A. Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

B. Massachusetts Pesticide Control Act (MPCA, Chapter 132B of the Massachusetts General Laws). Chapter 333 of the Code of Massachusetts Regulations (333 CMR).

C. ASA: American Society of Agronomy.

D. Recommended Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeastern Regional Publication No. 493.

1.05 DEFINITIONS

A. Agricultural Soil Scientist: Expert in agricultural soils that reviews test result and make recommendations for conformance to the specifications for Base Loam, Course Sand, Compost, Batching and Batch Mix Confirmation for the Amended Lawn and Planting Topsoil.

B. Subgrade: Soil material and levels resulting from the approved rough grading work.

1. Cultivation of all subgrade areas prior to placing amended topsoil is included in this section.

2. Subgrade soil(s): Subgrade soil shall be existing soil materials which are either undisturbed or have been placed resulting from the approved rough grading work and are located in lawn planting areas.

C. Existing Subsoil: Soils that exist on the site below the existing topsoil in the lawns and planting areas.

D. Existing On-Site Topsoil: Existing Topsoil/Stripped On Site Topsoil that was stripped from the site.

1. The amount of Existing On Site Topsoil is limited and can be used 'unamended' in Seed Mix #3 areas only. Refer the Amended Lawn and Planting Topsoil requirements for Seed Mix #3 areas outside of where the Existing On Site Topsoil is spread.

2. On-site topsoil shall be stripped and stockpiled on the Owner's property as part of the work of Section 31 20 00 – Earth Moving. Moving stockpiled topsoil to the site area shall be part of the work under this section. Existing topsoil shall be used to create Amended Lawn and Planting Soil.

a. Exceptions: On-site topsoil that has been stripped and stockpiled can be screened of all foreign debris larger than (½) inch and used 'as is' without amendments for areas of Seed Mix #3. Lime and fertilizer will need to be required as recommended by the testing laboratory.

E. Base Loam: Imported natural A-horizon topsoil free from admixtures, subsoil, sand, compost or other amendments that may be used to create soil blends for re-use after testing, submittals and acceptance by the Design Team.

F. Coarse Sand: Uniformly graded medium to coarse sand that meet the specifications. Concrete mason sand may meet the specification requirements.

G. Compost: Fully decomposed leaf and yard waste organic material that meets the specifications.

H. Amended Topsoil Mixes: Collective term for Amended Lawn/Grasses and Planting Topsoil Mix.

I. Amended Lawn/Grasses and Plant Topsoil: Imported Base Loam which has been amended with approved Coarse Sand and Compost as required by the soil test reports. The lawn and planting soils consisting of a blend of natural topsoil, coarse sand, and organic material. The quality of the blend depends on the quality of the original components. The Contractor is responsible for locating and obtaining approval of sources of natural topsoil, uniform sand, and organic material that meet the Specification requirements. The Contractor is then responsible for mixing the components.

1. Base Components

a. Base Loam is a natural growing medium free from admixtures of subsoil, compost or other amendments.

b. Coarse Sand is uniformly graded medium to coarse Uniform Sand. Concrete sand may meet Specification requirements.

c. Organic Material is fully decomposed organic material.

J. Batching: Mixing of Base Loam, Coarse Sand and Compost that meets the specifications as recommended by an approved agricultural Soil Scientist.

K. Batch Mix Confirmation: Conducted for each 500 cubic yards of soil material prepared for the project site as approved or adjusted by the agricultural Soil Scientist.

L. Soil Base Components: Accepted Base Loam, Coarse Sand and Compost.

M. Blended Soil Mixes: Accepted Base Loam, Coarse Sand and Compost.

N. Mock Up and Inspections.

O. References to Landscape Architect shall mean Architect or the Architect's designated representative.

1.06 SEQUENCE

A. Identification of sources for Imported Amended Topsoil, Imported Base Loam, Coarse Sand and Compost.

B. Sampling of Imported Base Loam, Coarse Sand, Compost, Amended Lawns/Grasses and Planting Topsoil.

C. Testing of Imported Base Loam, Coarse Sand, Compost, Amended Lawn/Grasses and Planting Topsoil for conformance to the specifications.

D. Batching recommendations for amending Imported Base Loam with Coarse Sand and Compost per cubic yard.

E. Preparation, sampling and testing of Batch Samples for conformance to the specifications.

F. Recommendations for adjustments the Amended Lawn/Grasses and Planting Topsoil as necessary.

G. Preparation, sampling and testing of additional samples of the Amended Lawn and Planting Topsoil for conformance to the specifications, as necessary.

H. Preparation of Amended Lawn/ Grasses and Planting Topsoil.

I. Testing of every 500 yards of Amended Lawn/Grasses and Planting Topsoil and recommended adjustment to the mix or other components that may need be added to the prepared Amended Lawn and Planting Topsoil for conformance to the specifications.

J. Scarification and recompression of the subgrade.

K. Plant percolation testing.

L. Installation and placement of soils.

M. De-compaction and re-compaction of soils.

N. Final in-place testing of soils.

O. Clean-up.

1.07 SUBMITTALS

A. Imported Base Loam, Course Sand, Compost and Amended Lawn/Grasses and Topsoil Chemical testing: Refer to Section 312000 – Earthwork, Part 2-Products, 2.01 Fill Materials for chemical testing.

B. Agricultural Soil Scientist: Resume of the Agricultural Soil Scientist with experience in Soil Base Components and Batching of the components to meet the specification for Amended Lawn and Planting Topsoil.

C. Sources for Soil Components and Soil Mixes: Submit information identifying sources for all soil components and the company responsible for mixing of Blended Soil Mixes.

D. Samples of individual components of soil base component materials, and blended soil mixes shall be submitted by the contractor for testing and analysis to the approved testing laboratory. The Landscape Architect, at any time, may request addition testing.

E. The Contractor is responsible for paying costs for all materials, delivery and testing of the samples.

F. Component Samples of Soil Base Components: Sampling to be completed by the contractor. A one gallon sample shall be a composite sample of the material consisting of (5) separate subsamples taken from (5) different locations at each source and mixed together to make the test sample.

G. All test reports must be recent, less than 90 days old and represent materials that are available for delivery to the site.

H. Mechanical gradation (sieve analysis) shall be performed and compared to the USDA Soil Classification System. Percent clay (0.002 mm) shall be reported separately in addition to silt and clay (ASTM D-422-63, hydrometer method).

I. The silt and clay content shall be determined by a Hydrometer Test of soil passing the #270 sieve.

J. Chemical analysis of amended topsoil shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, acidity (pH) and buffer pH. Recommendations for pH adjustments and fertilizer soil amendments shall be included with all test reports.

K. Tests shall be conducted in accordance with Recommended Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeastern Regional Publication No. 493; Agricultural Experiment Stations of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia. Tests include the following:

1. Test for soil Organic Matter by loss of weight on ignition, as described in Northeastern Regional Publication No. 493.
2. Test for soil CEC by exchangeable acidity method as described in Northeastern Regional Publication No. 493.
3. Test for soil Soluble Salts shall be by the 1:2 (v:v) soil: water Extract Method as described in Northeastern Regional Publication No. 493.
4. Test for Buffer pH by the SMP method as described in Northeastern Regional Publication No. 493.

L. Certified reports on analyses from producers of composted organic materials are required, particularly when sources are changed. Analyses will include all tests for criteria specified in this Section.

M. Testing Agencies: The following firms are acceptable testing agencies for the various components.

1. Leaf Yard Waste Compost Stability Test and Comprehensive Compost Testing: Woods End Research Laboratory, P.O. Box 297, Mt. Vernon, ME, 04352, tel: 201.293.2457, or alternate STA Certified Compost Testing Laboratory by the US Composting Council, www.compostcouncil.org.
2. Mechanical Gradation and Chemical Analysis, Sand and Loam Components and Soil Mixes: University of Massachusetts, West Experiment Station, Amherst, MA 01003, tel: 413.545.2311, fax: 413.545.1931.

N. Batching of Soil Components: Recommended mix of Base Loam, Course Sand and Compost to meet the specifications made by the agricultural Soil Scientists.

1. Recommendation for batching and review of test results to confirm that the Amended Lawn and Planting Soil batching meets the specifications. Soil Scientist shall recommend adjustments to the mix and review test results until a mix is developed that meets the specifications.

1.08 MOCK UP AND INSPECTIONS

A. At the beginning of landscape site work, the contractor shall demonstrate, in the presence of the Landscape Architect, subgrade preparations, including de-compaction and re-compaction methods that achieve the requirements of this Section. All subsequent subgrade preparations shall be in accordance with approved methods.

B. The Contractor shall not place Amended Lawn and Planting Topsoil on prepared subgrade prior to inspection and approval of Landscape Architect for compliance with depth and compaction. The Contractor shall request inspection before proceeding at least ten working days prior to placement of soils.

C. The Contractor shall not plant any lawn or plant material prior to inspection and approval of Landscape Architect for compliance with lawn and planting soil depth and compaction specifications.

1.09 QUALITY ASSURANCE

A. Delivery Storage and Handling

1. Refer to Earthwork for overall material handling requirements.
2. Material shall not be handled or hauled, placed or compacted when it is wet as after a heavy rainfall, early spring or if frozen. Soil shall be handled only when the moisture content is compliant with this Section.
3. Store and handle packaged materials in strict compliance with manufacturer's instructions and recommendations. Protect all materials from weather, damage, injury and theft.
4. Prohibit vehicular and pedestrian traffic on or around stockpiled planting soil, or any areas of prepared subgrade or placed planting soils.
5. Material that is to be stockpiled longer than two weeks, whether on or off site, shall not be placed in mounds greater than six feet high.

B. Soil Moisture Content

1. Contractor shall not move, blend or grade soil when moisture content is so great that free moisture is apparent, nor when it is so dry that dust will form in the air or that clods will not break readily, nor when frozen. Apply water, if necessary, or allow to dry to bring soil moisture between 60% of optimum moisture content and optimum moisture content as determined by ASTM D698 prior to compaction, grading or planting.

2. Field Soil Moisture Test

a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.

b. If the soil will not retain shape it is too dry and should not be worked.

c. If the soil retains shape and will not crumble, it is too wet and should not be worked.

d. If the soil glistens or free water is observed when the sample is patted in the palm of hand the soil is too wet and should not be worked.

1.10 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.11 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architect's designated representative.

PART 2 MATERIALS

2.01 MATERIALS

A. General

1. All soil mix material shall fulfill the requirements as specified and be tested to confirm the specified characteristics.
2. Samples of individual components of soil mixes in addition to blended soil mixes including mulch materials shall be submitted by the Contractor for testing and analysis to the approved testing laboratory. Comply with specific materials requirements specified.
    a. No base component material or soil components for soil mixes shall be used until certified test reports by an approved agricultural testing laboratory have been received and approved by the Landscape Architect.
    b. As necessary, make any and all soil mix amendments and resubmit test reports indicating amendments until approved. Imported Amended Topsoil: Topsoil imported to the site the meets the specification for Amended Lawn and Plant Topsoil.
3. The Landscape Architect may request additional testing by Contractor for confirmation of mix quality and/or soil mix amendments at any time until completion. Changes in mix ratios may be required at no additional cost to the Owner.

B. Soil Testing and Soils Testing Report Submittal

C. All testing of the soil mix components shall be carried out by the Soils Testing Laboratory. Recommendations for amending and/or correcting the soil mix will be provided to the Landscape Architect by the agricultural Soil Scientist.

1. Failure of any material by testing and/or amendment procedure to meet Specification requirements shall require the Contractor to seek another source for the failed material and the initiation of all testing procedures for the new replacement material shall immediately take place at no additional cost to the Owner.
2. The Contractor shall be responsible for recognizing that these critical project materials warrant timely and serious attention, that the testing process to achieve approved materials should be considered a lead time item, and that under no circumstance shall failure to comply with all specification requirements be an excuse for “staying on project construction schedule.”

D. Soil Samples: Contractor is responsible for paying costs for testing. Submit 1 gallon planting soil samples in two phases. Submit as phase one, planting soil base components for approval. Only after approval of phase one components, submit as phase two, soil blend mixes / mediums for approval. All reports must be from recent analyses, less than 90 days old, and represent materials that are available for delivery to the site.

1. Phase One Submittals of Lawns/Grasses and Planting Soil Base Components:
    a. Base Loam (Imported Topsoil)
    b. Organic Amendment Materials (Compost)
    c. Coarse Sand.
2. Phase Two Submittals of Planting Mediums: mixing and batching of soil mediums to be submitted in the same manner as bulk soils and will be prepared prior to delivery to site.
    a. Amended Lawn/Grasses and Planting Topsoil
3. Phase Three Submittals: shall be identical to Phase Two Submittals and be conducted for each 500 cubic yards of soil material prepared for the project site.
4. Submit reports for each of the above samples: Submit sample from each proposed source for testing and approval. Deliver samples to both the testing laboratory and the project and pay costs. Send report directly to Owner's Representative.
5. Soil Sample Submittals: Sampling shall be done by the Contractor. The size of the samples and method of sampling shall be as follows: Samples shall be representative of the material to be brought to the site. Each sample shall be a Composite Sample, which consists of 5 separate sub samples taken from a minimum of (5) different locations at each source and mixed together to make the test sample.
6. <u>The Contractor shall schedule this testing in order to permit reasonable time for testing, evaluation, and approvals prior to scheduled installation. Allow for a minimum of 6 weeks to perform testing and obtain approvals.</u>

E. Imported Topsoil/Base Loam: Imported Topsoil that has been determined by soils testing to meet the specifications as Base Loam.

F. Coarse Sand: Uniformly graded medium to coarse sand that meet the specifications. Concrete Mason Sand often meets Specification Requirements.

G. Compost: Leaf and yard waste organic material that meets the specifications.

H. Amended Lawn/Grasses and Planting Topsoil: Base Loam which has been blended with Coarse Sand and Compost to meet Specification Requirements.

1. Manufactured Amended Lawn and Planting Soil consisting of Base Loam, Coarse Sand and Compost that meet the specifications for Amended Lawn and Planting Soil.
2. Available from the following suppliers or approved equal:
    a. DH Loam, dhloam.com
    b. Read Custom Soils, readcustomsoils.com
    c. AgreSource Inc, agresourceinc.com
    d. New England Specialty Soils, nesoils.com

I. Imported Base Loam

1. Imported Base Loam, as required for blending with sand and compost, shall be a naturally occurring soil formed from geologic soil forming processes without admixtures of sand or organic matter sources (composts). Base Loam, which has been contaminated by incorporation of subsoil, shall not be acceptable for use. Base Loam as required for the work shall be free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots or other objectionable, extraneous matter or debris. Base Loam shall also be free of quack-grass rhizomes, Agropyron Repens, and the nut-like tubers of nutgrass, Cyperus Esculentus, and all other primary noxious weeds. Base Loam shall not be delivered or manufactured into soil blends while in a frozen or muddy condition. Base Loam for mixing shall conform to the following grain size distribution for material passing the #10 sieve:

	Percent Passing	
U.S. Sieve Size Number	Minimum	Maximum
10	---	100
18	85	100
35	70	95
60	50	85
140	36	53
270	32	42
0.002mm	3	6

2. The ratio of the particle size for 80% passing (D_{80}) to the particle size for 30% passing (D_{30}) shall be 8 or less ($D_{80}/D_{30} < 8$).

3. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.

4. The organic content shall be between 4.0 and 8.0 percent by weight.

5. pH shall be between 5.8 and 7.0.

6. Chemical analysis shall be undertaken for Soluble Salts, acidity (pH) and buffer pH.

J. Coarse Sand

1. Sand for Blended Soil Mixes shall be uniformly graded medium to coarse sand consisting of clean, inert, rounded to sub-angular grains of quartz or other durable rock free from loam or clay, mica, surface coatings and deleterious materials with the following grain size distribution for material passing the #10 sieve: Washed concrete sand often meets specification requirements.

U.S. Sieve Size Number	Percent Passing Minimum	Maximum
10	100	--
18	60	80
35	25	45
60	8	20
140	0	8
270	0	3
0.002mm	0	0.5

2. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.

3. The ratio of the particle size for 70% passing (D_{70}) to the particle size for 20% passing (D_{20}) shall be 3.0 or less ($D_{70}/D_{20} < 3.0$). Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422.

4. pH shall be less than 7.5.

K. Compost

1. Organic Matter for Blended Soil Mixes shall be a stable, humus-like material produced from the aerobic decomposition and curing of Leaf Yard Waste Compost, composted for a minimum of one year (12 months). The leaf yard waste compost shall be free of debris such as plastics, metal, concrete or other debris. The leaf yard waste compost shall be free of stones larger than 1/2", larger branches and roots. Wood chips over 1" in length or diameter shall be removed by screening. The compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management practices in conjunction with addition of fertilizer and other amendments as applicable, with no visible free water or dust, with no unpleasant odor, and meeting the following criteria as reported by laboratory tests.

   a. The ratio of carbon to nitrogen shall be in the range of 12:1 to 25:1.

   b. Stability shall be assessed by the Solvita procedure. Protocols are specified by the Solvita manual (version 4.0). The compost must achieve a maturity index of 6 or more as measured by the Solvita scale. Stability tests shall be conducted by Woods End Research Laboratory, Mt. Vernon, Maine.

   c. Organic Content shall be at least 20 percent (dry weight). Organic content shall be determined by weight loss on ignition for particles passing a number 10 sieve.

   d. One hundred percent of the material shall pass a 1/2-inch (or smaller) screen. Debris such as metal, glass, plastic, wood (other than residual chips), asphalt or masonry shall not be visible and shall not exceed one percent dry weight

   e. pH: The pH shall be between 6.5 to 7.4 as determined from a 1:1 soil-distilled water suspension.

f. Salinity: Electrical conductivity of a one to five soil to water ratio extract shall not exceed 2.5 mmhos/cm (dS/m).

g. The compost shall be screened to 1/2-inch maximum particle size and shall contain not more that 3 percent material finer than 0.002mm as determined by hydrometer test on ashed material.

h. Nutrient content shall be determined by the Soil Testing Laboratory and utilized to evaluate soil-required amendments for the mixed soils. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Iron, Manganese, Lead, Soluble Salts, Cation Exchange Capacity, soil reaction (pH), and buffer pH.

L. Amended Lawn/Grasses and Plant Topsoil Mix

1. Amended Lawn/Grasses and Planting Topsoil will be a mix of Base, Coarse Sand and Compost.

2. The mix ratio of Base Loam, Coarse Sand and Compost will be determined by the Soil Testing Laboratory or alternate consultant to meet the specifications after the components have been tested. Percentages of components are approximate and will be modified upon completion of the test results for components of the recommended mix(s). Mix ratios may require adjustments and re-submittal at the expense of the contractor until a final blend is approved.

3. All existing vegetation shall be removed from stockpiles prior to blending. Uniformly mix ingredients by windrowing/tilling on an approved hard surface area or by alternately processing materials through a screening plant. All soil components and Organic Amendment shall be maintained moist, not wet, during mixing. Amendments shall not be added unless approved to extent and quantity by the owner and additional tests have been conducted to verify type and quantity of amendment is acceptable.

4. Amended Lawn/Grasses and Plant Topsoil

a. Amended Lawn/Grasses and Planting Soil shall consist of a combination Imported Base Loam blended with Coarse Sand and Organic Amendment/Compost. Final mix ratios to be provided after Phase 1 Submittals of Base Components as provided in this Section. The following gradation for material passing a Number 10 Sieve shall be achieved in the final mix.

U.S. Sieve Size No.	Percent Passing Minimum	Maximum
10	100	
18	85	95
35	60	85
60	42	65
140	21	44
270	18	24
.002	2	4

b. Maximum size shall be one half-inch largest dimension. The maximum retained on the #10 sieve shall be 10% by weight of the total sample.

c. The ratio of the particle size for 80% passing (D_{80}) to the particle size for 30% passing (D_{30}) shall be 6 or less ($D_{80}/D_{30} < 6$).

d. The final mix shall have an organic content between 5 and 7 percent by weight.

e. The final mix shall have a hydraulic conductivity of not less than 1.5 inches per hour according to test procedure ASTM D5856-95 (2000) hour when compacted to a minimum of 86 percent Standard Proctor ASTM D 698. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.

f. Chemical analysis shall be undertaken for Phosphorus, Potassium, Calcium Magnesium, Aluminum, Copper, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts,

g. acidity (pH) and buffer pH.

2.02 EXISTING TOPSOIL/BASE LOAM FOR SEED MIX #3

A. All vegetation shall be removed from stockpiles prior to blending.

B. On-site topsoil that has been stripped and stockpiled can be screened of all foreign debris larger than (½) inch and used ‘as is’ without amendments for areas of Seed Mix #1.

C. Provide analysis to determine lime and fertilizer to be applied for Seed Mix #3 as determined by the testing laboratory.

1. Provide analysis to determine lime and fertilizer to be applied for Seed Mix #1 as determined by the testing laboratory.

2. Chemical analysis shall be undertaken for Phosphorus, Potassium, Calcium Magnesium, Aluminum, Copper, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, acidity (pH) and buffer pH.

2.03 CHEMICAL COMPONENTS: The following additives shall be used as applicable depending on the recommendations of the soils testing report(s).

A. Standard commercial pre-mixed and balanced pre-plant or lawn fertilizers which meet the recommendations of the Soils Testing Report(s).

B. Ground Limestone: Agricultural limestone containing not less than 85% of total carbonates, ground to such fineness that 50% will pass #100 sieve and 90% will pass #20 sieve.

C. Dolomite Lime: Agricultural grade mineral soil conditioner containing 35% minimum magnesium carbonate and 49% minimum calcium carbonate, 100% passing #65 sieve. "Kaiser Dolomite 65 AG" by Kaiser, Inc. or accepted equal.

D. Gypsum: Agricultural grade product containing 80% minimum calcium sulfate.

E. Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20% to 30% iron and 35% to 40% sulfur.

F. Sulfate of Potash: Agricultural grade containing 50% to 53% of water-soluble potash.

G. Single Superphosfate: Commercial product containing 20% to 25% available phosphoric acid.

H. Ammonium Sulfate: Commercial product containing approximately 21% ammonia.

I. Ammonium Nitrate: Commercial product containing approximately 34% ammonia.

J. Calcium Nitrate: Agricultural grade containing 15-1/2% nitrogen.

K. Ureaform: Granular commercial product containing 38% nitrogen, and minimum 27% water insoluble nitrogen (WIN).

L. I.B.D.U. (Iso Butyldiene Diurea): Commercial product containing 31% nitrogen.

M. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96% sulfur.

N. Iron Sequestrene: Geigy Iron Sequestrene 330 Fe, by Ciba-Geigy Corporation, (919) 292-7100, containing approximately 10% iron.

O. Potassium Nitrate: Agricultural grade containing approximately 13% nitrogen (N) and 44% potash (K20).

P. Trace Elements: FRIT Industries product 503 Micromax manufactured by Grace/Sierra or equal.

Q. Bone Meal: A fine ground, steam-cooked, packing house bone with a minimum analysis of (23) percent phosphoric acid and (1) percent nitrogen.

1. Bone meal shall be used for all bulbs in amounts as required by the Soils Lab.

2.04 COMMERCIAL FERTILIZER SUPPLIERS AND MIX BLENDERS

A. Sierra Chemical Co. (408-263-8080).

B. W. R. Grace and Co. (800-527-1893).

C. Or Equal.

2.05 ACCESSORIES

A. Water: Clean, fresh and potable. Transport as required.

PART 3 EXECUTION

3.01 PRE-INSTALLATION EXAMINATION AND PREPARATION

A. Reference Other Sections as necessary.

B. Coordinate activities with other project Sub-Sub-Contractors so that there is no soil disturbance from traffic or other construction activities subsequent to placement.

C. Pre-Installation Examination Required: The Contractor shall examine previous work, related work, and conditions under which this work is to be performed and shall notify Landscape Architect and in writing of all deficiencies and conditions detrimental to the proper completion of this work. Beginning work means Contractor accepts substrates, previous work, and conditions. The Contractor shall not place any planting soil until all work in adjacent areas is complete and approved by the Landscape Architect.

D. Kickoff Meeting: At least 10 working days prior to the start of work, the Contractor shall request a landscape construction kickoff meeting with the owners representative, landscape architect and any other parties involved with landscape construction. The Contractor must demonstrate familiarity with this Section 329113 Lawn/Grasses and Planting Soils, and other relevant sections of the construction documents. Contractor shall articulate the means and methods of subgrade preparation, soil placement and other steps outlined in the Specification.

E. Examination of Subgrade: The subgrade shall be examined by the Contractor prior to the start of subgrade preparation, soil placement and planting. Any deficiencies shall be noted and related to the Landscape Architect and in writing prior to acceptance of the subgrade by the Landscape Contractor. Deficiencies include, but shall not be limited to the following:

1. Construction debris present within the planting areas.
2. The subgrade is at incorrect depths for installing the designed soil profile.
3. Incomplete subsurface drainage installation.
4. Incomplete lighting and exterior electrical installation.
5. Conflict with underground utilities.

F. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope parallel to the finished grade and/or toward the subsurface drain lines as shown on the drawings.

1. All subgrade areas to be filled with Lawn/Grasses or Planting Soils shall be free of construction debris, refuse, vegetation, compressible or decay able materials, all stones greater than 2 inches, concrete washout or soil crusting films of silt or clay that reduces or stops drainage from the Lawn or Planting Soil into the subsoil; and/or standing water. Such material shall be removed from the site.

2. The subgrade must slope at a minimum of two percent towards the bottom of slopes and subdrains. Subgrade levels shall be adjusted as required to ensure that all planting and lawn areas have adequate drainage.

G. Planting Soil Preparation: Refer to Section 329113, 2.01. Examine soil and remove foreign materials, stones and organic debris over 1/2" in size. Remove all vegetation from stockpiles prior to placement. Mix-in or apply fertilizers and amendments as required by testing laboratory and as approved by the Landscape Architect. All preparation and mixing shall be accomplished when the soil moisture content is compliant with Section 329113, 1.09 and at a moisture content approved by the Landscape Architect. If lime is to be added, it shall be mixed with dry soil before fertilizer is added.

3.02 PLACING OF ORDINARY FILLS

A. Ordinary Fills under the Amended Lawn/Grasses and Planting Topsoil shall be placed and compacted to 86 to 88% Standard Proctor.

3.03 MIXING OF AMENDED LAWN/GRASSES AND PLANTING TOPSOIL MIX

A. Soil blends shall be produced with equipment that blends together each component in a thorough and uniform manner. This may be accomplished by a minimum of three handling events on a hard surfaced area with earth moving equipment or by alternately passing soil components through a screener.

3.04 BACKFILLING OF SOIL LAYERS

A. Soil Placement Preparation:

1. Verify that the subgrade preparations have been reviewed and accepted, including removal of all existing vegetation prior to placement of planting soils.

2. Notify the Landscape Architect of soil placement operations at least seven calendar days prior to the beginning of work.

B. Coordinate the following scarification work to eliminate subgrade compaction when located in lawn and planting areas. Maintain 12" clearance from any underground utilities during subgrade de-compaction.

1. Heavy Site Subgrade Compaction Mitigation:

a. Heavily compacted subgrade areas such as, but not limited to, temporary parking areas, material stockpile areas, temporary roadways, construction areas and areas around structures and other similar areas.

b. Prior to establishing the final subgrade of Earthwork material, these areas shall be dug up or ripped to a depth of (18) inches to break up the soil hard pan, then re-compacted with two passes of the tracks of a wide track bulldozer size D-6 or smaller, or other approved equipment and compacted to 86 to 88% Standard Proctor. Vibratory compaction of subgrade in planted areas is prohibited.

2. General Site Subgrade Compaction Mitigation for all general lawn and planting areas that are not heavily compacted and would be mitigated as specified in Item 1 above:

a. Immediately prior to placing Planting Soil, the entire subgrade shall be loosened to a minimum depth of 6-inches using the teeth of a backhoe or other suitable equipment, then re-compacted with two passes of the tracks of a wide track bulldozer size D-6 or smaller, or other approved equipment and compacted to 86 to 88% Standard Proctor. Vibratory compaction of subgrade in planted areas is prohibited.

C. After the subgrade soils have been loosened, re-compressed and inspected, and after the Granular Fill has been placed and inspected place the Amended Lawn and Planting Soil by using a wide track bulldozer size D-5 or smaller or may be dumped and spread with the bucket of a backhoe from the edge of the loosened area. No rubber-tired equipment or heavy equipment except for a small bulldozer or low ground pressure equipment shall pass over the subsoils (subgrade) after they have been loosened and recompressed. If the Contractor plans to utilize such areas for any use of heavy equipment, this work should be carried out prior to beginning the process of loosening soils or filling in that area.

D. Depth of Unamended Topsoils for Seed Mix #3 Areas: (12) inch minimum depth

E. Depth of Amended Topsoils for Lawns/Grasses, Plant Beds:

1. General Lawn and Seeded Areas: (12) inch minimum depth of Amended Topsoil.

2. Planting Bed Areas: (18) inches Amended Planting Soil.

F. F Placement of General Lawn/Seeded and Planting Bed Soil:

1. General Lawn/Seeded and Planting Bed Soil shall be placed in lifts not to exceed (6) inches in thickness and compacted to meet minimum and maximum requirements as specified below:

a. Amended Planting Bed Soil shall be compacted to between 82 and 85 percent Standard Proctor.

b. Amended General Lawn/Grasses Soil shall be compacted to between 86 and 88 percent Standard Proctor.

c. Amended Lawn and Planting Soils shall not be compacted with vibratory equipment.

G. Amendments incorporation for topsoil:

1. After the topsoil has been spread and graded, apply soil amendments at the rate recommended in the topsoil analysis. Apply limestone at least 5 days prior to application of fertilizer. Apply commercial fertilizer within 10 days of seeding or sodding.

2. Thoroughly and evenly incorporate soil amendments into the soil to a depth of 6 inches by disking or other approved method. In areas inaccessible to power equipment, use hand tools. Off-site mixing of soil amendments with topsoil is not acceptable unless approved in advance by Landscape Architect. After the incorporation of soil amendments into the soil, re-compact and fine grade the filed area to remove all ridges and depressions, and clear the surface of all stones one inch or more in diameter and other debris.

3. Seeding may be done immediately thereafter provided the bed has remained in a good friable condition and has not become muddy or hard. If it has become hard, till to a friable condition. Apply water to dry soil to a depth of 4 inches, 48 hours prior to seeding.

H. General:

1. In all cases, the soil being placed shall be in a dry to damp condition. No wet soils shall be placed. Soil moisture content must be compliant with Section 329113 1.06.H. All testing of in-place density for planting materials shall be made by the or according to ASTM D1556 Density of soil and rock in place using Sand Cone Method, ASTM D6938-10 Nuclear Methods, ASTM D2167-08 Rubber Balloon Method, after conducting ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

2. Prevention of compacted soils can be accomplished by beginning the work in corner, against walls, or the center of isolated beds, and progressing outwards towards the borders.

3. Lawn/Grasses Soils and Planting Soil shall never be moved or worked when wet or frozen.

4. The Contractor shall place barricades or steel plates as required to prevent any unnecessary compaction of planting soil from vehicles, equipment, or pedestrian traffic.

5. After planting and turf soil has been spread, it shall be carefully prepared by hand raking. Stones and debris over one inch in any direction shall be removed from the premises. Fine grade planting beds to a smooth even surface with loose uniformly fine texture. Remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas that can be planted immediately after grading. Maintain the finished surfaces at the grades shown and spread additional soil to correct settlement or erosion. Surface drainage shall be maintained. Soil shall be damp and free from frost during fine grading operations.

I. After the topsoil has been spread and graded, apply soil amendments, fertilizer and limestone at the rate recommended by the Soil Testing Laboratory. Apply limestone at least 5 days prior to application of fertilizer. Apply commercial fertilizer within 10 days of seeding or sodding.

J. Thoroughly and evenly incorporate soil amendments into the soil to a depth of 6 inches by disking or other approved method. In areas inaccessible to power equipment, use hand tools. Off-site mixing of soil amendments with topsoil is not acceptable unless approved in advance by Landscape Architect. After the incorporation of soil amendments into the soil, re-compact and fine grade the filed area to remove all ridges and depressions, and clear the surface of all stones one inch or more in diameter and other debris.

3.05 PROTECTION

A. The Contractor shall protect landscape work and materials from damage due to landscape operations, operations by other Contractors or trespassers. Maintain protection during installation until acceptance. Treat, repair or replace damaged Planting Soil installation work immediately.

B. Provide all means necessary, including fences, to protect all soil areas from compaction and contamination by trash, dust, debris, and any toxic material harmful to plants or humans after placement. Any area that becomes compacted, shall be de-compacted and tilled to the extent determined by the Landscape Architect and recompressed to the density ranges specified. Any uneven or settled areas shall be filled and re-graded. Soil that becomes contaminated shall be removed and replaced with specified soil material.

C. Phase the installation of the planting soil such that equipment does not have to travel over already installed planting soil.

D. Apply fabric coverings or other engineering controls over soil to protect placed soil in any area where the Contractor must work after the installation of Planting Soil.

E. Till compacted Amended Topsoil Mixes and replace Soil that has become contaminated as determined by the Landscape Architect. Amended Topsoil Mixes shall be tilled or replaced by the Contractor at no expense to the Owner.

FIELD QUALITY CONTROL

F. Tests: Right is reserved to take samples at any time of amended landscape soils and backfill mixes for testing for conformity to Specifications.

G. Rejected Materials: Remove and legally dispose off site at Contractor's cost. Pay cost of testing of materials, not meeting Specifications.

END OF SECTION

SECTION 329200

LAWNS AND GRASSES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Provide all labor, materials, equipment, services and transportation required to complete lawns and grasses as shown on the Drawings and as specified herein or both.

1.03 RELATED WORK

A. The following related work is to be performed under the designated Sections.

1. Landscape Maintenance – Section 310125
2. Finish Grading - Section 312219
3. Earthwork - Section 312000
4. Erosion and Sedimentation Control – 312500
5. Athletic Surfacing – Section 321800
6. Site Concrete – Section 321313
7. Miscellaneous Site Improvements – Section 323000
8. Fencing – Section 323100
9. Irrigation System - Section 328400.
10. Planting – Section 329000
11. Soil Preparation - Section 329113
12. Storm Drainage – Section 334000
13. Landscape Subdrainage – Section 334610

1.04 REFERENCES

A. Hortus III - 1976 Edition, Bailey Hortorium, Cornell University.

B. Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

C. Massachusetts Pesticide Control Act (MPCA, Chapter 132B of the Massachusetts General Laws). Chapter 333 of the Code of Massachusetts Regulations (333 CMR).

D. ASA: American Society of Agronomy.

E. Recommended Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeastern Regional Publication No. 493.

F. American Society for Material Testing (ASTM)

1.05 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 013300 – Submittals.

B. Test Reports: Soil Test reports of Amended Lawn and Planting Topsoil and recommendations for amendments and the rate of application to be applied before or after the installation of Lawns and Grasses. Refer to Sections 329113 Soil Preparation.

1. Limestone
2. Fertilizer
3. Herbicides and Fungicides

C. Product Data:

1. Limestone
2. Fertilizer
3. Herbicides and Fungicides
4. Hydroseeding Mulch.
5. Hydroseeding Mulch mix ratios and amounts.
6. Grass Seed for Lawn Areas.
7. Seed Mix #2 and Seed Mix #3.
8. Protective Coverings.

D. Certificates:

1. Certificates of inspection as required by law for transportation of each shipment of seed along with invoice.
2. Seed mix certificate confirming the grasses and their minimum percent grass seed purity and germination (including incorporated top dress fertilizer and rate of application for hydroseeding).

1.06 DELIVERY, STORAGE, AND HANDLING

A. Seed:

1. Furnish all seed, hydroseeding mulch, fertilizer and other products in unopened manufacturer's standard containers bearing original certification labels showing quantity, analysis and name of manufacturer.
2. Protect seed from weather or other conditions that would damage or impair effectiveness of the product.

B. Hydroseeding Mulch:

1. Labeling: Each package of cellulose fiber shall be marked by the manufacturer to show the air-dry weight content.
2. Storage: Protect from weather or other conditions, which would damage or impair the effectiveness of the product.

1.07 CLIMATE RESTRICTIONS

A. Do not install lawns during rainy or freezing weather, or when soil is frozen.

1.08 TIMING OF INSTALLATION

A. Hydroseeded Lawns:

1. Hydroseeding shall be done within (one) calendar days after the completion and acceptance of finish grading in any area.
2. Hydroseeding of Lawns and Seed Mix #2 and Seed Mix #3:

   Between April 15 - May 31 and

   Between September 1 - October 1.
3. If special conditions exist which may warrant a variance in the above dates, a written request shall be submitted to the Landscape Architect stating the conditions and proposed variance. Permission for the variance shall be given if in the opinion of the Landscape Architect the variance is warranted.

1.09 SEQUENCE OF REVIEW, MAINTENANCE, ACCEPTANCE AND WARRANTY

A. Preliminary Review: Refer to 310125 Landscape Maintenance Standards, Performance Requirements.

B. 90 Day Maintenance Period: Refer to 310125 Landscape Maintenance Standards and Performance Requirements to begin the 90 Day Maintenance Period.

C. 90 Day Maintenance Period Suspension and extension into the following year: Refer to Performance Requirements and suspension during the months of December through the end of March.

D. The Time Period: Warrant that lawns and grasses and shall be in a healthy and flourishing condition of active growth until acceptance by the Landscape Architect of the 90 Day Maintenance Period.

1. Refer to Section 310125 Landscape Maintenance Standards and Application for lawn maintenance requirements until and during the 90 Day Maintenance Period.

E. Appearance During the 90 Day Maintenance and Acceptance of the Maintenance Period Acceptance: Lawns and Grasses shall be free of dead or dying patches, disease and weeds. All areas shall show foliage of a normal density, size and color.

1. The flourishing coverage for the lawns and grasses shall mean that a minimum of 95% of the area planted shall be covered with the specified grasses, and cut a minimum of (eight) times, by the end of the 90 Day Maintenance Period in order to qualify for the acceptance of the 90 Day Maintenance Period.

F. Delays: Delays caused by the Contractor in completing lawn and grasses seeding operations which extend the planting into more than one planting season shall extend the 90 Day Maintenance Period correspondingly.

G. Coverage: Warrant growth and coverage of lawns and grasses areas shall be covered with vigorous well established lawn, weed free with no bare spots.

H. Exceptions: Sub-Contractor shall not be held responsible for failures due to damage by Owner, vandalism, or Acts of God during Warranty Period. Report such conditions in writing.

1.10 INSPECTIONS

A. Landscape Architect reserves the right to inspect seed mixes and the hydroseed accessories upon delivery to the site and to reject any or all of the shipment if it does not meet the specification and approved submittals.

1.11 MAINTENANCE AND PROTECTION OF NEW LAWNS AND GRASSES UNTIL THEIR ACCEPTANCE AT THE PRELIMINARY REVIEW.

A. The Sub-Contractor's Maintenance of Lawns shall begin as soon as each lawn area is hydroseeded and shall continue until acceptance by the Landscape Architect at the Acceptance of the 90 Day Maintenance Period.

B. Maintenance shall begin immediately after the installation of each lawn area.

1. Refer to Section 310125 Landscape Maintenance PART 3 -EXECUTION for requirements.

1.12 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury's Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.13 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architect's designated representative.

PART 2 PRODUCTS

2.01 SEED MIXES:

A. Seed Mix Uses: Use where shown on the Drawings.

B. Seed Composition: Use only fresh, clean, certified, new crop seed of the following varieties mixed in the following proportions:

C. Seed Mix Table:

1. Grass Seed mix for hydroseeded lawns:

Seeding Rate: 170 lbs. /acre or (4) lbs. per (1,000) square feet.

Seeds	Seed Mix Proportion (by weight)	Purity Min. (by weight)	Germin. Min.
Fine Fescue	40%	Latest Crop	Current Standard
Kentucky Bluegrass	40%	Latest Crop	Current Standard
Perennial Rye Grass	20%	Latest Crop	Current Standard
Total Mix	100%		

a. Kentucky Bluegrass and Fine Fescue shall consist of a minimum of (two) cultivars.

2. Seed Mix #2 - Bioretention Basin Bottom Seed Mix: New England Wet Mix available from New England Wetland Plants, 413-548-8000.

a. Application Rate: (40) lbs. per acre.

3. Seed Mix #3 –New England Conservation/Wildlife Mix available from New England Wetland Plants, 413-548-8000.

a. Application Rate: (30) lbs. per acre.

2.02 SEEDING ACCESSORIES

A. Water: Potable water. Transport as required.

B. Hydroseeding Mulch:

1. Composition: Green-colored, fibrous, 100% virgin wood fiber mulch containing no growth or germination-inhibiting factors.

2. Product: “EcoFibre” Premium Wood Fiber Mulch by Profile Products LLC www.profileproducts.com, or "Conwed Fibers Hydro Mulch 2000" with tackifier by Conwed Corporation www.conwedfibers.com.

C. Hydroseeding Soil Stabilizer:

1. Composition: Totally organic substance, supplied in powder form and at least 90% of which is 92% pure muciloid derived from ground Plantago ovata-insularis husks. Stabilizer shall be water-soluble, non-toxic hydrophilic and shall not inhibit germination.

2. Product: “FlocLoc Pro Plus” by Profile Products LLC www.profileproducts.com.

2.03 HYDROSEEDING EQUIPMENT

A. Type: Commercial hydro-seeder with built-in agitation system and an operating capacity sufficient to agitate, suspend and homogeneously mix slurry.

B. Distribution Lines: Sufficient to prevent stoppage and provide even distribution of the slurry over the ground.

C. Pump Capacity: (150) minimum psi at the nozzle.

D. Slurry Tank: (1,000) gallons minimum capacity.

A. Machine Pulled Equipment: Cultipactor Seeding equipment or other approved seeding equipment which will successfully seed the seed mixes specified for the Seeding Device.

B. Brillion Seeding Device or other approved seeding equipment for areas not accessible to the machine pulled equipment for the seeding mixes.

2.04 PROTECTIVE COVERINGS

A. Product: Refer to Section 312500 – Erosion Control for jute mesh.

PART 3 EXECUTION

3.01 EXAMINATION FOR LAWN INSTALLATION

A. Verification of Conditions:

1. Grades: Verify that grades are within (1) inch plus or minus of the required finished grades. Verify that all soil preparation has been completed and approved. Report all variations in writing.
2. Soil Preparation Work: Verify that all fertilization amending and scarification specified in Section 329113 has been completed before any seeding work in Lawn Areas shall be done.
3. Irrigation System: Do not commence planting work prior to completion and acceptance of the Irrigation System. See Section 328400.

3.02 PREPARATION

A. The seed bed shall be raked either by power rake or by hand to produce a loose friable seed bed.

B. Stones, Weeds, Debris: Verify that all areas to receive lawns grasses are clear of stones larger than (1/2) inch in any dimension, weeds, debris and other extraneous materials shall be removed.

1. Remove and legally dispose any of these materials at no additional cost to the Owner.

C. Excessive Soil Moisture: Do not commence work of this Section when soil moisture content is so great that excessive compaction will occur.

D. Inadequate Soil Moisture: Apply water, as necessary, to bring soil to an optimum moisture content for planting. Do not work soil when it is so dry that dust will form in air or that clods will not break readily.

E. Care shall be taken that no lime, fertilizer, hydroseed mulch or seed mix comes in contact with the adjacent planting areas.

3.03 LAWN INSTALLATION

A. Areas for Lawn Seed are designated and shall be where located on the Drawings and are listed below:

1. Lawn Seed Mix for Hydroseeded Lawns: This mix shall be for hydroseeded lawns.
2. Seed Mix #2 and Seed Mix #3: These mixes shall be hydroseeded.

B. Hydroseeding Preparation: Do all slurry preparation at the job site.

1. Do not dry mix seed or agitation that will damage the seed.
2. Blend the water, Seed mixtures or meadow grass mixtures, hydroseeding soil stabilizer and hydroseed mulch into the hydroseeding machine according to the machine's mix schedule and component manufacturer's directions.
3. Commence spraying immediately when the tank is full.

C. Hydroseeding Spraying Application:

1. General: Apply specified slurry mix in a sweeping motion to form a uniform mat at the specified rate. Keep hydroseeding within designated areas and keep from contact with other plant materials.
2. Unused Mix: Do not use any slurry mixture that has not been applied within four (four) hours of mixing. Promptly remove from the site.
3. Protection: After application, do not operate any equipment over the hydroseeded areas.
4. Reseeding: Reseed all areas and parts of areas that fail to show a uniform stand until all areas comply with the specified Warranty.

D. Watering for Hydroseeded Lawns and Grass Mixes

1. Watering shall be done again within (72) hours of installations or earlier if conditions require.
    a. Watering shall be done with a fine spray until the seed bed is moistened to a depth of (1/2) inches. Do not use a jet nozzle or permit disturbance of the seed bed or flood adjacent areas.
2. Rejected Materials: Remove rejected materials immediately from the site at Sub-Contractor's expense. Pay cost of testing of materials not meeting Specifications.

3.04 PROTECTIVE COVERINGS

A. Install jute mesh as specified in Section 312500 – Erosion and Sedimentation Control on slopes 3:1 or greater.

3.05 MAINTENANCE AND PROTECTION OF LAWNS AND ALL GRASS SEED MIXES UNTIL ACCEPTANCE OF THE PRELIMINARY REVIEW

A. See Section 310125 - Landscape Maintenance.

1. The Maintenance shall be as specified in PART-3 EXECUTION of Section 310125 for Lawns.
    a. This Maintenance shall begin immediately after the material is installed.

3.06 FIELD QUALITY CONTROL

A. Tests: Samples of materials may be taken and tested for conformity to Specifications at any time.

3.07 CLEANING

A. Erosion: Immediately restore eroded areas. Keep all adjacent paved surfaces cleaned of dirt, mud or stains and organic debris.

B. Over - Sprayed Hydroseed Mix: Immediately clean over - sprayed hydroseed mix from any surface other than lawn.

END OF SECTION

Division 33
Utilities

SECTION 331000

WATER DISTRIBUTION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION I of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. The Scope of the Work consists of the installation of all materials to be furnished under this Section, and without limiting the general quality thereof, includes:

1. Underground water piping and fittings
2. Disinfection of all site water piping
3. Tapping sleeves, gate valves and curb boxes
4. Protection of existing utilities
5. Flushing of all new water piping
6. Cutting/capping existing water service(s) presently serving existing building on site.
7. Hydrants
8. Removal/Abandonment of existing water lines where required.
9. Water services for domestic water supply and fire protection to a blind flange within the building.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. The following related work is to be performed under the designated SECTIONS:

1. Excavation and backfill: SECTION 312000 - EARTHWORK.
2. Electricity and water for all tests and temporary operation of systems: SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS.
3. Plumbing systems for continuation of water service: SECTION 220001 - PLUMBING.
4. Fire Protection systems for continuation of water service: SECTION 210001 - FIRE PROTECTION.
5. Site drainage systems: SECTION 334000 - STORM DRAINAGE.
6. Sanitary sewer systems: SECTION 333000 - SANITARY SEWERAGE.

7. Pavement, curbs, walks: SECTION 321200 – FLEXIBLE PAVING, SECTION 321300- RIGID PAVING, and SECTION 321600 – CURBS and GUTTERS.

1.04 INTENT

A. All work shall be in accordance with the arrangement, details and locations, as indicated on the Contract Drawings, Reference Drawings and any supplemental addenda, bulletins or drawings issued by the Architect. Layouts are diagrammatic and final arrangements shall suit field conditions. Install all necessary fittings and offsets required to meet job conditions. The Drawings are not intended to be scaled but shall be followed with sufficient accuracy to coordinate with other work and structural limitations. Work installed in a manner contrary to that shown on the Drawings, or interfering with the work of another trade, shall be removed and reinstalled. Discrepancies and questionable points shall be immediately reported to the Architect for clarification.

1.05 CODES, REGULATIONS AND STANDARD

A. All work shall be installed in conformance to the governing Codes, Regulations and Ordinances. It shall be the responsibility of this SECTION 331000 Subcontractor to familiarize himself with all governing Codes, Regulations and Ordinances and Amesbury Department of Public Works Standards. The Contractor shall report any non-compliance of the Plans and Specifications to the Architect, prior to entering into a contract. All the preceding requirements shall take precedence over the Plans and Specifications. These requirements are minimum criteria and no reductions permitted by code will be allowed without written permission of the Architect.

B. All workmanship, methods and materials shall meet the highest standards of the trade and, in general, shall conform to the standards of the following associations:

American Society of Testing Materials (ASTM)
Massachusetts Environmental Code
Massachusetts State Building Code
Massachusetts State Plumbing Code
Massachusetts and City of Amesbury Dept. of Public Works Standards
American Water Works Association
National Fire Protection Association

1.06 DRAWINGS AND CONFLICTS IN THE WORK

A. The Drawings and Specifications are intended to be complementary. Any materials shown or specified in one, but not in the other, or reasonably implied and usually included under good industry practice and/or required by applicable Codes and Regulations for the proper and safe completion and operation of the work described herein, shall be furnished and installed by this SECTION 331000 Subcontractor at no additional cost to the Owner. Drawings show general arrangements and are not intended to indicate the exact dimensions of runs.

1.07 EXCHANGE OF INFORMATION AND COORDINATION

A. Furnish, to the General Contractor and all other Contractors, all information relative to the portion of the installation specified in this Section that will affect them, sufficiently in advance, so that they may plan their work and installation accordingly. In the case of failure on the part of this SECTION 331000 Subcontractor to give proper information as indicated above, sufficiently in advance, this SECTION 331000 Subcontractor will pay for all back-charges incurred by the General Contractor and other Contractors for the modifications, renovation and/or relocation of any portion of the work already performed by them in conjunction with this Contract due to this SECTION 331000 Subcontractor's delay or for having given incorrect information.

1.08 WORKMANSHIP

A. The entire work provided in this Specification shall be constructed and finished, in every respect, in a workmanlike and substantial manner. It is not intended that the Drawings shall show every detail, but this SECTION 331000 Subcontractor shall furnish and install such parts as may be necessary to complete the work in accordance with the best trade practice and to the satisfaction of the Architect and the Owner.

1.09 SITE INVESTIGATION

A. It shall be the responsibility of the bidders to acquaint themselves with the available information, before submitting their bid. Bidders must visit the site and acquaint themselves with the existing conditions and shall study all Site, Architectural, Structural, Mechanical and Electrical Drawings, as well as the specifications. The Bidders shall fully inform themselves of all local and state Code requirements. Extra compensation will not be given for obvious conflicts apparent at the time of the start of the project. Refer to Section 011000 – Summary of Work.

1.10 INSURANCE

A. This SECTION 331000 Subcontractor shall include the premiums of the insurance required by the Contract and General Conditions.

1.11 PERMITS AND INSPECTIONS

A. This SECTION 331000 Subcontractor shall obtain, and pay for, all the permits required for this Section of the work. He shall also obtain and pay for all the inspections and tests required. Defects discovered in work, materials and/or equipment shall be replaced at no cost to the Owner, and the inspection and test shall be repeated. When work is completed, this SECTION 331000 Subcontractor shall furnish a Certificate of Inspection and Approval as well as the NFPA Materials and Test Certificate to the Owner before final payment of the Contract will be allowed.

1.12 CONTRACT COST BREAKDOWN

A. At the start of construction, submit a breakdown of material and labor costs to aid the Architect in determining the value of the work installed, as the job progresses. The cost breakdown shall itemize categories of materials or portions of systems, as may be the case, to place a value on the work as it is installed.

B. **NO REQUISITIONS WILL BE PAID UNTIL AFTER THE BREAKDOWN IS DELIVERED TO THE ARCHITECT.**

1.13 GUARANTEE

A. Unless otherwise noted, all materials, items of equipment and workmanship furnished under this Section shall carry the standard warranty against all defects in material and workmanship for a period of not less than one (1) year from the date of final acceptance of the work. Any fault due to defective or improper material or workmanship which may develop within that period, shall be made good, forthwith, by and at the expense of this SECTION 331000 Subcontractor, including all other damage done to areas, materials and other systems resulting from this failure.

B. This SECTION 331000 Subcontractor shall guarantee that all elements of the Systems are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.

C. Upon receipt of notice from the Owner of failure of any part of the Systems during the guarantee period, the affected part or parts shall be promptly replaced by this SECTION 331000 Subcontractor at no charge to the owner.

D. This SECTION 331000 Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

1.14 MATERIALS

A. Materials shall be the best of their respective kinds and in full accord with the most modern mechanical construction. All materials shall be new.

B. All materials necessary to make the installation complete in every detail shall be furnished and installed under this Contract, whether or not specifically shown on the Drawings or specified herein.

C. It is the intent of the Specifications that one manufacturer be selected, not a combination, for any particular classification of materials.

D. Where materials, equipment, apparatus or other products are specified by manufacturer, brand name, type or catalog number, such designation is to establish the standard of desired quality and style and shall be the basis of the bid.

1.15 MATERIALS AND EQUIPMENT HANDLING

A. This SECTION 331000 Subcontractor shall do all handling of his materials and equipment and the resulting cleanup, at his expense, in a safe and satisfactory manner. Special attention shall be paid to the protection of life and property and the equipment or apparatus handled, and any corresponding damages shall be replaced, repaired or paid for by this SECTION 331000 Subcontractor, as approved by the Architect. This SECTION 331000 Subcontractor shall provide all rigging and hoisting required to complete the work of this Section, unless specifically noted otherwise.

1.16 WATER DISTRIBUTION SYSTEM ACCEPTANCE

A. The entire system shall be fully operational prior to acceptance by the Owner. All equipment shall be test operated, calibrated and adjusted by this SECTION 331000 Subcontractor and the proper operation of all components of the system shall be demonstrated to the Owner. This SECTION 331000 Subcontractor shall secure a Letter of Acceptance of the system operation demonstration from the Owner. A copy of said letter shall be submitted to the Architect.

1.17 MAINTENANCE AND PROTECTION OF MATERIALS

A. This SECTION 331000 Subcontractor shall be responsible for the maintenance and protection, from loss or damage of all causes, of all equipment, materials and tools supplied by him and stored or installed on the job site, until final acceptance of the project by the Owner.

B. This SECTION 331000 Subcontractor shall store his materials and equipment in the location designated by the Owner and maintain the storage area in a safe condition.

1.18 SHOP DRAWING AND MATERIAL SCHEDULE

A. Submit complete Shop Drawings in accordance with provisions of Section 013300 - Submittals.

B. Within 30 days after the date of Notice to Proceed and before purchasing any materials or equipment, submit to the Architect for approval, a complete list of the names of manufacturers of all equipment proposed to fulfill the work of this Section. After the list has been processed by the Architect, submit complete Shop Drawings of all equipment and materials.

C. The approval of equipment and materials does not relieve this SECTION 331000 Subcontractor from the responsibility of Shop Drawing errors in details, sizes, quantities and dimensions which deviate from the Specifications, Contract Drawings and/or job conditions as they exist.

D. If apparatus or materials are substituted by this SECTION 331000 Subcontractor for those specified, and such substitution necessitates changes in any mechanical or electrical equipment, or alteration to connections, supports, or construction, same shall be provided. This SECTION 331000 Subcontractor is to assume the cost and entire responsibility thereof. The Architect's permission to make such a substitution shall not relieve this SECTION 331000 Subcontractor from full responsibility for the work.

E. Changes to work already performed, made necessary by delays in Shop Drawing approvals, are the responsibility of this SECTION 331000 Subcontractor.

1.19 RECORD DRAWINGS

A. Submit Record Drawings in accordance with the General Conditions and Supplementary Conditions and with Section 017700 - PROJECT CLOSEOUT.

B. Upon final completion of the project an "As-Built Plan" shall be provided to the Architect and the Amesbury Department of Public Works showing all utilities. Relative to Water Utilities, this plan shall include all water lines, valves and hydrants with locations accurately shown. These plans shall also show the locations of water lines and appurtenances abandoned in place under the scope of this project. These plans shall be prepared by a registered Land Surveyor contracted by this SECTION 331000 Subcontractor for this specific purpose. Note that in order for the “As-Built Plan” to be properly prepared, the surveyor must be on site sufficiently during the construction and installation to locate structures before backfill to permit the Surveyor to certify to the locations of underground utilities shown on the As-Built Plan. Notes on the plan such as “approximate location”, or “pipe / structure buried, could not be located” are not acceptable to meet this standard. As-built plans are to be provided in hard copy and electronic dwg, tiff and pdf formats.

1.20 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Provide operating instructions to the Owner's designated representative, with respect to operating and maintenance procedures, for all equipment and systems installed. The cost of such instruction, up to a full eight (8) hours, shall be included in the Contract price. This and all instruction sessions shall be videotaped by this SECTION 331000 Subcontractor and three (3) copies of the videotape submitted to the Architect.

B. At least two (2) months prior to occupancy or final acceptance of the project, turn over to the Architect, three (3) complete manuals containing the following, in accordance with SECTION 017700 - PROJECT CLOSEOUT:

1. Complete Shop Drawings of all piping, tapping sleeves, valves and valve boxes.
2. Names, addresses and telephone numbers of all suppliers of the equipment and Systems.
3. Guarantees on all equipment.
4. Preventive maintenance instructions for all Systems.

C. Each manual shall be typewritten and bound under a separate hard cover 3-ring binder and will be reviewed by the Architect. The manuals shall be clearly and permanently identified on the cover with the name of the project and the trade involved.

D. Upon completion of the instructions, this SECTION 331000 Subcontractor shall obtain a letter of acceptance of the instructions as being complete from the Owner. Submit a copy of said letter to the Architect.

1.21 RUBBISH REMOVAL

A. At the completion of the work, or when ordered by the General Contractor or the Architect, this SECTION 331000 Subcontractor shall remove from the property, all the rubbish, debris and waste material belonging to him. Keep the job site free from accumulation of waste material, debris and rubbish; premises must be maintained in a clean condition.

1.22 TEMPORARY STRUCTURES

A. This SECTION 331000 Subcontractor shall provide, on the premises where directed by the Architect, suitable and substantial watertight sheds in which he shall store all his materials and equipment. The subcontractor shall maintain said structures in good condition, and shall remove them when directed by the Architect.

1.23 TEMPORARY SERVICES

A. All water, electricity, fire protection and sanitary facilities required for safe and efficient construction during normal working hours shall be furnished in accordance with Section 015000 - TEMPORARY FACILITIES AND CONTROLS.

1.24 TESTS

A. Furnish all labor, materials, instruments, supplies and services and bear all cost for the accomplishment of the tests herein specified. Correct all defects appearing under test, repeat the tests until no defects are disclosed and leave the equipment clean and ready for use.

B. Perform any tests, other than herein specified, required by the Amesbury Department of Public Works and tests which may be required by other legal authorities or by agencies to whose requirements this work is to conform.

C. Dispose of test water and wastes after tests are complete, in accordance with applicable laws and regulations, and in a manner satisfactory to the Architect.

1.25 CERTIFICATION

A. This SECTION 331000 Subcontractor shall obtain pre-certification from the Amesbury Water Department for performing the work of this SECTION. Failure to obtain pre-certification from the local officials shall be the sole responsibility of this SECTION 331000 Subcontractor.

B. No work shall begin without the Amesbury Water Department certification. Submit letter of certification from the local officials to the Architect.

1.26 FIRE PROTECTION SYSTEMS

A. This SECTION 331000 Subcontractor shall note that all work associated with the laying, installation, flushing and testing of the fire service shall be performed by a person or persons duly licensed to install fire protection systems as by the Massachusetts State Building Code (See 780 CMR 903.3). The responsibility of this SECTION 331000 Subcontractor is to obtain the services of such a person or persons to perform this work.

B. This SECTION 331000 Subcontractor shall be responsible for securing and obtaining all required permits for the installation of these fire protections systems.

C. Before asking final approval of the installation, furnish NFPA Contractors Material and Test Certificate for the site water mains, countersigned by the City's representative, to the SECTION 210001 Fire Protection Subcontractor for his use in submitting to ISO.

D. This SECTION 331000 Subcontractor shall submit a complete shop drawing submittal set to the City of Amesbury Fire Department for review and approval. The submittal set shall be stamped and signed by a registered professional engineer. The submittal set shall include plans, materials and equipment catalog cuts.

E. This SECTION 331000 Subcontractor shall submit a complete set of AS-BUILT drawings to the City of Amesbury Fire Department for record purposes. This set of AS-BUILT drawings shall also include one copy of the Operating and Maintenance Manual. See Section 1.19 Record Drawings above for As-Built requirements.

Specific reference is made to the following NFPA Standards which shall govern provision of work as specified and as required by codes and authorities

No. 24 - Installation of Private Service Mains.

No. 25 - Inspection, Testing, and Maintenance of Water Based Fire Protection Systems.

1.27 REMOVAL/ABANDONMENT OF WATER LINES

A. Existing water services and mains that will no longer be in services are to be removed within the proposed building footprint and where they interfere with new construction. Where these utilities that will no longer be in service will not interfere with new construction, these may be either removed or properly abandoned in-place per the requirements of the municipal Department of Public Works. This shall be done by cutting, filling with flowable fill and capping. The location of the pipe will be survey located and shown on the As-Built Plan per Section 1.19 above.

PART 2 PRODUCTS

2.01 MATERIALS AND WORKMANSHIP

A. This SECTION 331000 Subcontractor shall comply with all the rules, Codes, ordinances, regulations and requirements of all legally constituted authorities having jurisdiction over the whole, or any part of the work herein specified. These requirements are minimum criteria and no reductions permitted by code will be allowed without written permission of the Architect.

B. All equipment and materials furnished in connection with the installation free from natural, manufacturing or construction flaws, defects or irregularities and finish, fittings and workmanship shall be equal to the highest commercial grade. The Owner shall have the right to reject any part of the work in case the material or workmanship is not of satisfactory quality and this SECTION 331000 Subcontractor shall replace same with acceptable work at his own expense.

C. All materials necessary to make the installation complete in every detail shall be furnished and installed under the Contract, whether or not specifically shown on the Drawings or specified herein.

D. It is the intent of the Specifications that one manufacturer be selected, not a combination, for any particular classification of material. For example, all piping of one manufacturer, all frames and covers of one manufacturer.

E. Where materials, equipment, apparatus, or other products are specified by manufacturer, brand name, type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the bid.

F. This Section 331000 Subcontractor shall make certain which materials are allowed by local authority and base his bid on these materials only. No extras will be allowed for compensating for materials rejected by local inspector regardless if they are named in this Specification or allowed by State or National Codes.

G. Information (Shop Submittals) of all materials and methods shall be submitted to the Amesbury Public Works Department and the Amesbury Fire Department for approval prior to purchasing any items. Materials and installation shall conform to the relative Department standards.

2.02 PIPE, JOINTS AND ACCESSORIES

A. Water Main Pipe

1. Shall be a Class 52 ductile iron pipe, (with a rated working pressure of 350 psi), cement lined inside, tar coated inside and outside in nominal 18-foot lengths, completed with all devices and materials normally furnished for making joints and conforming to ANSI A21.50+, ANSI A21.51, ANSI A21.4 (CISO-76 AWWA) or any revision thereto. Further conforming with the latest Federal Specification WW-p-421b. Cement lining to be twice the thickness specified in ANSI A21.4-1976 (C104-74 AWWA) or revision thereto and to be asphalt seal coated twice. The outside of all pipe shall be bituminous coated. The asphalt seal coat shall not impart taste, color or odor to the water being carded.

2. The ductile iron pipe shall be that of a manufacturer who can demonstrate at least five years of successful experience in the manufacturing of ductile iron pipe. The pipe shall be furnished with TYTON Joints, with gaskets conforming to ANSI A21.1 1. The pipe shall be jointed to all fittings by mechanical joints. All pipe shall be marked with the class, thickness, designation and initials of the manufacturer.

B. Fittings and Accessories

1. Fittings

a. All fittings shall be ductile iron Class 250 conforming to ANSI Specification A21.1 0 and A21.1 1, latest edition, unless specifically stated otherwise in the Specifications or on the Drawings. Fittings shall be of the same material and have the same outside coating as the pipe specified above. All fittings shall be marked with the pressure rating, the manufacturer's identification, nominal diameter of openings and the number and fraction of degrees of the circle on all bends.

b. All fittings shall be mechanical joint conforming and shall be cement lined in accordance with ANSI A21.4 except that cement lining shall be 1/8 inch thickness. Rubber gaskets for mechanical joints shall conform to ANSI A21.1 1.

c. The branch of tees for stubs shall be cement lined, tar coated, mechanical joint anchoring tees.

2.03 VALVES

A. Water System Valves

1. Shut-off valves shall be installed in the water mains where shown on the Drawings.

2. Gate Valves

a. Gate valves for valves four (4) inches through twelve (12) inches shall be ductile iron body, bronze mounted gate valves with double gate and two inch operating nut which shall conform in every respect with the latest standard specifications for gate valves adopted by the American Water Works Association, including, but not limited to C-509, C-153, and C-550. Valves shall be designed for a 200 psi working pressure, and a 300 psi test pressure, and shall open right. Ends shall be mechanical joint hubs.

b. Bodies and bonnets shall be a high quality ductile iron. Discs shall be cast iron with bronze disc rings. Disc rings shall be securely attached 'to the discs by approved methods. Discs shall be replaceable without removing the valve bodies.

c. Upper valve wedges shall be constructed of cast iron with monel sleeve. Bronze stem bushings shall be furnished on valves four (4) inches and larger to provide a bronze to bronze bushing surface with the stem. Seat rings shall be made of bronze, backfaced, threaded and screwed into machined seats in the valve bodies. Seat rings are made with lugs to facilitate removal and replacement while the valve bodies are in the line.

d. Stems shall be bronze with two inch cast iron operating nuts. Valve stems shall conform to AWWA with regard to size of stem, and pitch of thread. The word "open" and an arrow shall be cast into the operating nut. Gate valves shall open right.

e. Stem seals shall be double Buna-N-"O "ring type.

f. The exterior surface of all valves shall be coated with a minimum of three applications of a bitumastic solution.approved per this Section submittal, on a rust free casting prior to shipment. The body ring shall be free of any bitumastic solution.

3. Valves shall open in the same direction and with the same amount of turns as those presently used in the City.

4. Valve Boxes

a. Valve boxes shall be cast iron, tar coated, sliding type, adjustable valve boxes, together with cast iron covers. The bell end of the lower sections shall in all cases be sufficiently large to fit over the stuffing boxes of valves. The smallest inside diameter of the shaft shall be not less than 5-1/4 inches. The operating nut shall be centered in the bell end of the valve box.

b. The gate box upper section used in the work shall have a flange sufficiently strong to furnish the bearing for that section so that all weight or jolting resulting from street traffic or the like shall rest over and not be carried to the valve. Boxes shall be adjustable to such length as to be used with valves on pipe lines set in a trench with five feet of cover. The box shall have a six-inch lap and extended flange on the upper section to prevent settling.

c. This SECTION 331000 Subcontractor shall take great care to properly center the valve boxes over the operating nuts of valves and to adjust them to the proper height to correspond to the street or ground surface. Valves boxes are to be cut with a wheel cutter if it becomes necessary to cut them to adjust for height.

5. Plugs and Caps: Plugs and caps shall be furnished and installed where shown on the plans at pipe terminuses. Plugs and caps are to be of the same design classification as the pipe to which they are attached.

6. Clamps and Rods: All fittings will be clamped and rodded when poor soil bearing strength precludes the use of thrust blocks.

7. Other Materials: All materials not expressly referred to in this section that are necessary or proper for performing and completing the work specified herein, shall be furnished and installed by this SECTION 331000 Subcontractor.

2.04 THRUST BLOCKS

A. Thrust blocks shall be furnished and installed on water piping by Section 033000 CAST-IN-PLACE CONCRETE in accordance with NFPA Pamphlet No. 24, for the encountered soil conditions, except Amesbury Water Department requirements shall be satisfied when in excess of NFPA 24.

2.05 CONNECTIONS TO EXISTING WATER SYSTEM

A. The new water lines shall have a new tie-in to the existing water main at the locations shown on Drawings.

B. This SECTION 331000 Subcontractor shall coordinate with the Amesbury Water Department to ensure proper installation of water line, sleeves, tapping saddles, bracing and other necessary items to provide a complete service. The cost of furnishing all labor and materials required for a first class installation and tie-ins shall be the responsibility of this SECTION 331000 Subcontractor.

2.06 TAPPING SLEEVES

A. Tapping sleeves and valves shall conform to the latest specifications adopted by the American Water Works for tapping sleeves and valves. Tapping sleeves shall be a mechanical joint or poured joint long body cast iron tapping sleeve with two part casing, possessing a gasket which covers the entire surface area of each joint for the full length of the sleeve. Follower rings shall be of the solid thickness split ring type which utilizes 2 additional bolts to connect rings.

B. The tapping sleeve shall have a flanged outlet which is designed to insure proper centering of the tapping sleeve.

C. Cast iron tapping sleeves shall be installed by persons with experience satisfactory to the Amesbury Water Department,

D. Valves shall comply to paragraph 2.03 insofar as this applies. Valves shall have a mechanical joint on the outlet.

2.07 HYDRANTS

A. Fire Hydrant manufacturer and model to be confirmed with the City of Amesbury Department of Public Works Standards and the City of Amesbury Fire Department. Number of outlets (2) 2-1/2” hose connections; (1) 4 ½” steamer connection; Diameter valve opening 5 ½” (minimum); Hub mechanical joint; Direction of opening – open right; dry top design; 150 psi working pressure; latest AWWA specifications.

2.08 DEMARCATION WARNING TAPE

A. Two (2) different warning tapes are required for water main piping. Both warning tapes shall be a minimum 3-inch width, non-adhesive, reinforced, barricade style warning tapes. Both warning tapes shall be made of reinforced polypropylene with a minimum thickness of 4 mil and shall be yellow with black lettering. One (1) of the warning tapes shall have the words “CAUTION HAZARDOUS MATERIAL” repeating for the entire length. One (1) of the warning tapes shall have the words “CAUTION BURIED UTILITY” repeating for the entire length.

PART 3 EXECUTION

3.01 INSTALLATION

A. This SECTION 331000 Subcontractor shall comply with all the rules, codes, ordinances, regulations and requirements of all legally constituted authorities having jurisdiction over the whole or any part of the work herein specified. These requirements are minimum criteria and no reductions permitted by code will be allowed without written permission of the Architect.

B. This work shall include the furnishing and installation of all labor, materials and equipment except excavation and backfill necessary for the complete installation of all work in accordance with the requirements of the Amesbury Departments of Public Works and the Massachusetts State Departments of Public Works.

C. Excavation and backfill of the trenches for the pipe shall be performed under the work of SECTION 31 20 00 - EARTHWORK. It shall be the responsibility of this SECTION 331000 Subcontractor to ensure that bedding, depth, width, bottom of trench, is suitable for the proper installation of the work to the building.

D. Excavation: The trench for the pipe shall be excavated to the required line and grade and of sufficient width to permit thorough tamping of the fill material under the haunches and around the pipe. Soft or unsuitable material encountered below the normal bedding line of the pipe shall be removed as directed, replaced with graded gravel and thoroughly compacted. Graded gravel shall be installed to level the trench and shall be placed to a minimum depth of six (6) inch depth below the pipe. The bottom of the trench shall be shaped to conform to the curvature of the pipe. This bed shall also be excavated to accommodate the bells of pipes. If any cross pipes, conduits, drains or other unforeseen obstacles are encountered in the excavation, the grade of the bottom of the trench may be raised or lowered during the excavation operation, with the approval of the Architect. Use concrete or other approved support under the existing pipes passing through the excavation where said pipe would normally be supported by backfilled earth. Where concrete obstructions, ledge or boulder formations are encountered, it shall be removed to a line eight inches (8") below the bottom of the outside of the pipe barrel. No part of any rock remaining in the trench shall come within eight inches (8") of any portion of the pipe.

E. Bedding Pipe: The pipe shall be laid true to the specified lines and grades.

Material placed around and under the pipe shall be fine to medium sand. The pipe shall be bedded on a sand foundation of uniform density carefully shaped to fit the lower part of the pipe exterior for at least fifty percent (50%) of its overall height. No blocking of any kind shall be permitted. Bedding sand shall meet MHD M1.04.0 type B.

F. Assembly: After pipes have been bedded, joining and assembly shall be in accordance with the procedures hereinafter specified.

G. Backfilling: After pipe and joints have been inspected and approved by the City of Amesbury Water & Sewer Division and the Architect, the trench shall be backfilled.

1. Backfill above centerline of pipe to a point 12" above top of pipe shall be fine to medium sand and tamped by hand with a flat tamper, placed in six (6) inch layers. This backfill shall be bedding sand meeting MHD M1.04.0 type B.

H. Backfill material above sand backfill above top of pipe shall be graded gravel, free of stones larger than two (2) inches and tamped by hand with a flat tamper, placed in six (6) inch layers.

I. Tie cards shall be furnished to the City with "As-Built" measurements of the existing water service. A metallic identification tape shall be buried one foot below finished grade along the length of the service feed. See also As-Built Plan requirements in 1.19.

J. Provide two (2) continuous warning tapes above the entire length of installed water main piping located 12-inches below grade. The two warning tapes shall be laid no more than 6 inches apart.

3.02 EXTERIOR WATER PIPING

A. All outside underground water piping shall have a minimum cover of 4.5 feet.

B. The water main shall be laid and maintained to the required lines and grades.

C. Wherever it is necessary to deflect pipe from a straight line, either in the vertical horizontal plane, to avoid obstructions or where long radius curves are permitted, the amount of deflection allowed shall not exceed manufacturer's recommendations. No pipe shall be laid in water or when trench conditions are unsuitable.

D. All joints shall be left fully exposed in view, unless otherwise ordered by the Architect, until test has been completed and approved.

E. Care shall be taken in loading, transporting and unloading to prevent injury to the pipes or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective, any damage to the pipe coatings shall be repaired.

F. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by this SECTION 331000 Subcontractor at his own expense. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until used in the completed work, and when laid, shall conform to the lines and grades required.

G. Ductile iron pipe and fittings shall be installed in accordance with the requirements of AWWA Standard Specification 0600, except as otherwise provided herein. A firm, even bearing throughout the length of the pipe shall be constructed by tamping selected material at the sides of the pipe, up to the spring line. BLOCKING WILL NOT BE PERMITTED. Pipe shall be laid at 4'-6" minimum cover.

H. All pipe shall be sound and clean before laying. When laying is not in progress, including lunch time, the open ends of the pipe shall be closed by watertight plug or other means acceptable to the Amesbury Water and Sewer Department. Good alignment shall be preserved in laying. The deflection at joints shall not proceed that recommended by the manufacturer. Fittings, in addition to those shown on the Plans, shall be provided as necessary to complete the installations in crossing utilities which may be encountered upon opening the trench. Solid sleeves shall be used only where approved by the Architect and the Amesbury Water and Sewer Department.

I. When cutting of pipe is required, the cuffing shall be done by machine leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a Tyton bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.

J. Pipes, valves and fittings shall be inspected for damage when received and shall be inspected prior to installation. Bolted joints shall be checked for proper torquing of bolts. Pipe, valves and fittings shall be clean inside. When work is stopped, open ends shall be plugged to prevent stones and foreign materials from entering.

K. All pipe, valves and fittings shall be carefully lowered into the trench with suitable equipment. They shall be carefully examined for cracks or other defects while suspended above the trench immediately before installation. Plain ends shall be inspected with special attention as these ends are the most susceptible to damage. Under no circumstances shall water main materials be dropped or dumped. Pipe shall not be rolled or skidded against other pipe materials.

L. Pipes shall bear throughout their full length and shall not be supported by the bell ends only or by blocks.

M. Joints shall be assembled by persons familiar with the particular materials being used and in accordance with the manufacturer's instructions and specifications.

N. All bolted joint accessories shall be cleaned and thoroughly coated with asphalt or other corrosion-retarding material after installation.

O. All elbows and bends and all plugs at blanked openings shall be securely braced and clamped in approved manner, as required by Pamphlet No. 24 of the NFPA and the pipe manufacturer.

P. Clamps shall be 1/2" x 2" for pipe 4" in diameter; 5/8" x 2 1/2" for pipe 6" in diameter. Bolt holes shall be 1/16" diameter larger than bolts. Rods shall be 3/4" diameter for pipes 4" and 6" in diameter. Washers may be cast iron or steel, round, or square. Dimensions for cast iron washers are 1/2" x 3" for pipe 4" and 6” diameter. Holes shall be 1/8" larger than the rods.

Q. Straps shall be 5/8 in. thick and 2-1/2 in. wide for pipe 4” and 6” in diameter. Rod holes shall be 1/16 in. diameter larger than rods.

R. Material used for clamps, rods, rod couplings or turnbuckles, bolts, washers, anchor straps, and plug straps shall be of material having physical and chemical characteristics such that its deterioration under stress can be predicted with reliability.

S. After installation, rods, nuts, bolts, washers, clamps and other restraining devices except thrust blocks shall be cleaned and thoroughly coated with a bituminous or other acceptable corrosion retarding material.

T. Underground mains and lead-in connections to building shall be flushed thoroughly before connection is made to building piping in order to remove foreign materials which may have entered the underground main during the course of the installation or which may have been present in existing piping. The minimum flow rate for domestic water service shall be not less than the rate necessary to obtain 10 feet per second velocity. The minimum rate of flow for fire protection water service and pumper connection piping shall be not less than the fire protection system water demand rate, which is determined by the fire protection system design, or not less than that necessary to provide a velocity of 10 ft. per second (3 m/s), whichever is greater. For all systems, the flushing operations shall be continued for a sufficient time to ensure thorough cleaning. When planning the flushing operations, consideration shall be given to disposal of the water issuing from the test outlets.

U. This SECTION 331000 Subcontractor shall submit for approval a proposed flushing plan and schedule, including time of day, duration of flushing, disposal point of water, manpower to be used and equipment needed, to the Architect and the Amesbury Water Department at least thirty (30) days in advance of the proposed flushing. No flushing will be allowed until the Architect and Amesbury Water Department have approved this plan and schedule. This SECTION 331000 Subcontractor shall perform the flushing at times and dates and manner required by the Amesbury Water Department.

3.03 JOINTING DUCTILE IRON PIPE (PUSH-ON TYPE)

A. Push-on joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be joined, and pushed home with a jack or by other approved means. After joining the pipe, a metal feeler shall be used to make certain the rubber gasket is correctly located.

3.04 JOINTING MECHANICAL PIPE AND FITTING

A. The method of jointing pipe, valves, fittings, and where designated, shall be in accordance with the "Notes on Method of Installation" under ANSI Specification A21.11 and the instructions of the manufacturer. To assemble the joints in the field, this SECTION 331000 Subcontractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tightened to the specified torques. Under no conditions shall extension wrenches, or pipe over handle, or ordinary wrenches be used to secure greater leverage.

3.05 TESTS AND TESTING PROCEDURES

A. General

1. All labor, materials, instruments, devices and power required for testing shall be furnished by this SECTION 331000 Subcontractor. All tests shall be performed in the presence and to the satisfaction of the Architect, the Amesbury Water Department and such other parties as may have legal jurisdiction.
2. Repair, or if directed by the Architect, replace all defective work with new work without extra charge to the Contract. Repeat tests as directed until all work is proven to meet the requirements specified herein.
3. Restore to its finished condition, any work damaged or disturbed by tests.
4. Perform all tests herein specified and all other tests which may be required by any and all authorities or agencies to whose requirements this work is to conform.
5. This SECTION 331000 Subcontractor shall notify the Architect and all inspectors having jurisdiction, a minimum of 48 hours in advance of making any required tests, so that arrangements may be made for their presence to witness his scheduled tests.

B. Before asking final approval of the installation, furnish NFPA Contractors Material and Test Certificate for the site water mains, countersigned by the City's representative, to the SECTION 210001 Fire Protection Subcontractor for his use in submitting to ISO.

C. The trench shall be backfilled between joints before testing to prevent movement of pipe.

D. All new piping shall be tested hydrostatically at not less than 200 psi (13.8 bars).

E. Tests for leakage shall be conducted on all portions of the pipe lines. Prior to testing, the entire lengths of pipe lines shall be flushed clean and free from all dirt and foreign material. All air shall be released and the pipe lines completely filled with water. After allowing 3 days for absorption, the internal pressure shall be built up by use of a force pump to 200 psi. Filling of the lines shall be done as slowly as practicable so as not to cause dirty water and serious pressure drop within the municipal system.

Means shall be made to vent air from the mains during the filling process. After the mains have been filled, the controlling gate valves shall be closed and the new mains kept isolated from the existing system. The new mains shall be held at static pressure for at least 3 days before test is begun.

F. The piping shall be filled and pressurized to 200 psi after the 3 day period and this shall be held for 15 minutes. Then the pressure shall be dropped to the normal working pressure and then built back up to 200 psi.

G. The amount of leakage in piping shall be measured at the specified test pressure by measuring with a meter or if allowed by the Water Department pumping from a calibrated container.

H. The maximum allowable rate of leakage shall be calculated by one of the following methods. The method which results in the minimum leakage shall be the maximum allowable rate.

1. The amount of leakage at the joints shall not exceed two quarts per hour (1.89 Uh) per 100 gaskets or joints irrespective of pipe diameter. The amount of allowable leakage specified may be increased by one fluid ounce per inch valve diameter per hour (30 ml/25/mm/h) for each metal seated valve isolating the test section. If dry barrel hydrants are tested with the main valve open, so the hydrants are under pressure, an additional five ounces per minute (150 ml/min) leakage is permitted for each hydrant, or;

2. The maximum allowable amount of inflow of water to maintain the required test pressure shall not exceed 12 gallons per inch of internal diameter of the pipe lines per mile of pipes per day.

I. The test pressures shall be maintained for the full period of tests. (One hour)

J. In case the specified rate of leakage is exceeded, the leaks shall be removed and replaced by this SECTION 331000 Subcontractor and the pipe line retested, repeatedly if necessary, at no additional expense to the Owner, until the required conditions are met. The tests shall be continued for a period of at least one hour after all leaks have been stopped and all corrective work has been satisfactorily completed and after the maximum rate of inflow of water into the pipe line as specified above has not been exceeded.

K. If, in the judgment of the Owner, it is impracticable to follow any of the foregoing procedures exactly for any reason, modifications in the procedures shall be made as approved by the owner, but in any event this SECTION 331000 Subcontractor shall be responsible for the ultimate tightness of all pipelines within the respective leakage requirements specified herein. Any modifications to the procedures, shall be performed by this SECTION 331000 Subcontractor at no additional expense to the Owner. All hydrants shall be pressure tested in the open position at the same time as the main line.

L. Tests shall be made by the SECTION 331000 Subcontractor in the presence of Architect and Amesbury Water Department. Test certificate is to be completed and furnished to SECTION 210001- FIRE PROTECTION.

M. All control valves shall be fully closed and opened under system water pressure to ensure proper operation.

3.06 FLUSHING AND DISINFECTION

A. This SECTION 331000 Subcontractor shall furnish all plant, labor, material and equipment to flush and disinfect all lines carrying potable water, including hydrants and appurtenances. The work shall be performed in accordance with the procedures outlined in the AWWA Standard for Disinfecting Water Mains Designation C 601-68.

B. Care shall be exercised during the disinfecting period not to contaminate any water in existing lines. The Water used in disinfecting and flushing shall be disposed of in an acceptable manner.

C. Disinfection shall take place after the pressure testing procedure. Prior to disinfecting, the new line shall be flushed to remove all dirt and debris. Flushing shall include both intermediate and end hydrants on a run. Hydrants shall be flushed at sufficient volume to move any dirt in the pipe. Samples shall be taken during flushing and analyzed for sediment.

D. After flushing, the new line shall be isolated from existing water lines, and a chlorine solution introduced into the main. Chlorine shall be introduced through a hydrant or special tap in the main. During the introduction, the final hydrant shall be bled to ensure that the chlorine solution travels the entire length of the line. A test kit shall be used to verify that a suitable concentration exists.

E. Chlorine solutions shall be derived from calcium hypochlorinate or sodium hypochlorite. Sufficient chlorine shall be added to produce a 50 mg/l residual in the main.

F. Chlorine shall be allowed to remain in the main for a minimum of twenty four hours. A chlorine residual of at least 25 mg/l shall be maintained at the end of this 24 hours. Retain this water in the piping for 72 hours. At the end of the 72 hours, make arrangements with the Amesbury Water Department to dispose of the test water. During this period, all valves and hydrant valves shall be operated at least once. After disinfection, the line shall be flushed clean of all chlorine down to the normal residual level for the system. Samples shall be taken and analyzed for bacterial quality. A minimum of two samples shall be taken at different points. Additional samples may be required based on the length of line. Samples shall be analyzed by a State Certified Laboratory, subject to the approval of the Architect. Sampling shall be at this SECTION 331000 Subcontractor's expense.

G. Any sample which results in a positive coliform count shall be repeated until three successive zero counts are recorded. If a subsequent coliform count is recorded, then the flushing and chlorination procedure shall be repeated. The line shall not be placed in service until three successive zero coliform counts are recorded.

H. A full report of the disinfection results shall be furnished to the Architect for verification prior to acceptance of system.

3.07 OPERATION AND START-UP

A. This SECTION 331000 Subcontractor shall furnish all labor, materials, and equipment necessary to place the system into operation and demonstrate the fitness of the installation.

B. Prior to start-up, this SECTION 331000 Subcontractor shall check all systems for completeness, provide lubrication, clean and flush all piping and equipment, perform pressure tests and make all other adjustments necessary to start up.

C. This SECTION 331000 Subcontractor may start portion of the systems as the work progresses; however, all systems which are normally operating simultaneously must be so operated upon completion of the work.

3.08 OFFSITE WORK AND COORDINATION WITH EXISTING UTILITIES

A. Special attention shall be given to the protection of, and coordination with, existing off-site utilities. This SECTION 331000 Subcontractor shall contact the Amesbury Department of Public Works and "DIG-SAFE' to identify and to locate these service connections prior to beginning any work.

B. All utility work, both on and off site, shall comply with Amesbury Department of Public Works requirements and standards. Submit all equipment, materials and methods to the Amesbury Department of Public Works for approval prior to submitting to the Architect, and prior to purchasing any equipment or materials.

3.09 DISCONNECTION, CUTTING AND CAPPING OF EXISTING BUILDING SERVICES

A. Existing building on site is presently served by municipal services. This SECTION 331000 Subcontractor shall disconnect, cut and cap/plug existing water service(s) serving this building, as the project schedule requires.

B. The service(s) shall be disconnected and capped/plugged at the main. The valve(s) shall be flanged off watertight.

C. All work associated with this effort shall comply with the Amesbury Department of Public Works requirements for discontinuing services.

D. The disposition (location, elevation, size) of these discontinued services shall be recorded on the record drawings that shall be submitted to the Amesbury Department of Public Works at the end of the project.

END OF SECTION

SECTION 333000

SANITARY SEWERAGE UTILITIES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Furnish and install the following items required to complete the work of this SECTION, as shown on the Contract Drawings and specified herein:

1. Connections at 10 feet from the building wall to cast iron soil piping furnished by SECTION 220001
2. Sanitary Sewer from 10 feet beyond the building wall
3. Frames and covers
4. Sanitary Sewer Manholes
5. Removal/Abandonment of existing sewer force main, sewer and manholes.
6. Testing of sewer piping and manholes.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. The following related work is to be performed under the designated SECTIONS:

1. Excavation and backfill - SECTION 312000 EARTHWORK.
2. Demolition - SECTION 024100 DEMOLITION.
3. Water Piping - SECTION 331000 WATER DISTRIBUTION.
4. Interior plumbing to 10' from building - SECTION 220001 PLUMBING.
5. Site electrical - SECTION 260001 ELECTRICAL.
6. Storm Drainage - SECTION 334000 STORM DRAINAGE
7. Electricity and water for all tests and temporary operation of system - SECTION 015000 TEMPORARY FACILITIES AND CONTROLS.

8. Pavements, curbs, walks: SECTION 321000 – FLEXIBLE PAVING, SECTION 321313 – SITE CONCRETE, SECTION 321600 CURBS AND GUTTERS.

1.04 QUALIFICATIONS

A. This Section 333000 Subcontractor shall be authorized by, or obtain authorization from, the City of Amesbury to perform sewer construction in the City. No work may be begun without this authorization.

1.05 INTENT

A. All work shall be in accordance with the arrangement, details and locations, as indicated on the Contract Drawings, Reference Drawings and any supplemental addenda, bulletins or drawings issued by the Architect. Layouts are diagrammatic and final arrangement of equipment shall suit field conditions. Install all necessary fittings and equipment offsets required to meet job conditions. The Drawings are not intended to be scaled but shall be followed with sufficient accuracy to coordinate with other work and structural limitations. Work installed in a manner contrary to that shown on the Drawings, or interfering with the work of another trade, shall be removed and reinstalled when so directed by the Architect. Discrepancies and questionable points shall be immediately reported to the Architect for clarification.

1.06 CODES, REGULATIONS AND STANDARDS

A. All work shall be installed in conformance to the governing Codes, Regulations and Ordinances. It shall be the responsibility of this Section 333000 Subcontractor to familiarize himself with all governing Codes, Regulations and Ordinances and report any non-compliance of the Plans and Specifications to the Architect, prior to entering into a contract. All the preceding requirements shall take precedence over the Plans and Specifications. These requirements are minimum criteria and no reductions permitted by code will be allowed without written permission of the Architect.

B. All workmanship, methods and materials shall meet the highest standards of the trade and, in general, shall conform to the standards of the following associations:

American Society of Testing Materials (ASTM)
Massachusetts Environmental Code
Massachusetts State Building Code
City of Amesbury Building Regulations, Laws, Codes and Ordinances
City of Amesbury Water/Sewer Division Standards
Massachusetts Department of Public Works Standards

1.07 DRAWINGS AND CONFLICTS IN THE WORK

A. The Drawings and Specifications are intended to be complementary. Any materials shown or specified in one, but not in the other, or reasonably implied and usually included under good industry practice and/or required by applicable Codes and Regulations for the proper and safe completion and operation of the work described herein, shall be furnished and installed by this Section 333000 Subcontractor at no additional cost to the Owner. Drawings show general arrangement of equipment and are not intended to indicate the exact dimensions of runs.

1.08 EXCHANGE OF INFORMATION AND COORDINATION

A. Furnish to the General Contractor, and all other Contractors, all information relative to the portion of the installation specified in this Section that will affect them, sufficiently in advance, so that they may plan their work and installation accordingly. In the case of failure on the part of this Section 333000 Subcontractor to give proper information as indicated above, sufficiently in advance, this Section 333000 Subcontractor will pay for all back charges incurred by the General Contractor and other Contractors for the modifications, renovation and/or relocation of any portion of the work already performed by them in conjunction with this Contract due to this Section 333000 Subcontractor's delay or for having given incorrect information.

1.09 WORKMANSHIP

A. The entire work provided in this Specification shall be constructed and finished, in every respect, in a workmanlike and substantial manner. It is not intended that the Drawings shall show every detail, but this Section 333000 Subcontractor shall furnish and install all such parts as may be necessary to complete the work in accordance with the best trade practice and to the satisfaction of the Amesbury Water and Sewer Division.

1.10 SITE INVESTIGATION

A. It shall be the responsibility of this contractor to acquaint themselves with the available information, before submitting their bid. Bidders must visit the site and acquaint themselves with the existing conditions and shall study all Site, Architectural, Structural, Plumbing, Fire Protection, Mechanical and Electrical Drawings, as well as the specifications. The Bidders shall fully inform themselves of all local and state Code requirements. Extra compensation will not be given for obvious conflicts apparent at the time of the start of the project. Refer to Section 011000- Summary of Work.

1.11 INSURANCE

A. This Section 333000 Subcontractor shall include the premiums of the insurance required by the Contract and General Conditions.

1.12 PERMITS AND INSPECTIONS

A. This Section 333000 Subcontractor shall obtain, and pay for, all the permits required for this Section of the work. This Section 333000 Subcontractor shall also obtain and pay for all the inspections and tests required. Defects discovered in work, materials and/or equipment shall be replaced at no cost to the Owner, and the inspection and test shall be repeated. When work is completed, this Section 333000 Subcontractor shall furnish a Certificate of Inspection and Approval to the Owner before final payment of the Contract will be allowed.

B. The system installer is responsible for notifying the Architect, 48 hours prior to significant construction events, to schedule necessary inspections.

1.13 CONTRACT COST BREAKDOWN

A. At the start of construction, submit a breakdown of material and labor costs to aid the Architect in determining the value of the work installed, as the job progresses. The cost breakdown shall itemize categories of materials or portions of systems, as may be the case, to place a value on the work as it is installed.

B. **NO REQUISITIONS WILL BE PAID UNTIL AFTER THE BREAKDOWN IS DELIVERED TO THE ARCHITECT.**

1.14 GUARANTEE

A. Unless otherwise noted, all materials, items of equipment and workmanship furnished under this Section 333000 shall carry the standard warranty against all defects in material and workmanship for a period of not less than one (1) year from the date of final acceptance of the work. Any fault due to defective or improper material or workmanship, which may develop within that period, shall be made good, forthwith, by and at the expense of this Section 333000 Subcontractor, including all other damage done to areas, materials and other systems resulting from this failure.

B. This Section 333000 Subcontractor shall guarantee that all elements of the Systems are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.

C. Upon receipt of notice from the Owner of failure of any part of the Systems during the guarantee period, the affected part or parts shall be promptly replaced by the Section 333000 Subcontractor at no charge to the Owner.

D. This Contractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

1.15 SYSTEM ACCEPTANCE

A. The entire Sanitary Sewerage System shall be fully operational prior to acceptance by the Owner. All components of the system shall be cleaned and /or flushed out by this Section 333000 Subcontractor and the proper operation of all components of the system shall be demonstrated to the Owner. The Section 333000 Subcontractor shall secure a Letter of Acceptance of the System from the Owner. A copy of said Letter shall be submitted to the Architect prior to formal acceptance of the Sanitary Sewerage Systems.

1.16 MATERIALS AND INSTALLATIONS

A. Materials shall be the best of their respective kinds and in full accord with the most modern construction. All materials shall be new.

B. All materials necessary to make the installation complete in every detail shall be furnished and installed under this Contract, whether or not specifically shown on the Drawings or specified herein.

C. It is the intent of the Specifications that one manufacturer be selected, not a combination, for any particular classification of materials.

D. Where materials, equipment, apparatus or other products are specified by manufacturer, brand name, type or catalog number, such designation is to establish the standard of desired quality and style and shall be the basis of the bid.

1.17 MATERIALS AND EQUIPMENT HANDLING

A. This Section 333000 Subcontractor shall do all handling of his materials and equipment and the resulting cleanup, at his expense, in a safe and satisfactory manner. Special attention shall be paid to the protection of life and property and the equipment or apparatus handled, and any corresponding damages shall be replaced, repaired or paid for by this Section 333000 Subcontractor. This Section 333000 Subcontractor shall provide all rigging and hoisting required to complete the work of this Section.

1.18 MAINTENANCE AND PROTECTION OF MATERIALS

A. This Section 333000 Subcontractor shall be responsible for the maintenance and protection, from loss or damage of all causes, of all equipment, materials and tools supplied by him and stored or installed on the job site, until final acceptance of the project by the Owner.

B. This Section 333000 Subcontractor shall store his materials and equipment in the location designated by the Architect and maintain the storage area in a safe condition.

1.19 OPERATING INSTRUCTIONS AND MAINTENANCE MANUAL

A. Provide operating instructions to the Owner's designated representative, with respect to operating and maintenance procedures, for all equipment and systems installed. The cost of such instruction, up to a full eight (8) hours, shall be included in the Contract price. This and all instruction sessions shall be videotaped by the Section 333000 Subcontractor and three (3) copies of the videotape submitted to the Architect.

B. At least two (2) months prior to occupancy or final acceptance of the project, turn over to the Architect three (3) complete manuals containing the following, in accordance with SECTION 017823 OPERATION AND MAINTENANCE DATA and SECTION 017700 - PROJECT CLOSEOUT:

1. Complete Shop Drawings of all structures, covers, pumps, piping and appurtenances.
2. Names, addresses and telephone numbers of all suppliers of the materials and Systems.
3. Guarantees on all equipment.
4. Preventive maintenance instructions for all systems.

C. Each manual shall be typewritten and bound under a separate hard cover 3-ring binder and will be reviewed by the Architect. The manuals shall be clearly and permanently identified on the cover with the name of the project and the trade involved.

D. Upon completion of the instructions, this Section 333000 Subcontractor shall obtain a letter of acceptance of the instructions as being complete from the Owner. Submit a copy of said letter to the Architect.

1.20 SHOP DRAWING AND MATERIAL SCHEDULE

A. Submit complete Shop Drawings in accordance with provisions of Section 013300 - SUBMITTALS.

B. Within 30 days after the date of Notice to Proceed, and before purchasing any materials or equipment, submit to the Architect for approval a complete list of the names of manufacturers of all materials and equipment proposed to fulfill the work of this Section. After the list has been processed by the Architect, submit complete Shop Drawings of all equipment and materials.

C. The approval of equipment and materials does not relieve this contractor from the responsibility of Shop Drawing errors in details, sizes, quantities and dimensions which deviate from the Specifications, Contract Drawings and/or job conditions as they exist.

D. Changes to work already performed, made necessary by delays in Shop Drawing approvals, are the responsibility of this Section 333000 Subcontractor.

1.21 RECORD DRAWINGS

A. Submit Record Drawings in accordance with SECTION 017839 PROJECT RECORD REQUIREMENTS and - SECTION 01700, Project Closeout.

B. In addition to the above, upon final completion of the project, an "As-Built Plan" shall be submitted as part of the closeout documents provided to the Amesbury Water/Sewer Division and the Architect showing the layout of the system. This plan shall consist of all sewer lines, structures, rim and invert elevations, service cleanouts, and distances (swing ties) to the nearest permanent structures. These plans shall also show the locations of the sewer lines and appurtenances abandoned in place under the scope of this project. These plans shall be prepared by a Massachusetts Registered Land Surveyor retained by this Section 333000 Subcontractor for this specific purpose. Note that in order for the “As-Built Plan” to be properly prepared, the surveyor must be on site sufficiently during the construction and installation to locate structures before backfill to permit the Surveyor to certify to the locations of underground utilities shown on the As-Built Plan. Notes on the plan such as “approximate location”, or “pipe / structure buried, could not be located” are not acceptable to meet this standard. As-built plans are to be provided in hard copy and electronic dwg, tiff and pdf formats.

1.22 RUBBISH REMOVAL

A. At the completion of the work, or when ordered by the General Contractor or the Architect, this Section 333000 Subcontractor shall remove from the property, all the rubbish, debris and waste material belonging to him. Keep the job site free from accumulation of waste, material, debris and rubbish; site must be maintained in a clean condition.

1.23 TEMPORARY STRUCTURES

A. This Section 333000 Subcontractor shall provide on the premises, where directed by the Architect, shall maintain in good condition, and shall remove when directed, suitable and substantial watertight sheds in which he shall store all his materials and equipment.

1.24 TEMPORARY SERVICES

A. All water, electricity, fire protection and sanitary facilities required for safe and efficient construction during normal working hours shall be furnished in accordance with Section 015000, TEMPORARY FACILITIES AND CONTROLS.

1.25 TESTS

A. Furnish all labor, materials, instruments, supplies and services and bear all cost for the accomplishment of the tests herein specified. Correct all defects appearing under test, repeat the tests until no defects are disclosed and leave the systems ready for use.

B. Perform low pressure vacuum test on all new and modified sewer manholes per ASTM C1244 and / or other methodology required by the Amesbury Sewer and Water Division.

C. Perform low pressure air tests for PVC Sewer Pipe in accordance with ASTM F1417-98 and UBPPA UNI-B-6 and / or other methodology required by the Amesbury Sewer and Water Division.

D. Perform any tests, other than herein specified, required by the Amesbury Department of Public Works and also which may be required by legal authorities or by agencies to whose requirements this work is to conform.

E. Dispose of test water and wastes after tests are complete, in a manner in accordance with applicable laws and satisfactory to the Architect.

F. Submit all test results to the Architect.

1.26 REMOVAL / ABANDONMENT OF SANITARY SEWERS

A. Existing sewer lines and structures that will no longer be in services are to be removed where they interfere with new construction. Where sewer lines that will no longer be in service will not interfere with new construction, these are to be properly abandoned in-place per the requirements of the municipal Department of Public Works. Where allowed, abandonment in place shall be done by cutting, filling with flowable fill and capping. The location of the pipe will be survey located and shown on the As-Built Plan per Section 1.21 above. All sewer manholes no longer in service shall be removed and properly disposed of.

PART 2 PRODUCTS

2.01 MATERIALS AND WORKMANSHIP

A. This Section 333000 Subcontractor shall comply with all the rules, Codes, ordinances, regulations and requirements of all legally constituted authorities having jurisdiction over the whole, or any part of the work herein specified. These requirements are minimum criteria and no reductions permitted by code will be allowed without written permission of the Architect.

B. All equipment and materials furnished in connection with the installation shall be only new, first quality and of grade satisfactory to the Owner. They shall be of the best grade and quality of their respective kinds, free from natural, manufacturing or construction flaws, defects or irregularities and finish, fittings and workmanship shall be equal to the highest commercial grade. The Owner shall have the right to reject any part of the work in case the material or workmanship is not of satisfactory quality and this Section 333000 Subcontractor shall replace same with acceptable work at his own expense.

C. This Section 333000 Subcontractor shall make certain which materials are allowed by local authority and base his bid on these materials only. No extras will be allowed for compensating for materials rejected by local inspector regardless if they are named in this Specification or allowed by State or National Codes.

2.02 GRAVITY SEWER PIPING

A. Gravity piping 15 inches or less shall be PVC type SDR 35 piping with bell and spigot ends and fittings, except where noted otherwise on the drawings. Gravity sewers from 18 to 30 inch sewer piping shall be PVC PS115 Sewer Pipe with bell and spigot ends and Double Seal Locked in Rubber gasket system.

B. Polyvinyl chloride pipe for gravity sewers shall conform to standard specifications for PVC sewer pipe as outlined in ASTM D 3034, Standard Specification PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, 4-inch to 15-inch and 18 to 30 inch PVC sewer pipe shall also conform to ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic pipes Using Flexible Elastomeric Seals.

C. PVC Sewer pipe shall be made of PVC sewer plastic having a cell classification of 12454-B or 12454-C or 13364-13, with a minimum tensile modular 500,000 psi as defined in ASTM D 1784. Standard laying lengths shall be 10 feet, 12.5 feet and 20 feet as required. Larger pipe may be furnished in alternate sizes.

D. The pipe surface, both interior and exterior shall be free from cracks, fissures or defects in manufacture as delivered to the installation site. The interior surface of the pipe shall present a smooth, even surface of the pipe shall present a smooth, even surface and be free from surface layer eruptions. Pipe, which is determined to be defective, shall be promptly removed from the job site.

E. Pipe wall thickness shall be as specified in ASTM D 3034 for SDR pipe 35 is as enumerated below:

Nominal Pipe Size (Inches)	Pipe O.D. (Inches)	Wall Thickness (Inches)
6	6.275	0.180
8	8.400	0.240
12	12.500	0.360

F. The bell or receptacle end of the PVC pipe shall be installed upstream and shall be free from dirt, debris, or defects in manufacture which would in any way hinder the formation of a water tight joint. The spigot end of the pipe shall possess a factory bevel that is free from surface projections, cracks, fissures, and other defects, and must present a smooth even surface for jointing. The spigot end shall be clearly marked with a reference line that completely encircles the pipe, and shows the proper depth to which the spigot end should be inserted in the bell.

G. The recommended deflection for PVC pipe conforming to ASTM D 3034 standards under in place soil loadings shall not exceed 5% at any time, measured after the backfill has been in place for thirty (30) days. The minimum "pipe stiffness" at 5% deflection shall be 46 psi for all sizes when tested in accordance to ASTM Method of Testing D 2412 "External Loading Properties of Plastic Pipe by Parallel-Plate Loading". In addition, there shall be no evidence of splitting, cracking or breaking when the pipe is tested as follows:

H. Flatten a six-inch long specimen of pipe between parallel plates in a suitable press until the distance between the plates is 40% of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes.

I. The acceptability of PVC pipe shall be determined by the results of strength and deflection tests and by inspection at the delivery site. Pipe testing where required by this Section shall be completed by the Contractor at his expense. The testing laboratory shall be approved by the Owner. PVC pipe shall be CertainTeed Fluid Tite Pipe, John S. Manville Ring-Tite Gravity Sewer Pipe, J.M. Eagle Ring-Tite Pipe, or approved equal.

J. PVC PIPE JOINTS: After the PVC pipe has been laid in place in a properly graded bed, the pipes shall be jointed. Prior to jointing, the bedding directly under the bell shall be excavated to ensure that the pipe is supported uniformly throughout its length. All joints will be assembled in accordance with the manufacturer’s recommendations, and must be tested in accordance with ASTM 3212, "Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals."

The elastomeric gaskets may either be part of the integral bell design or may be supplied separately. In the latter case, only those gaskets which are designed for and supplied with the pipe may be used. The manufacturer’s suggestions for

gasket choice and installation shall be followed. All gasket materials must comply in all respects with the physical requirements as specified in ASTM F 477 "Standard Specifications for Elastomeric Seals for Joining Plastic Pipe".

Prior to making the joint, the spigot end shall be lubricated with a sealer recommended by the pipe manufacturer. Only manufacturer recommended lubricants shall be used. Once lubricated, the spigot end should be inserted to the reference mark. Use of pullers and mechanical equipment for making joints shall not be allowed.

K. FITTINGS & ADAPTORS FOR PVC PIPE GRAVITY SEWERS:

Fittings and adaptors for PVC gravity sewer pipe shall be supplied by the pipe manufacturer and assembled in the field, according to the recommendations of the supplier. (All fittings must conform to ASTM D 2466 and/or ASTM D2467 "Socket Type Polyvinyl Chloride Plastic Pipe Fittings.)"

Fittings and adaptors shall be of the injection-molded type, and shall contain elastomeric seals to insure a proper sea]. Elastomeric seals are subject to the requirements of ASTM 3212.

When an adaptor must be installed for a building connection, or any field cut pipe must be joined, the cut spigot end must be beveled to the proper taper, and must present an even surface free from cracks, fissures, or projections to insure a proper seal.

Pipe cutting should be performed with a hand keyhole saw or power sabre saw. Adequate ventilation must be afforded, to protect workers from noxious fumes generated during cutting. Manufacturer’s recommendations for cuffing and beveling PVC sewer pipe shall be followed when installing fittings and adaptors.

2.03 FRAMES AND COVERS

A. Furnish and install all iron work for manholes, structures and for all other work under this section.

B. Except as otherwise indicated on drawings, covers and frames shall be machined gray cast iron, ASTM A-48, Class 20 as manufactured by LeBaron Foundry, New Bedford, Massachusetts, Mechanics Foundry, Boston, Massachusetts, or Neenah Foundry, Neenah, Wisconsin or approved equal, as approved by the Architect. Covers shall have 2 lift holes. Cast iron frames and covers shall be cleaned of all dirt, rust and scale, and while cleaned, shall be given a full coat of coal-tar pitch varnish applied hot. The manhole frame shall have a 26" dia cover with 24 clear opening and be 8" in height and shall be heavy duty (Massachusetts D.P.W. Standards). Frames shall be set upon a full bed of mortar, and mortar shall be brought up alongside of frame to provide a watertight joint.

C. Manufacturer's nameplate, name, or trademark shall be permanently affixed to all castings. Covers for manholes shall be vented and shall be marked "SEWER" sewer in a 3" letters, centered in cover.

D. Steps shall be aluminum or steel reinforced copolymer polyethylene rungs cast in place at point of manhole manufacturer, 12" on center and formed to drop front design, meeting OSHA requirements. Steps are required on all manholes over 4 feet in depth from ground surface to the inside bottom.

2.04 PRECAST CONCRETE SANITARY MANHOLES

A. Precast reinforced concrete monolithic manhole base, barrel and eccentric top sections shall conform to Specifications for Precast Reinforced Concrete Manhole Sections, ASTM Designation C478, and the following additional requirements:

1. The wall thickness shall be not less than five (5) -inches.
2. Barrel sections shall have tongue and groove joints with 'O"-ring type rubber gasket conforming to ASTM C443.
3. Type 11 cement shall be used except as otherwise approved.
4. Top sections shall be eccentric except that concentric top sections shall be used where shallow cover requires a top section less than 4 feet deep.
5. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section.
6. Sections shall be cured by an approved method and shall not be shipped, nor manhole steps subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair whichever is the longer.

B. The tops of bases shall be suitably shaped to mate with the precast barrel section.

C. The bricks for tables and inverts shall be good, sound, hard and uniformly burned, regular and uniform in shape and size, of compact texture and satisfactory to the Amesbury Water and Sewer Division. Bricks shall comply with the latest specifications of the American Society for Testing and Materials for Sewer Brick, Grade B, except that the mean of five tests for absorption shall not exceed 8 percent and no individual brick exceed 11 percent. Underburned or Salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Architect, they shall be immediately removed from the site of the work and satisfactory bricks substituted, therefore.

D. Bricks for building up and leveling manhole frames shall conform to ASTM C62.

E. Mortar shall be composed of one part Type 11 portland cement to two parts sand to which a small amount of hydrated lime not to exceed 10 lbs to each bag of cement shall be added. This mortar composition shall also be used for mortared troughs.

F. The sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. It shall be free from vegetable matter, loam, organic or other materials of such nature or of such quantity as to render it unsatisfactory.

G. The hydrated lime shall also conform to the American Society for Testing and Materials, Serial Designation C207.

H. Inverts and Table shall be constructed of hard burned, Grade B red clay brick with Portland Cement joints. The table shall be constructed at an elevation even with the top of the pipe and shall slope up toward the sidewalls. Inverts shall be constructed in a manner to provide smooth flow through manholes, with no sharp turns or projecting portions of brick. Bricks for inverts shall be placed on edge and laid flat for table.

I. All exteriors of manholes shall be waterproofed by heavy application of emulsified asphalt moisture repellent compound.

2.05 CONCRETE STRUCTURES

A. All components shall be constructed of precast reinforced concrete.

B. All components shall be constructed to the dimensional requirements shown on the plans.

C. All construction materials shall meet the following minimum requirements:

1. concrete strength: f'c=4,000 psi at 28 days, density 140 pcf.
2. cement: portland type i or iii per ASTM c150-81.
3. admixtures: per ASTM c233-82.
4. minimum design loading: (H-20)
5. minimum wall thickness: (see details)

D. Components shall be embossed with a seal stating that the quality control/quality assurance standard outlined in ASTM c 1227-93, has been met.

E. All components shall be placed on a level stable base that has been mechanically compacted and onto which six (6) inches of crushed stone (2 inch minus stone meeting MHD M2.01.1) has been placed. For components placed in fill, the base material shall be compacted to 95% of standard proctor density, before placement of crushed stone.

F. No structures shall be located directly upon or above any component access locations which interfere with performance, access, inspection, pumping or repair.

G. All components shall be either:

1. watertight through manufacturer's specifications and warranty; or

2. made watertight by the manufacturer, equipment supplier or installer using asphalt or synthetic polymer sealer specified by the concrete or synthetic polymer material manufacturer.

H. All components shall have a minimum cover of nine (9) inches.

I. The contractor shall provide shop drawings of the units proposed, the configuration and calculations showing conformance with the above stated design criteria for approval by the Architect. If unit other than the units above and configuration shown on the plan is proposed, the contractor will also be responsible to demonstrate to permit approving authorities that the unit proposed is an equal or better alternative and shall obtain approval from applicable regulatory authorities.

2.06 DEMARCATION WARNING TAPE

A. Two (2) different warning tapes are required for sewer piping. Both warning tapes shall be a minimum 3-inch width, non-adhesive, reinforced, barricade style warning tapes. Both warning tapes shall be made of reinforced polypropylene with a minimum thickness of 4 mil and shall be yellow with black lettering. One (1) of the warning tapes shall have the words “CAUTION HAZARDOUS MATERIAL” repeating for the entire length. One (1) of the warning tapes shall have the words “CAUTION BURIED UTILITY” repeating for the entire length.

PART 3 EXECUTION

3.01 INSTALLATION

A. This Section 333000 Subcontractor shall comply with all the rules, codes, ordinances, regulations and requirements of all legally constituted authorities having jurisdiction over the whole or any part of the work herein specified. Regulations supplement to this Specification and shall take precedence.

B. Subsurface components of a system shall not be backfilled, or otherwise concealed from view, until a final inspection has been conducted by the approving authority and permission has been granted by the approving authority to backfill the system.

C. Excavation and backfill of the trenches for the pipe, manholes and subsurface concrete structures shall be performed under the work of SECTION 312000 - EARTHWORK. It shall be the responsibility of this SECTION 333000 Contractor to ensure that bedding, depth, width, bottom of excavation, is suitable for the proper installation of the work.

3.02 PIPING

A. Excavation: The trench for the pipe shall be excavated to the required line and grade and of sufficient width to permit thorough tamping of the fill material under the haunches and around the pipe. (Soft or unsuitable material encountered below the normal bedding line of the pipe shall be over excavated and filled with graded gravel (Structural Fill) and thoroughly compacted to provide a stable base). Graded gravel shall be installed to level the trench and shall be placed to a minimum six (6) inch depth below the pipe. If any cross pipes, conduits, drains or other unforeseen obstacles are encountered in the excavation, the grade of the bottom of the trench may be raised or lowered during the excavation operation, subject to the approval of the Amesbury Water and Sewer Division and the Architect. Use concrete or support approved per this Section under the existing pipes passing through the excavation where said pipe would normally be supported by backfilled earth. Where concrete obstructions, rock, ledge or boulder formations are encountered, it shall be removed to a line eight (8) inches below the bottom of the outside and twelve (12) inches on each side of the pipe barrel or structure. No part of any rock remaining in the trench shall come within eight (8) inches of any portion of the pipe or structure. No blocking of any kind shall be permitted.

B. Bedding Pipe: Pipe bedding shall consist of 3/4 inch crushed stone meeting MHD M2.01.0 and M2.01.4. The trench shall be filled and compacted to the bottom elevation of the pipe with pipe bedding. The pipe shall be laid true to the specified lines and grades. Each section of pipe shall have a firm bearing throughout its length. After the pipe has been installed and inspected, pipe bedding material shall be brought up to halfway up to 12 inches above the pipe in 6" layers and hand tamped as it is placed. Care shall be taken to carefully grade and compact the graded gravel, and prevent pipe displacement.

C. Following placement of the pipe and bedding to 12 inches above the pipe, a select backfill material consisting of graded gravel meeting MHD M1.03.0 type c, with no stone over two (2) inches shall be placed in twelve (12) inch layers and compacted. Care shall be taken in compacting backfill material to prevent pipe deflection or displacement. Within proposed landscape areas where no pavement or structures are proposed, backfill material above 12 inches above the pipe may consist of “Ordinary Borrow” as described under Section 312000 Earthwork. Backfill material above 12" above top of pipe shall be compacted in 12" layers with a suitable power driven tamper.

D. All pipe shall be carefully cleaned just before laying. Extreme care shall be exercised so as not to damage the pipe in handling. Each pipe shall be laid true to line and grade and so laid as to form a tight joint with the next adjoining pipe and to bring the inverts continuous. No piping shall be laid in water. Water in trench shall be kept below pipes until pipes have been back filled.

E. LASER BEAM - ALIGNER: The use of laser aligning equipment may be used for the laying of lines to the specified lines and grades, in lieu of batter boards. The laser beam projector is to be rigidly mounted with two (2) point suspension, to its support platforms. This will assure that all ground equipment vibrations will be kept to a minimum and permit the laser beam to project itself coaxially through the center of the pipe.

F. Assembly: After pipes have been bedded, joining and assembly shall be in accordance with the manufacturers recommendations.

G. Backfilling: After pipe and joints have been inspected, tested and recorded on record drawings, and approved by the Amesbury Water/Sewer Division and the Architect, the trench shall be backfilled.

H. Plug all open ends when work is stopped or suspended for any reason or any length of time.

I. Provide two (2) continuous warning tapes above the entire length of installed sewer piping located 12-inches below grade. The two warning tapes shall be laid no more than 6 inches apart.

3.03 STRUCTURES

A. Stake layout of structures for Architect's approval before proceeding with installation and construction.

B. Structures shall be built to the lines, grades, dimensions and design shown on the drawings and as directed with the necessary frames and covers, and in accordance with these specifications.

C. Utility structures shall not be constructed when the temperature is below 32 degrees F.

D. The joints in precast units shall be wetted and completely mortared immediately prior to setting a section. No structure shall be backfilled until all mortar has completely set.

E. Cement concrete bases or precast concrete bases shall be founded on 6" minimum of graded crushed stone (2 inch minus meeting MHD M2.01.0 and M2.01.1 with no stone over two (2) inches compacted to grade.

F. Paved inverts shall be constructed to conform to the size of pipe and flow. At changes in direction, the inverts shall be laid out in curves of the longest radius possible tangent to the center line of the pipes. Invert channels shall be smooth and accurately shaped to elevations called for on the drawings.

G. Manholes shall be constructed as detailed on the Drawings.

H. Precast concrete manhole sections shall be set so as to be vertical and with sections in true alignment, 1/4" maximum tolerance to be allowed. Joints shall be mortared inside and outside after the precast sections are set in place. Mortar shall be comparatively dry (one part cement to two parts sand) and shall be finished flush with the surface. Allow joints to set for 24 hours before backfilling. If leaks appear in the manholes, the inside joints shall be caulked with lead wool. The Section 333000 Subcontractor shall install the precast sections in a manner that will result in a watertight joint.

I. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done prior to setting them in place. This is to prevent any subsequent jarring which may loosen the mortar joints. Joints shall be finished flush with adjoining surfaces.

J. All holes in sections, if any, used for handling, and all joints shall be thoroughly plugged/filled with a non-shrink grout (or by grout in combination with concrete plugs). Joints shall be smoothed.

K. Manhole pipe connections may be accomplished in two manners:

1. Pipe connections shall be of the neoprene boot with stainless steel clamp type; or,

2. "A-Lok type rubber 'O'-ring integral to hole. (with prior approval of the Amesbury Water/Sewer Division).

3.04 CASTINGS AND CLEANING

A. Manhole frames and covers within the limits of bituminous concrete pavement shall be set at the elevation of the top of the wearing course.

B. All new manholes shall be thoroughly cleaned by the removal of all accumulations. of silt, debris and foreign matter of any kind, prior to final inspection.

3.05 INSPECTION OF STRUCTURES

A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Architect, or other representative of the Owner. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places, and the sections shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. All sections which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the SECTION 333000 Contractor's expense.

B. At the time of inspection, the sections will be carefully examined for compliance with the ASTM designation hereinbefore specified and these Specifications, and with the approved manufacturers' drawings. All sections shall be inspected for general appearance, dimension, "scratch strength", blisters, cracks, roughness, and soundness. The surface shall be dense and close-textured.

C. Imperfections may be repaired, subject to the approval of the Architect, after demonstration by the manufacturer that strong and permanent repairs will result.

Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at the end of 7 days and 5,000 psi at the end of 28 days, when tested in 3" x 6" cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Amesbury Water and Sewer Division.

3.06 CONNECTIONS TO EXISTING STRUCTURES

A. Existing structures which are to be connected to are noted on the drawings. For connection to existing sewer manholes use a hydraulic or electronic coring machine (jackhammer not allowed), install rubber boot and hydraulic cement at connection. Adjust mortar table to accommodate new sewer connection.

3.07 CLEANING AND ADJUSTING

A. Before the systems are accepted, all piping and structures shall be thoroughly cleaned so that no dirt, stones or other foreign matter will be deposited and be detrimental to the operation of the systems.

B. After laying of the pipe is completed, the interior of the sewer pipe line shall be thoroughly cleaned from construction debris. Pipe line shall be flushed to remove any foreign matter, with bulkheads placed at strategic locations to prevent wash of undesirable material through completed sections of the system. When deemed necessary by the Architect, a TV inspection may be required of the sewer line. All costs for such a TV inspection, if required by the Architect, shall be borne by this Section 333000 Subcontractor, as part of the Contract.

3.08 OPERATION AND START-UP

A. This Section 333000 Subcontractor shall furnish all labor, materials, and equipment necessary to place the system into operation and demonstrate the fitness of the installation.

B. Prior to start-up, the Section 333000 Subcontractor shall check all systems for completeness, provide lubrication, clean and flush all piping and equipment, perform pressure tests and make all other adjustments necessary to start up.

C. The Section 333000 Subcontractor may start portion of the systems as the work progresses; however, all systems which are normally operating simultaneously must be so operated upon completion of the work.

3.09 COORDINATION WITH EXISTING UTILITIES

A. Special attention shall be given to the protection of, and coordination with, existing off-site utilities. This Section 333000 Subcontractor shall contact the Amesbury Water/Sewer Division and "DIG-SAFE" to identify and to locate these services prior to beginning any work.

3.10 TESTING OF STRUCTURES

A. The Sewer Manholes shall be tested for watertightness. Test shall consist of filling structure to overflowing with water and maintaining the water level for 1-hour without adding water.

B. Make all repairs and retesting required to accomplish a successful test.

C. Provide all water, labor and equipment necessary to perform testing.

D. Alternative test for structures with approval of the Amesbury Department of Public Works would be a low-pressure vacuum test. Procedure to be submitted for approval by the Architect and DPW.

3.11 TESTING OF PIPING SYSTEMS

A. General

1. All piping shall be subjected to water or air testing as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the owner and the Architect with 48-hour notice given these authorities. All tests shall be performed by an independent agency acceptable to the City of Amesbury DPW. Test reports shall be submitted to the Architect and the Amesbury DPW.
3. All equipment, material and labor required for testing any of the various systems or any part thereof shall be furnished by this SECTION 333000 contractor.
4. Repair, or if directed by the Architect, replace all defective work with new work without extra charge to the Contract. Repeat tests as directed until all work is proven to meet the requirements specified herein.
5. Restore to its finished condition, any work damaged or disturbed by tests.
6. Perform all tests herein specified and all other tests which may be required by any and all authorities or agencies to whose requirements this work is to conform.
7. This SECTION 333000 Subcontractor shall notify the Architect and the inspectors having jurisdiction, a minimum of 48 hours in advance of making any required tests, so that arrangements may be made for their presence to witness his scheduled tests.

B. Exterior Sewer System

1. Leakage tests: upon completion of a section of the sewer, this SECTION 333000 Subcontractor shall dewater it and conduct a satisfactory test for at least 24-hours. This SECTION 333000 Subcontractor shall be responsible for the satisfactory water-tightness of the entire section of sewer and shall satisfactorily repair all joints or other locations that are not sufficiently watertight.
2. The piping shall be tested before any connections are made to buildings.
3. Construct such weirs or other means of measurements as may be required, furnish water and do all necessary pumping to enable the tests to be properly made.
4. Should the sections under test fail to meet the requirements, do all work of locating and repairing leaks and retesting without additional compensation.

5. Low pressure air tests shall be used to test the sewer lines. Low pressure air tests shall be completed in accordance with ASTM F 1417-98. Leakage shall be measured in terms of time for the pressure to drop from 3.5 pounds per square inch gauge to 3.0 pounds per square inch gauge. The maximum allowable leakage rate shall be 0.0015 cubic feet per minute per square foot of internal pipe surface.

6. This SECTION 333000 Subcontractor shall make all necessary arrangements for leakage tests. Certified test results shall be submitted to the Amesbury Division of Public Works.

7. DEFLECTION TESTING: PVC sewer pipe shall be tested for abnormal deflection due to installation and backfill methods. Deflection testing may be completed with a deflectometer, calibrated television of go, no go mandrel or sewer ball. The sewer ball or mandrel shall have a diameter of no less than 95 percent. of the inside pipe diameter. Maximum allowable deflection (reduction in vertical diameter) should not exceed 5 percent. Locations with deflection in excess of this limit shall be excavated and repaired by rebuilding or replacement.

8. The test pressures shall be maintained for the full period of tests.

9. In case the specified rate of leakage is exceeded, the leaks shall be removed and replaced by this SECTION 333000 Subcontractor and the pipe line retested, repeatedly if necessary, at no additional expense to the Owner, until the required conditions are met. The tests shall be continued for a period of at least one hour after all leaks have been stopped and all corrective work has been satisfactorily completed and after the maximum rate of inflow of water into the pipe line as specified above has not been exceeded.

10. If, in the judgement of the Owner, it is impracticable to follow any of the foregoing procedures exactly for any reason, modifications in the procedures shall be made as approved, but in any event this SECTION 333000 Subcontractor shall be responsible for the ultimate tightness of all pipelines within the respective leakage requirements specified herein. Any modifications to the procedures, as directed, shall be performed by this SECTION 333000 Subcontractor at no additional expense to the Owner.

11. Tests shall be made by the SECTION 333000 Subcontractor in the presence of the representative of the Owner.

END OF SECTION

SECTION 334000

STORM DRAINAGE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Furnish and install the following items required to complete the work of this SECTION, as shown on the Contract Drawings and specified herein:

1. Storm drains from 10 feet beyond the building wall
2. Connections at 10 feet from the building wall to storm drain piping furnished by SECTION 220001 - PLUMBING
3. Drain manholes
4. Catch basins and drain inlets.
5. Structure grates, frames and covers.
6. Connection to existing storm drains.
7. Protection of existing utilities
8. Resetting of existing frames, covers, grates and tops to new grades.
9. Bioretention Basins
10. Underground Recharge Chamber Systems
11. Underground Detention Systems
12. Sediment Forebays
13. Stormwater Treatment Units
14. Removal/Abandonment of existing drains.
15. Pipe Outfalls.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. The following related work is to be performed under the designated SECTIONS:

1. Excavation and backfill - SECTION 312000 - EARTHWORK.
2. Interior plumbing to 10' from building - SECTION 220001 - PLUMBING.
3. Electricity and water for all tests and temporary operation of system - SECTION 015500 - TEMPORARY FACILITIES AND CONTROLS.

4. Roads, drives and walkways including patching of existing streets - SECTION 321200 - FLEXIBLE PAVING and SECTION 321300 - RIGID PAVING.

5. Landscape Drainage - SECTION 334610 - LANDSCAPE SUBDRAINAGE.

1.04 QUALIFICATIONS

A. This SECTION 334000 Subcontractor shall be authorized by, or obtain authorization from, the City of Amesbury to perform drain laying work in the City.

B. No work may be begun without this authorization.

1.05 INTENT

A. All work shall be in accordance with the arrangement, details and locations, as indicated on the Contract Drawings, Reference Drawings and any supplemental addenda, bulletins or drawings issued by the Architect. Layouts are diagrammatic and final arrangement shall suit field conditions. Install all necessary fittings, structures and piping offsets required to meet job conditions. The Drawings are not intended to be scaled but shall be followed with sufficient accuracy to coordinate with other work and structural limitations. Work installed in a manner contrary to that shown on the Drawings, or interfering with the work of another trade, shall be removed and reinstalled when so directed by the Architect. Discrepancies and questionable points shall be immediately reported to the Architect for clarification.

1.06 CODES, REGULATIONS AND STANDARDS

A. All work shall be installed in conformance to the governing Codes, Regulations and Ordinances. It shall be the responsibility of this Section 334000 Subcontractor to familiarize himself with all governing Codes, Regulations and Ordinances and report any non-compliance of the Plans and Specifications to the Architect, prior to entering into a contract. All the preceding requirements shall take precedence over the Plans and Specifications. These requirements are minimum criteria and no reductions permitted by code will be allowed without written permission of the Architect.

B. All workmanship, methods and materials shall meet the highest standards of the trade and, in general, shall conform to the standards of the following associations:

American Society of Testing Materials (ASTM)
Massachusetts Environmental Code
Massachusetts State Building Code
Massachusetts Stormwater Management Regulations
Massachusetts Wetlands Protection Act
City of Amesbury Building Regulations, Laws, Codes and Ordinances
City of Amesbury Dept. of Public Works Construction Standards
Massachusetts Department of Transportation (MDOT) Standards

1.07 DRAWINGS AND CONFLICTS IN THE WORK

A. The Drawings and Specifications are intended to be complementary. Any materials shown or specified in one, but not in the other, reasonably implied and usually included under good industry practice and/or required by applicable Codes and Regulations for the proper and safe completion and operation of the work described herein, shall be furnished and installed by this SECTION 334000 Subcontractor at no additional cost to the Owner. Drawings show general arrangement of the work and are not intended to indicate the exact dimensions of runs.

1.08 EXCHANGE OF INFORMATION AND COORDINATION

A. Furnish to the General Contractor, and all other Contractors, all information relative to the portion of the installation specified in this Section that will affect them, sufficiently in advance, so that they may plan their work and installation accordingly. In the case of failure on the part of this SECTION 334000 Subcontractor to give proper information as indicated above, sufficiently in advance, this SECTION 334000 Subcontractor will pay for all back charges incurred by the General Contractor and other Contractors for the modifications, renovation and/or relocation of any portion of the work already performed by them in conjunction with this Contract due to this SECTION 334000 Subcontractor's delay or for having given incorrect information.

1.09 WORKMANSHIP

A. The entire work provided in this Specification shall be constructed and finished, in every respect, in a workmanlike and substantial manner. It is not intended that the Drawings shall show every detail, but this SECTION 334000 Subcontractor shall furnish and install all such parts as may be necessary to complete the work in accordance with the best trade practice and to the satisfaction of the Architect and the Owner.

1.10 SITE INVESTIGATION

A. It shall be the responsibility of all bidders to acquaint themselves with the available information, before submitting their bid. Bidders must visit the site and acquaint themselves with the existing conditions and shall study all Site, Architectural, Structural, Mechanical and Electrical Drawings, as well as the specifications. The Bidders shall fully inform themselves of all local and state Code requirements. Extra compensation will not be given for obvious conflicts apparent at the time of the start of the project. Refer to Section 011000 - Summary of Work.

1.11 INSURANCE

A. This SECTION 334000 Subcontractor shall include the premiums of the insurance required by the Contract and General Conditions.

1.12 PERMITS AND INSPECTIONS

A. This SECTION 334000 Subcontractor shall obtain, and pay for, all the permits required for this Section of the work. He shall also obtain and pay for all the inspections and tests required. Defects discovered in work, materials and/or equipment shall be replaced at no cost to the Owner, and the inspection and test shall be repeated. When work is completed, this SECTION 334000 Subcontractor shall furnish a Certificate of inspection and Approval to the owner before final payment of the Contract will be allowed.

1.13 CONTRACT COST BREAKDOWN

A. At the start of construction, submit a breakdown of material and labor costs to aid the Architect in determining the value of the work installed, as the job progresses. The cost breakdown shall itemize categories of materials or portions of systems, as may be the case, to place a value on the work as it is installed.

B. **NO REQUISITIONS WILL BE PAID UNTIL AFTER THE BREAKDOWN IS DELIVERED TO AND APPROVED BY THE ARCHITECT.**

1.14 GUARANTEE

A. Unless otherwise noted, all materials, items of equipment and workmanship furnished under this Section 334000 shall carry the standard warranty against all defects in material and workmanship for a period of not less than one (1) year from the date of final acceptance of the work. Any fault due to defective or improper material or workmanship which may develop within that period, shall be made good, forthwith, by and at the expense of the Subcontractor, including all other damage done to areas, materials and other systems resulting from this failure.

B. This SECTION 334000 Subcontractor shall guarantee that all elements of the Systems are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.

C. Upon receipt of notice from the owner of failure of any part of the Systems during the guarantee period, the affected part or parts shall be promptly replaced by this SECTION 334000 Subcontractor at no charge to the Owner.

D. This SECTION 334000 Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

1.15 SYSTEM ACCEPTANCE

A. The entire Storm Drainage System shall be fully operational prior to acceptance by the Owner. All equipment, valves, and appurtenances, shall be test operated, calibrated and adjusted by this SECTION 334000 Subcontractor and the proper operation of all components of the system shall be demonstrated to the Owner. This SECTION 334000 Subcontractor shall secure a Letter of Acceptance of the system operation demonstration from the Owner. A copy of said Letter shall be submitted to the Architect.

1.16 MATERIALS AND INSTALLATIONS

A. Materials shall be the best of their respective kinds and in full accord with the most modern construction. All materials shall be new.

B. All materials necessary to make the installation complete in every detail shall be furnished and installed under this Contract, whether or not specifically shown on the Drawings or specified herein.

C. It is the intent of the Specifications that one manufacturer be selected, not a combination, for any particular classification of materials.

D. Where materials, equipment, apparatus or other products are specified by manufacturer, brand name, type or catalog number, such designation is to establish the standard of desired quality and style and shall be the basis of the bid.

1.17 MATERIALS AND EQUIPMENT HANDLING

A. This SECTION 334000 Subcontractor shall do all handling of his materials and equipment and the resulting cleanup, at his expense, in a safe and satisfactory manner. Special attention shall be paid to the protection of life and property and the equipment or apparatus handled, and any corresponding damages shall be replaced, repaired or paid for by this SECTION 334000 Subcontractor. This SECTION 334000 Subcontractor shall provide all rigging and hoisting required to complete the work of this Section.

1.18 MAINTENANCE AND PROTECTION OF MATERIALS

A. This SECTION 334000 Subcontractor shall be responsible for the maintenance and protection, from loss or damage of all causes, of all equipment, materials and tools supplied by him and stored or installed on the job site, until final acceptance of the project by the Owner.

B. This SECTION 334000 Subcontractor shall store his materials and equipment in the location designated by the Owner and maintain the storage area in a safe condition.

1.19 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Provide operating instructions to the Owner's designated representative, with respect to operating and maintenance procedures, for all equipment and systems installed. The cost of such instruction, up to a full eight (8) hours, shall be included in the Contract price.

B. At least two (2) months prior to occupancy or final acceptance of the project, turn over to the Architect three (3) complete manuals containing the following, in accordance with SECTION 017700 - PROJECT CLOSEOUT:

1. Complete Shop Drawings of all equipment.
2. Names, addresses and telephone numbers of all suppliers of the equipment and Systems.

3. Guarantees on all equipment.

4. Preventive maintenance instructions for all systems.

C. Each manual shall be typewritten and bound under a separate hard cover 3-ring binder and will be reviewed by the Architect. The manuals shall be clearly and permanently identified on the cover with the name of the project and the trade involved.

D. Upon completion of the instructions, this SECTION 334000 Subcontractor shall obtain a letter of acceptance of the instructions as being complete from the owner. Submit a copy of said letter to the Architect.

1.21 SHOP DRAWING AND MATERIAL SCHEDULE

A. Submit complete Shop Drawings in accordance with provisions of Section 013300 SUBMITTALS.

B. Within 30 days after the date of Notice to Proceed and before purchasing any materials or equipment, submit to the Architect for approval, a complete list of the names of manufacturers of all materials and equipment proposed to fulfill the work of this Section. After the list has been processed by the Architect, submit complete Shop Drawings of all equipment and materials.

C. The approval of equipment and materials does not relieve this SECTION 334000 Subcontractor from the responsibility of Shop Drawing errors in details, sizes, quantities and dimensions which deviate from the Specifications, Contract Drawings and/or job conditions as they exist.

D. Changes to work already performed, made necessary by delays in Shop Drawing approvals, are the responsibility of this SECTION 334000 Subcontractor.

1.21 RECORD DRAWINGS

A. Submit Record Drawings in accordance with SECTION 011000 - SUMMARY OF WORK and SECTION 017700 - PROJECT CLOSEOUT.

B. In addition to the above, upon final completion of the project an "As-Built Plan" shall be provided to the Amesbury Department of Public Works, the Architect and Owner, showing the accurate location of the systems. This plan shall include all drain lines, structures, rim and invert elevations, service cleanouts, and distances (swing ties to buried access covers) to the nearest permanent structures. These plans shall also show the locations of drains and appurtenances abandoned in place under the scope of this project. These plans shall be prepared by a Massachusetts Registered Land Surveyor retained by this Section 334000 Subcontractor for this specific purpose. Note that in order for the “As-Built Plan” to be properly prepared, the surveyor must be on site sufficiently during the construction and installation to locate structures before backfill to permit the Surveyor to certify to the locations of underground utilities shown on the As-Built Plan. Notes on the plan such as “approximate location”, or “pipe / structure buried, could not be located” are not acceptable to meet this standard. As-built plans are to be provided in hard copy and electronic dwg, tiff and pdf formats.

1.22 RUBBISH REMOVAL

A. At the completion of the work, or when ordered by the General Contractor or the Architect, this SECTION 334000 Subcontractor shall remove from the property, all the rubbish, debris and waste material belonging to him. Keep the job site free from accumulation of waste material, debris and rubbish; site must be maintained in a clean condition.

1.23 TEMPORARY STRUCTURES

A. This SECTION 334000 Subcontractor shall provide on the premises, where directed by the Architect, suitable and substantial watertight sheds in which he shall store his materials and equipment. The subcontractor shall maintain these in good condition, and shall remove when directed,

1.24 TEMPORARY SERVICES

A. All water, electricity, fire protection and sanitary facilities required for safe and efficient construction during normal working hours shall be furnished in accordance with Section 015000, TEMPORARY FACILITIES AND CONTROLS.

1.25 TESTS

A. Furnish all labor, materials, instruments, supplies and services and bear all cost for the accomplishment of the tests herein specified. Correct all defects appearing under test, repeat the tests until no defects are disclosed and leave the systems ready for use.

B. Perform any tests, other than herein specified, required by the Amesbury Department of Public Works and also which may be required by other legal authorities or by agencies to whose requirements this work is to conform.

C. Dispose of test water and wastes after tests are complete, in a manner in accordance with applicable laws and satisfactory to the Architect.

1.26 REMOVAL/ABANDONMENT OF STORM DRAINS

A. Existing drain lines and structures that will no longer be in services are to be removed within the proposed building footprint and where they interfere with new construction. Where drain lines that will no longer be in service will not interfere with new construction, these may be either removed or properly abandoned in-place per the requirements of the municipal Department of Public Works. Abandonment in place shall be done by cutting, filling with flowable fill and capping. The location of the exposed portion of the pipe will be survey located and shown on the As-Built Plan per Section 1.22 above. Drain manholes no longer in service shall be removed and properly disposed of.

PART 2 PRODUCTS

2.01 MATERIALS AND WORKMANSHIP

A. This SECTION 334000 Subcontractor shall comply with all the rules, Codes, ordinances, regulations and requirements of all legally constituted authorities having jurisdiction over the whole, or any part of the work herein specified. These requirements are minimum criteria and no reductions permitted by code will be allowed without written permission of the Architect.

B. All equipment and materials furnished in connection with the installation shall be only new, first quality and of grade satisfactory to the Owner. They shall be of the best grade and quality of their respective kinds, free from natural, manufacturing or construction flaws, defects or irregularities and finish, fittings and workmanship shall be equal to the highest commercial grade. The Owner shall have the right to reject any part of the work in case the material or workmanship is not of satisfactory quality and this SECTION 334000 Subcontractor shall replace same with acceptable work at his own expense.

C. This SECTION 334000 Subcontractor shall make certain which materials are allowed by local authority and base his bid on these materials only. No extras will be allowed for compensating for materials rejected by local inspector regardless if they are named in this Specification or allowed by State or National Codes.

D. Furnish and install temporary storm drainage system piping and components as shown on the drawings and as otherwise necessary to keep the existing school building and site drainage operational during construction.

2.02 IRON WORK

A. Furnish and install all iron work for manholes, structures and for all other work under this section.

B. Except as otherwise indicated on drawings, covers and frames shall be machined gray cast iron, ASTM A-48, Class 20 as manufactured by LeBaron Foundry, New Bedford, Massachusetts, Mechanics Foundry, Boston, Massachusetts, or Neenah Foundry, Neenah, Wisconsin or approved equal.. Cast iron frames and covers shall be cleaned of all dirt, rust and scale, and while cleaned, shall be given a full coat of coal-tar pitch varnish applied hot. All frames shall be set upon a full bed of mortar, and mortar shall be brought up alongside of frame to provide a water tight joint. Covers shall have 2 lift holes. The manhole frame shall have a 26 inch diameter cover with 24 inch clear opening and be 8 inches in height and shall be heavy duty (Massachusetts D.O.T. Standards). Drain manhole covers shall have the word "DRAIN" cast in the center and shall be heavy duty H-20 loading.

Catch Basin frames and grates shall be heavy duty H-20 loading. Catch Basin grates shall be type F, 24 inch square castings or Massachusetts Cascade Grate style as noted on the plans. Where frames abut a curb inlet, the frame shall be a 3-flange style. Beehive style grates shall be heavy duty H-20 loading. Grates shall be 28 inch diameter with a 7 inch minimum dome with 50% minimum area opening.

C. Manufacturer's nameplate, name, or trademark shall be permanently affixed to all castings. Covers for manholes and shall be marked “DRAIN”, centered in cover. See the cover pattern shown on the plan.

D. Ladder rungs shall be aluminum or steel reinforced copolymer polypropylene, formed to drop front design meeting requirements of OSHA and conforming to ASTM C478 Standards. Rungs shall be spaced 12 inches on center and shall be cast in place at the point of manufacture. Rungs are required on all manholes over 41 inches inside height.

2.03 PVC DRAIN PIPING

A. PVC gravity piping shall be PVC type 35 SDR piping with bell and spigot ends and fittings, except where noted otherwise on the drawings.

B. Polyvinyl chloride pipe for gravity storm drains shall conform to standard specifications for PVC sewer pipe as outlined in ASTM D 3034, Standard Specification PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings SDR 35, for 4-inch to 15-inch diameter. PVC pipe shall also conform to ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic pipes Using Flexible Elastomeric Seals.

C. PVC Drain pipe shall be made of PVC sewer plastic having a cell classification of 12454-2 or 12454-C or 13364-B, with a minimum tensile modular 500,000 psi as defined in ASTM D 1784. Standard laying lengths shall be 10 feet, 12.5 feet and 20 feet as required. Larger pipe may be furnished in alternate sizes.

D. The pipe surface, both interior and exterior shall be free from cracks, fissures or defects in manufacture as delivered to the installation site. The interior surface of the pipe shall present a smooth, even surface and be free from surface layer eruptions. Pipe which is determined to be defective shall be promptly removed from the job site.

E. Pipe wall thickness shall be as specified in ASTM D 3034 for SDR pipe as enumerated below:

Nominal Pipe Size Inches	Pipe O.D. Inches	Wall Thickness Inches
6	6.275	0.180
8	8.400	0.240
10	10.500	0.300
12	12.500	0.360
15	15.300	0.440

F. The bell or receptacle end of the PVC pipe shall be installed upstream and shall be free from dirt, debris, or defects in manufacture which would in any way hinder the formation of a water tight joint. The spigot end of the pipe shall possess a factory bevel, which is free from surface projections, cracks, fissures, and other defects, and must present a smooth even surface for jointing. The spigot end shall be clearly marked with a reference line, which completely encircles the pipe, and shows the proper depth to which the spigot end should be inserted in the bell.

G. The recommended deflection for PVC pipe conforming to ASTM D 3034 standards under in place soil loadings shall not exceed 5% at any time, measured after the backfill has been in place for thirty (30) days. The minimum "pipe stiffness" at 506 deflection shall be 46 psi for all sizes when tested in accordance to ASTM Method of Testing D 2412 "External Loading Properties of Plastic Pipe by Parallel-Plate Loading". In addition, there shall be no evidence of splitting, cracking or breaking when the pipe is tested as follows:

H. Flatten a six-inch long specimen of pipe between parallel plates in a suitable press until the distance between the plates is 40% of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes.

I. The acceptability of PVC pipe shall be determined by the results of strength and deflection tests and by inspection at the delivery site. Pipe testing where required shall be completed by this SECTION 334000 Subcontractor at his expense. The testing laboratory shall be approved by the Owner. PVC pipe shall be CertainTeed Fluid Tite Pipe, John S. Manville Ring-Tite Gravity Sewer Pipe, or approved equal.

J. PVC PIPE JOINTS: After the PVC pipe has been laid in place in a properly graded bed, the pipes shall be jointed. Prior to joining, the bedding directly under the bell shall be excavated to ensure that the pipe is supported uniformly throughout its length. All joints will be assembled in accordance with the manufacturer's recommendations, and must be tested in accordance with ASTM 3212, "Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals." The elastomeric gaskets may either be part of the integral bell design or may be supplied separately. In the latter case, only those gaskets which are designed for and supplied with the pipe may be used. The manufacturer's suggestions for gasket choice and installation shall be followed. All gasket materials must comply in all respects with the physical requirements as specified in ASTM F 477 "Standard Specifications for Elastomeric Seals for Joining Plastic Pipe".

Prior to making the joint, the spigot end shall be lubricated with a sealer recommended by the pipe manufacturer. Only manufacturer recommended lubricants shall be used. Once lubricated, the spigot end shall be inserted to the reference mark. Use of mechanical equipment for making joints is not permitted.

K. FITTINGS & ADAPTERS FOR PVC PIPE GRAVITY DRAINS:

Fittings and adapters for PVC gravity drain pipe shall be supplied by the pipe manufacturer and assembled in the field, according to the recommendations of the supplier. (All fittings must conform to ASTM D 2466 and/or ASTM D2467 "Socket-Type Polyvinyl Chloride Plastic Pipe Fittings.)"

Fittings and adapters shall be of the injection molded type, and shall contain elastomeric seals to insure a proper seal. Elastomeric seals are subject to the requirements of ASTM 3212.

When an adapter must be installed or any field cut pipe must be joined, the cut spigot end must be beveled to the proper taper, and must present an even surface free from cracks, fissures, or projections to insure a proper seal.

Pipe cutting should be performed with a hand keyhole saw or power saber saw. Adequate ventilation must be afforded, to protect workers from noxious fumes generated during cutting. Manufacturer's recommendations for cutting and beveling PVC sewer pipe shall be followed when installing fittings and adapters.

2.04 HDPE DRAIN PIPING

A. HDPE drain piping and fittings shall be heavy duty, high-density polyethylene double wall pipe with smooth interior and "Watertite" joints. Fabrication of manifolds (header pipe), inlet tees and outlet tees as shown on the plan shall be in accordance with the pipe manufacturer's specifications.

B. HDPE pipe as specified in 2.04 A above is required at the locations as shown on the plans and details.

2.05 CATCH BASINS, DEEP SUMP DRAIN MANHOLES AND DRAIN INLETS

A. Precast concrete shall conform to ASTM Designation C478 and radial block to ASTM C139 and shall meet the following requirements:

1. Type II cement shall be used except as otherwise approved.
2. All sections shall be cured by approved ASTM methods and shall not be shipped nor subject to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer. Precast concrete sections, blocks and bases shall be designed for a minimum of H-20 loading plus the weight of the soil above.
3. The date of the manufacturer and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.
4. Catch basin top sections shall be precast concrete dome or top slabs as shown on the Drawings.
5. The round rubber "O"-ring gaskets shall conform to ASTM C443. They shall be designed and manufactured so that the completed joint will withstand an internal water pressure in excess of 15 psi without showing any leakage by the gasket or displacement of it. The Contractor's supplier shall test the effectiveness of the joints against leakage. Such tests shall be made by an internal pressure against the joint of at least 15 psi. A complete set of records of the test shall be submitted to the Architect.
6. All sections shall be cured by approved ASTM methods and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer. Precast barrel sections, eccentric or concentric top sections, top slabs, and bases shall be designed for a minimum of H-20 loading plus the weight of the soil above.
7. Precast concrete bases shall conform to all the requirements of the specification on barrel sections ASTM C478, and shall be installed as shown on the Drawings.

8. The thickness of the bottom slab of the precast bases shall not be less than the thickness of the barrel sections or top slab, whichever is greater.

9. All catch basins in paved areas shall contain a 48 inch deep (minimum) sump. All catch basin sumps shall be water tight.

B. Catch Basin and Drain Inlets, Cast Iron Frames and Gratings

1. Castings shall be of good quality, strong, tough, even-grained, smooth cast iron, free from scale, lumps, blisters, sand holes, and defects of any kind which render them unfit for the service for which they are intended.

2. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field by the Architect.

3. All finished surfaces shall be machined to a true plane surface, and shall be true and seat at all points without rocking. Allowances shall be made in the patterns so that the thickness specified or shown shall not be reduced in obtaining finished surfaces. Castings shall not be acceptable if the actual weight is less than 95 percent of the theoretical weight computed from the dimensions as shown. The Contractor shall provide facilities for weighing castings in the presence of the Architect or shall furnish invoices to the Owner showing true weights, certified by the supplier.

4. Cast iron shall conform to ASTM Specification A48, Class 20.

5. Before shipment from the foundry, castings shall be given a coat of coal tar pitch varnish which shall present a coating which is smooth and tough, but not brittle.

6. Catch basin grates shall be cast iron and shall be as described in 2.02. B above (Mass. DOT Standard) unless otherwise shown on the plan.

7. Area Drain grates shall be cast iron.

C. Catch Basin Hoods

1. A catch basin hood (oil and gas trap) shall be installed in each new catch basin structure. The unit installed shall meet the Amesbury Department of Public Works Standards. The shop drawing must be approved by the Amesbury City Engineer prior to submission to the Architect for review and approval.

2.06 PRECAST CONCRETE STORM DRAIN MANHOLES

A. Precast concrete manhole barrel and eccentric top sections shall conform to Specifications for Precast Reinforced Concrete Manhole Sections, ASTM Designation C478, and the following additional requirements.

1. The wall thickness shall be not less than 5-inches when less than 8 feet deep, and not less than 6 inches when 8 feet or deeper.

2. Barrel sections shall have tongue and groove joints with approved round or fin type rubber gasket conforming to ASTM C443.

3. Type II cement shall be used except as otherwise approved.

4. Top sections shall be eccentric except that concentric top sections shall be used where shallow cover requires a top section less than 4 feet deep as shown on the Drawings.

5. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section.

6. Ladder rungs shall be aluminum, formed to drop front design meeting requirements of OSHA and conforming to ASTM C478 Standards. Rungs shall be spaced 12 inches on center and shall be cast in place at the point of manufacture. Rungs are required on all manholes over 41 inches inside height.

7. Sections shall be cured by an approved method and shall not be shipped nor manhole rungs subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair whichever is the longer.

B. The tops of bases shall be suitably shaped to mate with the precast barrel section.

C. Precast manhole bases may be used if they meet the requirements of ASTM C478, the applicable requirements above.

D. The bricks shall be good, sound, hard, and uniformly burned, regular and uniform in shape and size, of compact texture. Bricks shall comply with the latest specifications of the American Society for Testing and Materials for Sewer Brick, Grade SS (from clay or shale) C32, except that the mean of five tests for absorption shall not exceed 8 per cent and no individual brick exceed 11 per cent. Underburned or Salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Architect, they shall be immediately removed from the site of the work and satisfactory bricks substituted therefor.

E. Bricks for building up and leveling manhole frames shall conform to ASTM C62.

F. Mortar shall be composed of one part Type II portland cement to two parts sand to which a small amount of hydrated lime not to exceed 10 lbs to each bag of cement shall be added. This mortar composition shall also be used for mortared troughs.

G. The sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. It shall be free from vegetable matter, loam, organic or other materials of such nature or of such quantity as to render it unsatisfactory.

H. The hydrated lime shall also conform to the American Society for Testing and Materials, Serial Designation C207.

2.07 BIORETENTION BASINS

A. General:

1. The surface basin is a vegetation-lined depression constructed in the configuration and grades as shown on the design plan. These are designed to treat and infiltrate certain volumes of stormwater runoff prior to discharge.

B. Water Storage Volume Requirements

1. It is critical that the Bio-Retention Basin is constructed to the dimensions and elevations as shown on the plan in order to have the required water storage capacity as specified at the elevations shown below. Cumulative storage volumes must not be less than as shown above but may exceed the volumes shown below:

BIORETENTION BASIN #1
@ Elev. 134.50 storage capacity = 0 cu. ft.
@ Elev. 135.00 storage capacity = 4,533 cu. ft.
@ Elev. 136.00 storage capacity = 16,910 cu. ft.
@ Elev. 136.80 storage capacity = 27,987 cu. ft.

BIORETENTION BASIN #2
@ Elev. 131.30 storage capacity = 0 cu. ft.
@ Elev. 132.00 storage capacity = 2,010 cu. ft.
@ Elev. 133.00 storage capacity = 6,338 cu. ft.
@ Elev. 133.50 storage capacity = 9,431 cu. ft.
@ Elev. 134.00 storage capacity = 13,344 cu. ft.

BIORETENTION BASIN #3
@ Elev. 126.50 storage capacity = 0 cu. ft.
@ Elev. 127.00 storage capacity = 494 cu. ft.
@ Elev. 128.00 storage capacity = 2,446 cu. ft.
@ Elev. 128.50 storage capacity = 4,252 cu. ft.

C. Construction:

1. During construction, avoid excessively compacting soils around the bioretention areas and accumulating silt around the drain field. To minimize sediment loading in the treatment area, direct runoff to the bioretention area only from areas that are stabilized; always divert construction runoff elsewhere except as noted in C.2. below.

2. During site construction activity the excavated basin may be used as a temporary sediment basin. This will be following rough grading of the basin, before any finished loaming, seeding or installation of free draining soils and topsoils. Following use as a sediment basin, the basin shall be thoroughly cleaned to remove all sediment and the prepared bottom excavation shall be scarified to loosen any compaction of the natural soil in preparation for the completion of the basin.

D. Bottom of Basin:

1. The bottom of the basin shall be constructed according to the plans and details. Fill material shall be in accordance with SECTION 312000.

E. Finished Grading, Loam and Seeding:

1. The engineered soil mix for the bottom of basins should be a mixture of 40% sand, 20-30% topsoil, and 30-40% compost (Percent is by volume).
   a. The soil mix must be uniform, free of stones, stumps, roots or similar objects larger than 2 inches. Clay content shall not exceed 5%.
   b. Soil pH should generally be between 5.5 - 6.5, a range that is optimal for microbial activity and adsorption of nitrogen, phosphorous, and other pollutants.
   c. Use soils with 1.5% to 3% organic content and maximum 500-ppm soluble salts.
   d. The sand component should be gravelly sand that meets ASTM D 422.

Sieve Size	Percent Passing
2-inch	100
¾-inch	70-100
¼-inch	50-80
U.S. No. 40	15-40
U.S. No. 200	0-3

   e. The topsoil component shall be a sandy loam or loamy sand texture (USDA Classification).
   f. The compost component must be processed from yard waste in accordance with MassDEP Guidelines (see http://www.mass.gov/dep/recycle/reduce//leafguid.doc). The compost shall not contain biosolids.
2. On-site soil mixing or placement is not allowed if soil is saturated or subject to water within 48 hours. Cover and store soil to prevent wetting or saturation.
3. Test soil for fertility and micro-nutrients and, only if necessary, amend mixture to create optimum conditions for plant establishment and early growth.
4. Cover the soil with 2 to 3 inches of fine-shredded hardwood mulch.
5. The seed specification for the basin and the discharge swale are shown on the Stormwater Detail Plans. For application of loam and finish grading see related SECTIONS 329113 - Planting Soils, 329200 - Lawns, 329000 - Planting and 312000.

F. Outlet Control Structure: (see plan for locations)

1. Precast concrete structure (where applicable) as shown on the plan.

2. H-20 Loading (minimum)

3. Install precast unit at proper elevations and locations as shown on plans. The elevation of the top of the structure, the orifice outlet and pipe inverts are critical to the performance of the system.

4. Opening at top of structure shall accept frame & grate or trash rack as applicable and as shown on the plans and details.

G. Subdrain: (see plan for locations)

1. See section 334000 2.11.

2.08 SUBSURFACE RECHARGERS and DETENTION STRUCTURES (CONCRETE)

A. General:

1. These structures are underground precast concrete infiltration galley chamber systems surrounded with washed crushed stone, designed to capture a certain volume of storm water runoff for recharge to the groundwater and to overflow stormwater flows above the recharge requirements to the downstream stormwater system at a controlled rate. The system must meet the Mass. DEP Stormwater Management Handbook for the underground stormwater infiltration systems.

B. Water Storage Volume Requirements

It is critical that the chamber systems are constructed to the dimensions and elevations as shown on the plan in order to have the required water storage and recharge capacity as specified at the elevations shown below. Storage volumes of the system must not be less than as shown above but may exceed the volumes shown. The area of the system shall be equal or greater than shown on the plans to provide the required bottom infiltration surface.

1. System Volume

RECHARGER #1
@ Elev. 113.10 storage capacity = 0 cu. ft.
@ Elev. 114.00 storage capacity = 1,672 cu. ft.
@ Elev. 115.00 storage capacity = 4,290 cu. ft.
@ Elev. 115.60 storage capacity = 5,862 cu. ft.

RECHARGER #2
@ Elev. 113.00 storage capacity = 0 cu. ft.
@ Elev. 114.00 storage capacity = 2,396 cu. ft.
@ Elev. 115.00 storage capacity = 5,649 cu. ft.
@ Elev. 115.50 storage capacity = 7,275 cu. ft.

DETENTION SYSTEM #1

@ Elev. 111.10 storage capacity = 0 cu. ft.
@ Elev. 112.00 storage capacity = 879 cu. ft.
@ Elev. 113.00 storage capacity = 2,236 cu. ft.
@ Elev. 114.00 storage capacity = 3,594 cu. ft.
@ Elev. 115.00 storage capacity = 4,951 cu. ft.
@ Elev. 115.60 storage capacity = 5,766 cu. ft.

DETENTION SYSTEM #2

@ Elev. 111.00 storage capacity = 0 cu. ft.
@ Elev. 112.00 storage capacity = 528 cu. ft.
@ Elev. 113.00 storage capacity = 2,726 cu. ft.
@ Elev. 114.00 storage capacity = 4,925 cu. ft.
@ Elev. 115.00 storage capacity = 7,123 cu. ft.
@ Elev. 115.50 storage capacity = 8,222 cu. ft.

DETENTION SYSTEM #3

@ Elev. 109.50 storage capacity = 0 cu. ft.
@ Elev. 110.00 storage capacity = 780 cu. ft.
@ Elev. 111.00 storage capacity = 2,340 cu. ft.
@ Elev. 112.00 storage capacity = 3,900 cu. ft.
@ Elev. 113.00 storage capacity = 5,460 cu. ft.
@ Elev. 114.00 storage capacity = 7,020 cu. ft.
@ Elev. 115.00 storage capacity = 8,580 cu. ft.
@ Elev. 116.00 storage capacity = 10,141 cu. ft.
@ Elev. 116.50 storage capacity = 10,921 cu. ft.

2. In computing the volume of voids (storage) within the stone component of the system, a void ratio of 0.4 shall be used.

3. The computed storage volumes must not be less than the units as shown on the plans but may exceed the volumes.

4. If other than the units and / or configuration shown on the plan is proposed, the Contractor shall provide shop drawings of the chamber units proposed, the configuration and calculations showing conformance with the storage and area requirements for approval by the Engineer.

C. Chamber Units

1. For Recharger #1 and #2: Precast concrete 8’ wide by 14’ long by 2’ inside height.

   For Detention #1 and #2: Precast concrete 8’ wide by 14’ long by 4’ inside height.

   For Detention #3: Precast concrete structures with overall dimensions equal to 30’-3¼” wide by 59’-6” long with a 7’ inside height.

2. All chamber system shall meet (AASHTO) H-20 load rating standards with 1 foot of cover.

3. The chamber systems shall include inspection/ access covers raised to finished grade to permit observation of and access to the chamber bottom and piping for maintenance. The covers shall be at the locations shown on the design plan.

D. Outlet Control Manhole:

1. Structure: Precast concrete manhole structure.
2. Weir Wall: Construct precast concrete weir wall to dimensions and elevations as shown on plans. Wall shall be sealed to the manhole to form two water-tight chambers.
3. See specifications for Drain Manholes for structure requirements in this Section 340000.

E. Stone

1. Stone used to surround the chambers shall be 3/4" to 1-1/2" double washed stone with less than 0.2 percent material finer than a No. 200 sieve as determined by the A.A.S.H.O. test methods T-11 and T-24 (latest edition).

F. Peastone

1. The stormwater recharger systems shall be covered with a minimum 3 inches of clean peastone located between filter fabric and stone as shown on the drawings.

G. Filter Fabric

1. A filter fabric material shall be installed at the interface between the soil and the chamber system as shown on the design plan. The material shall be a non-woven, 4 oz. per sq. yd. (min.) geotextile and installed per the manufacturer's specifications.

H. Excavation and Removal of Unsuitable Material

1. The excavation for the installation of the recharge system shall be completed to the limits and elevations as shown on the design plan. The entire bottom and sides of the excavation must be clean natural soil identified on the soil test logs as the “B” and “C” horizon. All topsoil, or unsuitable material shall be removed to a minimum depth of 4 feet below the bottom elevation of the chamber system and to a distance of 5 feet horizontally from the system and shall be replaced with suitable sand / gravel fill meeting Mass. Title 5 regulations (310 CMR 15.255 (3)) or Free Draining Granular Borrow per the Earthwork specifications.
2. Prior to installation of the filter fabric, stone, and chamber units, all surfaces of the excavation shall be scarified to break up any compacted soil surface, and must be inspected and approved by the design Engineer.

I. Compacted Cover

1. The stormwater recharge systems shall be covered with a minimum 12 inches of common borrow (see Section 312000) placed in two - 6 inch lifts compacted to 90 percent of standard proctor density unless otherwise shown on the plan. When units are under pavement, compaction shall be per pavement and earthwork specifications relative to pavement base

2.09 SURFACE DETENTION BASIN

A. General:

1. The surface basin is a vegetation-lined depression constructed in the configuration and grades as shown on the design plan. These are designed to temporarily store and regulate the discharge to certain required.

B. Water Storage Volume Requirements

1. It is critical that the Detention Basin is constructed to the dimensions and elevations as shown on the plan in order to have the required water storage capacity as specified at the elevations shown below. Cumulative storage volumes must not be less than as shown above but may exceed the volumes shown.

DETENTION BASIN #4
@ Elev. 119.50 storage capacity = 0 cu. ft.
@ Elev. 120.00 storage capacity = 33 cu. ft.
@ Elev. 121.00 storage capacity = 539 cu. ft.
@ Elev. 122.00 storage capacity = 1,895 cu. ft.
@ Elev. 123.00 storage capacity = 4,220 cu. ft.

C. Construction:

1. During construction, avoid excessively compacting soils around the Detention Basin area and accumulating silt in and around the basin. To minimize sediment loading in the treatment area, direct runoff to the Detention Basin area only from areas that are stabilized; always divert construction runoff elsewhere except as noted in C.2. below.

2. During site construction activity the excavated basin may be used as a temporary sediment basin. This will be following rough grading of the basin, before any finished loaming, seeding or installation of free draining soils and topsoils. Following use as a sediment basin, the basin shall be thoroughly cleaned to remove all sediment and the prepared bottom excavation shall be scarified to loosen any compaction of the natural soil in preparation for the completion of the basin.

D. Bottom of Basin:

1. The bottom of the basin shall be constructed according to the plans and details.

E. Finished Grading, Loam and Seeding:

1. Topsoil: Shall be in conformance with the Landscape Plans and specifications for Lawns.

2. The seed specification for the Detention Basin is shown on the Stormwater Detail Plans. For application of loam and finish grading see related SECTIONS 329113 - Planting Soils, 329200 - Lawns, 329000 - Planting and 312000.

F. Outlet Control Structure:

1. Precast concrete structure as shown on the plan.
2. H-20 Loading (minimum)
3. Install precast unit at proper elevations and locations as shown on plans. The elevation of the top of the structure, the orifice outlet and pipe inverts a critical to the performance of the system.
4. Opening at top of structure shall accept frame & grate specified below.
5. Frame & Grate: Round Cast Iron Beehive (Inset style), 28-inch diameter per Section 2.02 above.

2.10 STORMWATER TREATMENT UNIT (STU)

A. General:

1. The Water Quality Structure is classified by the Mass. Department of Environmental Protection (DEP) as “Innovative Stormwater Management Technologies”. The purpose of the unit is to separate and trap oils, grease and sediment from stormwater runoff. This unit, in combination with other stormwater “Best Management Practices” is designed to meet the DEP Stormwater Management Policy Standard requiring 50 percent minimum total suspended solids removal for pre-treatment purposes.

B. Chamber Unit

1. The contractor shall provide shop drawings of the units proposed. If the unit proposed is other than listed below in this section, the Contractor shall submit the configuration and calculations showing conformance with the above stated design criteria for approval by the City Engineer, Conservation Commission and the Project Engineer.

   For sizing purposes, the units selected must perform equal to or better than the following models manufactured by Contech Engineered Solutions LLC:

STUs 1, 2, 3, 4, 5, 6, 8	Model: CDS1515-3-C
STUs 7	Model: CDS2015-4-C

2. The concrete unit shall be designed and manufactured in accordance with ASTM C-478. The concrete joints shall be oil resistant, water tight, and meet the design criteria according to ASTM C-433.
3. The unit shall meet a minimum of 50 percent total suspended solids removal for the intended application rates and shall be acceptable to the City of Amesbury Engineering Department and Conservation Commission. The unit must have a MASTEP review rating of 2 or better and must be approved for a minimum of 50 percent total suspended solids removal per Mass. DEP Requirements.
4. Installation shall be in accordance with the manufacturer’s specifications and recommendations.

C. Unit shall be placed on a level stable base that has been mechanically compacted and onto which six inches of crushed stone has been placed and compacted.

D. Unit shall be watertight through the manufacturer's specifications and warranty.

E. Unit shall meet the dimensional requirements as shown on the plan with manhole openings as shown.

F. Cast Iron manhole frames and covers shall be designed for HS 20-44 loading.

2.11 SUBDRAINS

A. Drain Pipes and Fittings

1. The piping shall be perforated High Density Polyethylene Pipe in accordance with Section 334000 – 2.04.

B. Stone

1. Stone used to surround the subdrain pipe shall be 3/4" to 1-1/2" double washed stone with less than 0.2 percent material finer than a No. 200 sieve as determined by the A.A.S.H.O. test methods T-11 and T-24 (latest edition).

C. Filter Fabric

1. A filter fabric material shall be installed at the interface between soil and the 3/4" – 1-1/2" stone as shown on the design plan. The material shall be a non-woven, 4 oz. per sq. yd. (min.) geotextile equal to Mirafi 140 N and installed per the manufacturer's specifications.

D. Excavation and Removal of Unsuitable Material

1. The entire bottom and sides of the subdrain trench must be clean natural soil or specified backfill material. All topsoil, fill and deleterious material, if any, must be excavated and removed from all sides and below the bottom of the trench to a minimum depth of two feet below the bottom elevation and within two feet of the trench sides. The excavated material shall be replaced with suitable sand / gravel fill meeting Mass. Title 5 Regulations (310 CMR 15.255 (3)).
2. Prior to installation of the filter fabric, and stone, all surfaces of the trench shall be scarified to loosen any compacted soil surface.

2.12 LEVEL SPREADERS

A. Level Spreaders shall be constructed to the dimensions and elevations as shown on the plan.

1. Stone: Stone rip-rap shall consist of evenly graded, 2 inch to 4 inch durable angular broken stone with an average stone size of 3 inches. Not more than 15 percent of the stone by weight may be scattered, broken spalls not less than 2 inches. Size designation refers to mean spherical diameter.

2. Filter Fabric: The material shall be a non-woven, 4 oz. per sq. yd. (min.) geotextile equal to Mirafi 140 N and installed per the manufacturer's specifications.

3. Spillway (Curb): Precast concrete curb sections (6' long x 18" deep x 6" top width) shall be set at the elevations shown on the plan. Joints between curb sections shall be filled with hydraulic cement.

2.13 DEMARCATION WARNING TAPE

A. Warning tape shall be a minimum 3-inch width, non-adhesive, reinforced, barricade style warning tape. Warning tape shall be made of reinforced polypropylene with a minimum thickness of 4 mil. The warning tape shall be yellow with black lettering and shall have the words "CAUTION HAZARDOUS MATERIAL" repeating for the entire length

PART 3 EXECUTION

3.01 INSTALLATION

A. This SECTION 334000 Subcontractor shall comply with all the rules, codes, ordinances, regulations and requirements of all legally constituted authorities having jurisdiction over the whole or any part of the work herein specified. Regulations supplement this Specification and shall take precedence.

B. This work shall include the furnishing and installation of all labor, materials and equipment except for excavation and backfill necessary for the complete installation of all work in accordance with the requirements of the Amesbury Public Works Department and the Mass. DOT.

C. Excavation and backfill of the trenches for the pipe and for structures shall be performed under the work of SECTION 312000 - EARTHWORK unless otherwise specified in this Section 334000. It shall be the responsibility of this SECTION 334000 Subcontractor to insure that bedding, depth, width and bottom of trench, is suitable for the proper installation of the work.

D. This Section 334000 Subcontractor shall furnish materials, equipment, and labor necessary to temporarily reroute storm drainage system components in accordance with the phasing documents.

3.02 PIPING

A. Excavation: The trench for the pipe shall be excavated to the required line and grade and of sufficient width to permit thorough tamping of the fill material under the haunches and around the pipe. (Soft or unsuitable material encountered below the normal bedding line of the pipe shall be over excavated and filled with graded gravel (Structural Fill)and thoroughly compacted to provide a stable base). Structural fill shall be installed to level the trench and shall be placed to a minimum six (6) inch depth below the pipe. If any cross pipes, conduits, drains or other unforeseen obstacles are encountered in the excavation, the grade of the bottom of the trench may be raised or lowered during the excavation operation, as required to provide an installation in accordance with this Section. Use concrete or other approved support under the existing pipes passing through the excavation where said pipe would normally be supported by backfilled earth. Where concrete obstructions, rock, ledge or boulder formations are encountered, it shall be removed to a line eight (8) inches below the bottom of the outside and twelve (12) inches on each side of the pipe barrel or structure. No part of any rock remaining in the trench shall come within eight (8) inches of any portion of the pipe or structure. No blocking of any kind shall be permitted.

B. Bedding Pipe: Pipe bedding shall consist of 3/4 inch crushed stone meeting MHD M2.01.0 and M2.01.4. The trench shall be filled and compacted to the bottom elevation of the pipe with pipe bedding. The pipe shall be laid true to the specified lines and grades. Each section of pipe shall have a firm bearing throughout its length. After the pipe has been installed and inspected, pipe bedding material shall be brought up to halfway up to 12 inches above the pipe in 6" layers and hand tamped as it is placed. Care shall be taken to carefully grade and compact the graded gravel, and prevent pipe displacement.

C. Following placement of the pipe and bedding to 12 inches above the pipe, a select backfill material consisting of graded gravel meeting MHD M1.03.0 type c, with no stone over two (2) inches shall be placed in twelve (12) inch layers and compacted. Care shall be taken in compacting backfill material to prevent pipe deflection or displacement. Within proposed landscape areas where no pavement or structures are proposed, backfill material above 12 inches above the pipe may consist of “Ordinary Borrow” as described under Section 312000 Earthwork. Backfill material above 12" above top of pipe shall be compacted in 12" layers with a suitable power driven tamper.

D. All pipe shall be carefully cleaned just before laying. Extreme care shall be exercised so as not to damage the pipe in handling. Each pipe shall be laid true to line and grade and so laid as to form a tight joint with the next adjoining pipe and to bring the inverts continuous. No piping shall be laid in water. Water in trench shall be kept below pipes until pipes have been back filled.

E. LASER BEAM - ALIGNER: The use of laser aligning equipment may be used for the laying of lines to the specified lines and grades, in lieu of batter boards. The laser beam projector is to be rigidly mounted with two (2) point suspension, to its support platforms. This will assure that all ground equipment vibrations will be kept to a minimum and permit the laser beam to project itself coaxially through the center of the pipe.

F. Assembly: After pipes have been bedded, joining and assembly shall be in accordance with the manufacturers recommendations.

G. Backfilling: After pipe and joints have been inspected, tested and recorded on record drawings, and approved by the Amesbury Department of Public Works and the Architect, the trench shall be backfilled,

H. Plug all open ends when work is stopped or suspended for any reason or any length of time.

I. Provide a continuous warning tape above the entire length of installed drainage piping located 12-inches below grade.

3.03 STRUCTURES

A. Stake layout of structures for Architect's approval before proceeding with installation and construction.

B. Structures shall be built to the lines, grades, dimensions and design shown on the drawings and as directed with the necessary frames, gratings and covers, and in accordance with these specifications.

C. Utility structures shall not be constructed when the temperature is below 32 degrees F.

D. The joints in precast units shall be wetted and completely mortared immediately prior to setting a section. No structure shall be backfilled until all mortar has completely set.

E. Cement concrete bases or precast concrete bases shall be founded on 6 inches, minimum of graded crushed stone meeting MHD M2.01.0 and M2.01.1, compacted to grade.

F. Paved inverts shall be constructed to conform to the size of pipe and flow. At changes in direction, the inverts shall be laid out in curves of the longest radius possible tangent to the center line of the pipes. Invert channels shall be smooth and accurately shaped to elevations called for on the drawings.

G. Precast concrete manhole sections shall be set so as to be vertical and with sections in true alignment, 1/4 in. maximum tolerance to be allowed. Joints shall be mortared inside and outside after the precast sections are set in place. Mortar shall be comparatively dry (one part cement to two parts sand) and shall be finished flush with the surface. Allow joints to set for 24 hours before backfilling. If leaks appear in the manholes, the inside joints shall be caulked to be water tight. This SECTION 334000 Subcontractor shall install the precast sections or block in a manner that will result in watertight joints.

H. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done prior to setting them in place. This is to prevent any subsequent jarring which may loosen the mortar joints. Joints shall be finished flush with adjoining surfaces.

I. All holes in sections, if any, used for handling shall be thoroughly plugged with a non-shrink grout or by grout in combination with concrete plugs.

J. Manhole pipe connections may be accomplished in two manners:

1. Pipe connections shall be of the neoprene boot with stainless steel clamp type or approved equal.
2. With prior approval of the Amesbury DPW, a tapered hole filled with non-shrink waterproof grout after the pipe is inserted is acceptable, providing the grout is placed carefully to completely fill all around the pipe. If this method is used, place concrete encasement around the stub and down to the cast-in-place foundation slab.

3.04 CASTINGS AND CLEANING

A. Manhole frames and covers as well as catch basin and drain inlet frames and grates within the limits of bituminous concrete pavement shall be set at the elevation of the top of the wearing course.

B. All new manholes shall be thoroughly cleaned by the removal of all accumulations of silt, debris and foreign matter of any kind, prior to final inspection.

3.05 INSPECTION OF STRUCTURES

A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Architect, or other representative of the Owner. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places, and the sections shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. All sections which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the SECTION 334000 Contractor's expense.

B. At the time of inspection, the sections will be carefully examined for compliance with the ASTM designation specified below and these Specifications, and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch strength", blisters, cracks, roughness and soundness. The surface shall be dense and close-textured.

C. Imperfections may be repaired, subject to the approval of the Architect, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at the end of 7 days and 5,000 psi at the end of 28 days, when tested in 311 x 611 cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Amesbury Water and Sewer Department.

3.06 CONNECTIONS TO EXISTING STRUCTURES

A. Existing structures which are to be connected to are noted on the drawings. For connection to existing drain manholes use a hydraulic or electronic coring machine (jackhammer not allowed), install rubber boot or mortared joint per this Section 334000 hydraulic cement at connection. Adjust invert table to accommodate new drain connections.

3.07 TESTING OF PIPING SYSTEMS

A. General

1. All piping shall be subjected to water or air testing as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the owner and the Architect with 48-hour notice given these authorities. All tests shall be performed by an independent agency acceptable to the City of Amesbury DPW.
3. All equipment, material and labor required for testing any of the various systems or any part thereof shall be furnished by this SECTION 334000 contractor.

4. Repair, or if directed by the Architect, replace all defective work with new work without extra charge to the Contract. Repeat tests as directed until all work is proven to meet the requirements specified herein.

5. Restore to its finished condition, any work damaged or disturbed by tests.

6. Perform all tests herein specified and all other tests which may be required by any and all authorities or agencies to whose requirements this work is to conform.

7. This SECTION 334000 Subcontractor shall notify the Architect and the inspectors having jurisdiction, a minimum of 48 hours in advance of making any required tests, so that arrangements may be made for their presence to witness his scheduled tests.

B. Exterior Storm Drain System

1. Leakage tests: upon completion of a section of the storm drain, this SECTION 334000 Subcontractor shall dewater it and conduct a satisfactory test for at least 24-hours. This SECTION 334000 Subcontractor shall be responsible for the satisfactory water-tightness of the entire section of storm drain and shall satisfactorily repair all joints or other locations that are not sufficiently watertight.

2. The piping shall be tested before any connections are made to buildings.

3. Construct such weirs or other means of measurements as may be required, furnish water and do all necessary pumping to enable the tests to be properly made.

4. Should the sections under test fail to meet the requirements, do all work of locating and repairing leaks and retesting without additional compensation.

5. Low pressure air tests shall be used to test the storm drain lines. Low pressure air tests shall be completed in accordance with ASTM C 828-76T. Leakage shall be measured in terms of time for the pressure to drop from 3.5 pounds per square inch gauge to 3.0 pounds per square inch gauge. The maximum allowable leakage rate shall be 0.0015 cubic feet per minute per square foot of internal pipe surface.

6. This SECTION 334000 Subcontractor shall make all necessary arrangements for leakage tests. Certified test results shall be submitted to the Department of Public Works.

7. DEFLECTION TESTING: PVC sewer pipe shall be tested for abnormal deflection due to installation and backfill methods. Deflection testing may be completed with a deflectometer, calibrated television of go, no go mandrel or sewer ball. The sewer ball or mandrel shall have a diameter of no less than 95 percent. of the inside pipe diameter. Maximum allowable deflection (reduction in vertical diameter) should not exceed 5 percent. Locations with deflection in excess of this limit shall be excavated and repaired by rebuilding or replacement.

8. The test pressures shall be maintained for the full period of tests.

9. In case the specified rate of leakage is exceeded, the leaks shall be removed and replaced by this SECTION 334000 Subcontractor and the pipe line retested, repeatedly if necessary, at no additional expense to the Owner, until the required conditions are met. The tests shall be continued for a period of at least one hour after all leaks have been stopped and all corrective work has been satisfactorily completed and after the maximum rate of inflow of water into the pipe line as specified above has not been exceeded.

10. If, in the judgement of the Owner, it is impracticable to follow any of the foregoing procedures exactly for any reason, modifications in the procedures shall be made as approved, but in any event this SECTION 334000 Subcontractor shall be responsible for the ultimate tightness of all pipelines within the respective leakage requirements specified herein. Any modifications to the procedures, as directed, shall be performed by this SECTION 334000 Subcontractor at no additional expense to the Owner.

11. Tests shall be made by the SECTION 334000 Subcontractor in the presence of the representative of the Owner.

3.08 TESTING OF STRUCTURES

A. Structures shall be tested for watertightness prior to installation. Test shall consist of filling structure to overflowing with water and maintaining the water level for 1-hour without adding water. Low pressure vacuum testing may be acceptable if approved by the Amesbury DPW. Contractor to submit information on the testing procedure and equipment to be used and information on the testing company.

B. Make all repairs and retesting required to accomplish a successful test.

C. Provide all water, labor and equipment necessary to perform testing.

3.09 CLEANING AND ADJUSTING

A. Before the systems are accepted, all piping and structures shall be thoroughly cleaned so that no dirt, stones or other foreign matter will be deposited and be detrimental to the operation of the systems.

3.10 OPERATION AND START-UP

A. This SECTION 334000 Subcontractor shall furnish all labor, materials, and equipment necessary to place the system into operation and demonstrate the fitness of the installation.

B. Prior to start-up, this SECTION 334000 Subcontractor shall check all systems for completeness, provide lubrication, clean and flush all piping and equipment, perform pressure tests and make all other adjustments necessary to start up.

C. This SECTION 334000 Subcontractor may start portion of the systems as the work progresses; however, all systems which are normally operating simultaneously must be so operated upon completion of the work.

3.11 OFFSITE WORK AND COORDINATION WITH EXISTING UTILITIES

A. Special attention shall be given to the protection of, and coordination with, existing onsite and off-site utilities. This SECTION 334000 Subcontractor shall contact the Amesbury Public Works Department and "DIG-SAFE" to identify and to locate these services prior to beginning any work.

B. All utility work, both on and off site, shall comply with Amesbury Public Works Department requirements and standards. Submit all equipment, materials and methods to the Public Works Department for approval prior to submitting to the Architect, and prior to purchasing any equipment or materials.

3.12 PROTECTION OF STORMWATER INFILTRATION / RECHARGE STRUCTURES

A. Protect existing and proposed stormwater management structures from sediment. All proposed new stormwater management structures that recharge and/or infiltrate runoff (Underground Rechargers and Bio-Retention Basins) are particularly sensitive to damage by sediment. Site runoff from unstabilized areas shall not be discharged into any of these facilities until the tributary drainage area is stable or the runoff is treated to be essentially free from sediment to the satisfaction of the Engineer. (Refer to Condition _____ of the Wetlands Order of Conditions).

END OF SECTION

SECTION 334610

LANDSCAPE SUBDRAINAGE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. PART A and DIVISION 1 of PART B are hereby made a part of this SECTION.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION.

1.02 SCOPE OF WORK

A. Provide all labor, materials, equipment, services and transportation required to complete landscape subdrainage as shown on the Drawings and as specified herein or both.

B. Coordinate the Landscape Subdrainage work with the installation of the playground equipment (Under Separate Contact to the Owner).

1.03 RELATED WORK

A. The following related work is to be performed under the designated Sections.

1. Earthwork - Section 312000
2. Finish Grading - Section 312219
3. Playground Safety Surface – Section 321819
4. Miscellaneous Site Improvements - Section 323000
5. Soil Preparation – Section 329313
6. Lawns and Grasses – Section 329200
7. Storm Drainage – Section 334000
8. Landscape Drainage – Section 334620

1.04 SUB-CONTRACTOR'S IMPLEMENTATION OF THE 1 % MINIMUM PIPE PITCH DESIGN CRITERIA

A. The Sub-Contractor is to establish the invert elevations from the following design criteria and as shown on the drawings to install the subdrainage system. The intent is to follow the slope of surface finish grades that keep the trench depth constant. Exceptions to this would be where runs are level, or less than 1%, or on lines which have to connect to storm drainage structures, in these cases the depth of the trench and its component parts would increase as necessary to accommodate a minimum of 1% or greater slope.

B. Layout: Pipe layout and sizing is shown on the drawings.

C. Adjustments:

1. Adjust the Subdrainage System to accommodate any adjustments that may be required. Notify the landscape architect of these conditions before doing adjustments.

1.05 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 013300 – Submittals.

B. Product Data: Manufacturers' current catalog cuts and specifications and/or test results demonstrating compatibility with the specifications for the following:

1. Rigid Pipe: Solid and perforated PVC drain pipes and fittings.
2. Flexible Pipe: Perforated and solid flexible pipe and fittings.
3. Filter Fabric.

C. Shop Drawings:

1. Minimum 1” = 20’ scale plan drawing showing all subdrain piping, invert elevations at all ends, intersections and connections for the subdrain piping. Indicate the perforated and solid pipe slope percentages for each pipe section.

D. Samples:

1. Filter Fabric - (12) inch x (12) inch.

E. Landscape Subdrainage Systems Testing

1. Testing for Obstructions and Debris of the Installed Landscape Subdrainage System.
    a. Before trench backfilling and final connections are completed to the drainage lines installed in Section 02720 Storm Drains, test with adequate flowing water and where possible visual observation to confirm that there is no debris or obstructions, bad connections or any other fault in landscape subdrainage as follows:
        1) For each subdrainage line, test all cleanouts one at a time in incremental from the furthermost one from the connection point to the closest one from the connection point to the Storm Drainage System Connection Point(s).
        2) Written Drainage Testing Certification

a) The Sub-Contractor shall provide written certification that drainage flows unobstructed from each cleanout.

b. Any part of the Landscape Sub Drainage system which fails this testing for any reason shall have the problem corrected by the Sub-Contractor and that portion retested until it passes at no additional expense to the Owner.

2. Testing and Flushing of the Subdrainage System after the Playground Safety Surface has been installed.

a. Flush the Subdrainage System with adequate flowing water and where possible visual observation to confirm that there is no debris or obstructions, bad connections or any other fault in subdrainage as follows:

1) For each subdrainage line, test all cleanouts one at a time in incremental from the furthermost one from the connection point to the closest one from the connection point to the Storm Drainage System Connection Point(s).

F. Record Drawings (Plans and details): Refer to Division 1 General Requirements, Closeout Procedures for additional Record Document requirements.

1. Locate such items as but not limited to the following items:

a. Connection to existing drainage lines.

b. Solid PVC pipe sizes, locations and invert elevations.

c. Perforated Pipe sizes, locations and invert elevations.

d. Cleanout locations.

e. Sleeves.

f. All other miscellaneous components.

2. Deliver (one) reproducible Record Drawings to the Landscape Architect within (seven) working days before the date of Final Inspection. Delivery of the record drawings shall not relieve the Sub-Contractor of the responsibility of furnishing required information in the future.

1.06 PROJECT/SITE CONDITIONS

A. Protection of Utilities:

1. Provide temporary support and protection of underground and surface utility structures, drains, services and other improvements to remain.

2. Where grade or alignment of pipe is obstructed by existing utility structures such as conduits, ducts or pipes, notify the Landscape Architect in writing and provide a recommendation to reroute the underdrain line meeting all other drawing and specification requirements for his approval.

3. Restore all damaged improvements to original condition at no additional cost.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: All containerized products shall be delivered to the site in manufacturer's original, unopened, legibly labeled containers. All pipe to be delivered bound securely to prevent damage. Supply pallets as required to protect products.

B. Storage: Protect materials from damage, water and rust. Store pipes on beds that are full length of pipe. (Protect plastic materials from direct sunlight.)

C. Pipe: Cap openings to prevent entry of dust, debris and other foreign matter.

1.08 SEQUENCING AND SCHEDULING

A. Concealed Work: Prior to and work in this Section Verify in the field the locations and invert elevations of all drainage structures to receive landscape subdrainage connections.

1. Refer to Item 3.01B of this Section for additional requirements.

2. Refer to Civil Engineering Drawings for storm drainage structures.

B. Lines and Levels: Establish for each drainage system and coordinate with other systems to prevent conflicts and maintain proper clearances.

1.09 ORDER OF CONDITIONS

A. This project is subject to the regulations of the Town of Amesbury’s Conservation Commission that are made part of the Contract Documents. A copy is included in Section 013500 – Order of Conditions.

1.10 DEFINITIONS

A. References to Landscape Architect shall mean Architect or the Architect's designated representative.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. RIGID PIPE: Solid And Perforated PVC Drain Pipe And Fittings

1. PVC drain and fittings shall conform to ASTM D-30343 or ASTM F679 (SDR 35 minimum). Polymer compounding and classification shall be in accordance with ASTM D-1784, (Class 12454-B).
2. All fittings shall be injected molded. Fabricated fittings are not allowed except as permitted by the Landscape Architect.
3. Joint for PVC pipe shall be oil resistant compression ring of elastomeric material conforming to ASTM D-3212, push on bell and spigot pressure type joints.
4. Solid PVC pipe and fittings and components shall be by a manufacturer who meets the specifications for these items as specified herein.
5. Pipes shall be sized to meet the requirements as shown on the Drawings.

B. FLEXIBLE PIPE: Solid And Perforated Pipe And Fittings

1. Flexible Pipe: Corrugated polyethylene pipe shall have an interior surface that is smooth, even, free from roughness, projections, indentations, offsets and irregularities of any kind.
   a. Pipe shall conform to AASHTO M252, Type S.
   b. Fittings shall conform to AASHTO M252, AASHTO M294 or ASTM F2306.
   c. Pipe and Fittings shall be high density polyethylene meeting requirements of ASTM 3350.
   d. Pipe size as shown on the drawings.
   e. Pipe units shall have a minimum laying length of 20-feet unless indicated or allowed by the Landscape Architect.

C. Flat Pipe Materials and Accessories from (one) source: (12) inch Advanedge Flat Pipe and Accessories as Manufactured by Advanced Drainage Systems, Inc., 800-733-9554; or (12) inch Multi-Flow Drainage System as manufactured by Varicore Technologies, Inc., 800-978-8007; or J-Drain MVP-12 as manufactured by JDrain Enterprises Inc., 800-843-7569. The Advanedge system components are referenced below.

1. (12) inch Flat Pipe: Flat Pipe and Filter Fabric.
2. (12) inch Side Out: #1471 AA.
3. (12) inch End Out: #1472 AA.

4. (12) inch Endcap: #1432 AA.

5. (12) inch Wye: #1480 AA.

6. (12) inch Tee: 1460 AA.

D. Filter Fabric: Mirafi # 140 or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify locations of the play equipment, all storm drainage structures and drain lines prior to beginning of work. Identify required layout lines, finish grading, subgrading, contours, and datum. Immediately report to Landscape Architect all discrepancies found prior to installation of drainage system.

B. Establish the connection outfall locations, grades and depths to accommodate the minimum 1% pitch (unless shown otherwise on the drawings) required for all subdrainage piping.

1. Concealed Work Storm Drainage Structure's: Prior to and work in this Section Verify in the field the locations and invert elevations of all drainage structures to receive landscape subdrainage connections.

2. Verify before any excavation that all subdrainage lines shall have a minimum of 1% pitch to the storm drainage structure unless noted on the drawings.

a. Notify the Landscape Architect immediately if the minimum 1% pitch is not achievable.

C. Refer to the Site Grading Plans and Details, Subdrainage Plans and Details and the Planting Plans and Details for the location and installation of the Site Drainage System and as specified herein.

3.02 INSTALLATION OF SUBDRAINAGE

A. The Subdrainage System shall be the Subdrainage installed as shown on the Drawings and Details and as specified herein.

1. Verify the Site Conditions to date and accommodate any changes that could affect the Subdrainage system.

2. Locate all the storm drainage structures for storm drainage pipe stub in locations and verify in the field the correct elevations in these structures as provided under the Civil Engineering Drawings.

a. Core drill into the storm drainage structures and install a 6 inch solid PVC pipe into the drainage structure so 6 inches of the pipe penetrates out of the inside wall of the structure and 2 - feet beyond the outside wall of the structure unless otherwise required by the Civil Engineer.

b. Provide mortar as required by the Civil Engineer that will provide secure acceptable pipe connection into the storm drainage structure. This work shall be done at no additional cost to the Owner.

3. Install the Flexible Pipe and Flat Drain gasketed PVC adaptor fittings to connect the solid PVC pipe to the Flexible Pipe.

4. Subdrainage Conditions and installation refer to the Drawings and the Details and as specified herein:

   a. Drains:

      1) Refer to the Drawings and Details.

   b. Cutoff Drains:

      1) Refer to the Drawings and Details.

   c. Install all other items required to install the system as shown on the Drawings or as specified herein.

3.03 MAINTENANCE AND PROTECTION

A. General: Keep clean and protect subdrainage system until Acceptance of the work.

1. Sediments: Regularly inspect and clean all landscape drainage lines and pavement drains to prevent flooding. Sweep, hand, machine, or hose clean all drainage as necessary to maintain proper Landscape Drainage.

2. Subdrainage: Monitor sub-drainage systems and immediately identify all problems with drainage. Make adjustments and clean out as necessary to maintain proper functioning sub-drainage.

END OF SECTION