

LAND STEWARDSHIP FOR POWOW RIVER CONSERVATION AREA



Prepared for the
City of Amesbury

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the Collaborative

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As planners, engineers, and transportation experts we build communities and create places that are welcoming, dynamic, and environmentally sound.

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Introduction

The intent of this plan is to provide stewardship recommendations for Battis Farm and the contiguous Powow Hill areas (collectively known as the Powow River Conservation Area) that will foster ecological values, passive recreational uses, and aesthetic qualities. The site includes areas of forest, wetlands, and highly significant areas of cultural grasslands. The plan will address stewardship of these habitats, other wildlife enhancement opportunities, efforts to control invasive species, and management of passive recreation uses.

Land Acknowledgement

Land that is well managed sustains us in many ways – often referred to as ecosystem services. A few examples of what land provides when it is managed sustainably include:

- The air we breathe,
- The water we drink,
- The food we eat,
- Sequestration and storage of carbon,
- Climate moderation,
- Protection from flooding,
- Recreation that renews our spirits,
- The lumber we use to build our shelters,
- Filtration and decomposition of our wastes, and
- Habitats for a diversity of plants and animals.

The land in Amesbury is part of the traditional, contemporary, and unceded territory of the Pentucket, a branch of the Pennacook-Abenaki people. These lands were taken from the Indigenous people, creating a legacy of injustice that persists to this day. Indigenous stewardship of the land kept its ecological communities vibrant, strong, and interconnected for thousands of years, but far from being relics of the past, Indigenous peoples, including 37,000 individuals who currently reside in Massachusetts, are still at the forefront of environmental protection, ecological stewardship, and climate mitigation. This land helped sustain them for thousands of years before its occupation by Europeans.

Acknowledgement is not enough, how we care for the land will determine how well it will sustain us and our descendants.

Property Descriptions – Powow River Conservation Area

The two adjacent properties, Battis Farm and Powow Hill, are a major resource for the City (See Figure 1) and total 114 acres.

Amesbury at a Glance

- Total Area: 8,784 acres (13.7 square miles)
- 12.3 sq. mi. land, 1.4 sq. mi water
- Human Population in 2020: 17,366
- Open space protected in perpetuity: 1,125 acres, or 13% percent of total area*
- Conservation Commission managed land: 825 acres

*Calculated using MassGIS and City of Amesbury data.

Battis Farm

The 85.3-acre Battis Farm was purchased by the Amesbury Conservation Commission in 1985 with partial funding from the Massachusetts Self-Help Program. The parcels are protected under Article 97 of the Massachusetts Constitution, meaning that they cannot be used for other purposes or disposed of without a two-thirds roll call vote of the Massachusetts Legislature. Battis Farm is characterized by open and rolling fields, small areas of wetlands, the floodplain and banks of the Powow River and Lake Gardner, and stands of birch, beech, pine, and oak. Protecting a portion of Amesbury's Powow River watershed the site includes an area used for community gardens. It is fully open to the public. Popular uses are dog walking, sledding, bird watching, hiking, snowshoeing, and skiing.

Battis Farm includes 4 fields, wetlands, and forested areas separating the fields and to the south. The fields are on a rotation where one field is left fallow, and 3 fields are managed for hay with up to 3 cuttings per year. It is adjacent to the 16.5-acre Camp Kent Environmental Center, a city-owned property (formally a Girl Scout Camp) focused on providing environmental education, recreation, and stewardship, established in 1997. The Stagecoach Trail is laid out along Lake Gardner and connects Battis Farm to the adjacent Powow Hill, Batchelder Park at its summit, and the Town Beach.

Battis Farm has a parking lot with room for a few dozen cars at 76 South Hampton Road (opposite Woodman Road).

Powow Hill

The Powow Hill (27.2 acres) starts on the eastern shores of Lake Gardner and encompasses Powow Hill (Po Hill to locals), Amesbury's highest point. Batchelder Park (1.6 acres – not in the care of the Conservation Commission) is at the summit of Po Hill (elevation of 332 feet), and offers beautiful views east of Amesbury, on a clear day views including Maine's high peaks, the Isles of Shoals in the Gulf of Maine, and beyond to the open ocean can be seen. George E. Batchelder gave this land as a gift to Amesbury in 1925. It was dedicated as the Victoria Batchelder Park in honor of his wife. Powow Hill was an important site to the Native Americans and was used in the 20th century as a ski area and is now mostly forested.

The Powow River Conservation Area is adjacent to many other open spaces, including Lake Gardner to the west, with its swimming area to the south, and the Amesbury Elementary School (AES) open space to the east. In 2007, the Lake Gardner Improvement Association completed an improved trail network. It continues to be maintained by volunteers. Some trails are steep, prone to erosion, and not suitable for all users. Motorized vehicles are prohibited on all trails and boardwalks are for pedestrian use only. A trail leaves the park and crosses the former ski slope, ending at the former elementary school. This trail is now little used.

Batchelder Park can be accessed by parking at the end of Powow Street, or by hiking up the hill on trails from Lake Gardner or Battis Farm.

Site Setting and Context

The City of Amesbury is located at the crossroads of I-95 and I-495 in northeastern Massachusetts in Essex County. It is a primarily residential community that lies along the northern banks of the Merrimack River and is bordered by the Towns of Merrimac to the west, West Newbury to the southwest, Newburyport to the southeast, Salisbury to the east, and South Hampton, New Hampshire,

to the north. The city is rich in natural resources that provide ample recreation opportunities. Lake Attitash and Lake Gardner, several ponds, a public beach, the Merrimack and Powow Rivers, open space preserves, protected and unprotected farmland, numerous parks, Woodsom Farm Park, the Town Forest, and the Riverwalk dot Amesbury's natural landscape.



FIGURE 2 - LAKE GARDNER TOWN BEACH WITH POWOW HILL

Amesbury has a rolling, hilly landscape whose unique features include six glacially formed drumlins: Beech, Lone Tree, Mundy, Powow, Ring and Whittier Hills. These hills function as visual landmarks and provide orientation and identity within the community. There are also three smaller unnamed hills just south of Friend Street. Until recently most of the taller hills have remained forested but development is now either occurring or proposed on some of them. Powow Hill, like several of the other hills, is partially owned by the town. Wireless communication towers have been built on it and residential development has occurred on privately owned parcels south of South Hampton Road.

The city owns 17 additional acres known as the Amesbury Elementary Open Space that is adjacent to the former elementary school. A privately owned parcel (13-20Z) of 21 acres is associated with a cluster development at Locke Hill Lane and is dedicated open space.

Battis Farm and Powow Hill are located off South Hampton Road north of the town center.

History

Before the arrival of the colonists, members of the Pawtucket group (also called Pentucket, a branch of the Penacook-Abenaki people) were active along the Merrimack River, where Native American sites are evidenced by shell middens and artifacts including near the mouth of the Powow River and Presby's Creek. The abundance of fish and clams provided an inexhaustible supply to these indigenous people.

In December 1633, a smallpox epidemic introduced by contact with European traders and explorers killed the group's leaders (sachems) along with a large portion of their followers. This depopulation made it easy for English settlement. The Merrimack Plantation was authorized by the General Court in 1638, and English settlers arrived shortly after. The town was incorporated in 1668. It originally included Merrimac, which became a separate community in 1876. Boundaries shifted as late as 1886 when Amesbury annexed parts of Salisbury.

In the early years of settlement Amesbury was mostly agricultural, with dispersed farmsteads producing primarily grains and practicing animal husbandry. There was a village center at Amesbury Ferry/Salisbury Point and later another settlement along the west bank of the Powow River. Later in the early 18th century plentiful waterpower allowed the establishment of a variety of small-scale industries including ironworks, sawmills, gristmills, fulling mills, stave factories, tanneries, hat manufacturing, shipyards, and maritime commerce. While most colonial residents were Congregationalists, Quakers also settled in Amesbury in the early 18th century.



Published by Howes & Allen Lake Gardner and Powow Hill, Amesbury, Mass

FIGURE 3 - LAKE GARDNER AND PO HILL c1900

By the late 1700s transportation improved with the construction of several bridges. Fishing, shipping, and shipbuilding remained important until maritime trade shifted to ports with deeper harbors in the 1800s. Textile mills were built along the falls (90-foot drop) of the Powow River and resulted in the moving of the commercial and civic center of the community. Carriage making, nail manufacturing and hat making were other industries active in Amesbury in the 19th century. Lake Gardner was created just after the Civil War, in 1872 by the construction of the dam, which was built of Cape Ann granite by the Salisbury Mills Corporation.

By 1913 the textile mills had closed, and the carriage industry had shifted to car manufacture which was active until the depression of the 1930s. Farming continued into the 20th century, with emphasis on dairy products and hay. Manufacturing became more diverse by the mid-20th century with residential development in the town center and in outlying areas. Battis Farm was in agricultural use for generations and owned by a succession of different families until it was purchased by the city in 1985. The community gardens were established in 2003.

Natural Assets Inventory and Assessment

The Powow River Conservation Area provides experiences of field, forest, and wetland habitats. The large area, just minutes away from the center of town, is highly valued for the opportunities to enjoy the

nature it provides for the community. Any use for recreation or other municipal uses should be balanced with preserving the diversity and statewide importance of its habitats. Examples include maintaining mowed trails that hug the forest edge to minimize disturbance to habitat, as well as smart field management including late and/or early season mowing to avoid disturbing grassland nesting birds and leash law enforcement for dog walkers especially during the bird nesting season.

Ecoregion and Ecological Features

Amesbury is in the Gulf of Maine Coastal Lowland Ecoregion, a 10- to 20-mile-wide coastal strip extending north from the Boston Basin. The ecoregion has relatively low relief, and elevations are mostly from sea level to 250 feet. Extensive glacial deposits blanket this region, with sandy beaches that front large salt marshes. The vegetation mosaic includes oak forests, extensive post-settlement white pine, pitch pine in sandy areas, and saltmarsh. The area includes a variety of significant ecological features, including physical features such as topography and soils, and natural habitats.

Topography

As seen in Figure 4, Battis Farm and Powow Hill have a variety of topography running from a high point of about 332 feet at the summit of Powow Hill and sloping down to Lake Gardner and the Powow River wetlands at 86 feet. Much of the area has gentle to moderate slopes (3 to 15%) with steeper slopes along the shore of Lake Gardner at Battis Farm and as the terrain rises towards Powow Hill where slopes are 15-25%. The high point at Battis Farm is 138 feet. Areas below 90 feet are mostly wetlands. There are some very steep slopes going up to Powow Hill, that make trails prone to erosion unless carefully designed. Water drains from the higher areas toward Lake Gardner and the Powow River.

Geology and Soils

Much of Amesbury's bedrock in the western part of the city is known as the Berwick Formation, a thin-to thick-bedded metamorphosed calcareous sandstone, siltstone, and minor muscovite schist. Granite predominates in the eastern half of the city. The metamorphic Berwick Formation is thought to have been formed 420 million years ago during the Silurian era when seas covered much of the planet and there was much active volcanism. The calcium contributes to the presence of prime agricultural land in Amesbury. The Laurentide Ice Sheet that covered most of the northeastern United States with a layer of ice up to a mile thick. As this ice sheet advanced and retreated across the landscape, it scoured the earth and left behind distinct glacial features, such as erratics (large rocks carried by the glacier from other areas), moraines, drumlins (like nearby Whittier Hill and Powow Hill), and eskers (like the one along Kimball Road). As a result of its glacial past, Amesbury is covered with glacial drift deposited by the ice sheet or rivers of melted ice.

Soil texture is classified by the relative composition of clay, silt, and sand particles. Sandy soils tend to be well-drained and nutrient poor. Silt laden soils are described as "dusty" and commonly found in floodplains. Clay soils are typically poorly drained and are often heavy, dense, and sticky, conditions which limit root growth in some plants. Ideal agricultural soil, a "loam", is a combination of sand, silt and clay with moderate drainage and nutrient availability, and density conducive to root growth and microbial community colonization. Loamy soils can retain moisture but drain moderately well so the soil does not remain saturated for long periods of time.

Soils at Battis Farm include both poorly drained small wetland areas, rich in organic material from decaying plants, and moderately drained sandy loam in the higher field areas. Much of the sandy loams (Charlton fine sandy loam) are listed as “Prime Agricultural Soils” and are “farmland of statewide importance”. Most of the soils at Powow Hill are also Charlton fine sandy loam but too steep for most agriculture. Before 1900 the slopes of Powow Hill were used for sheep grazing.

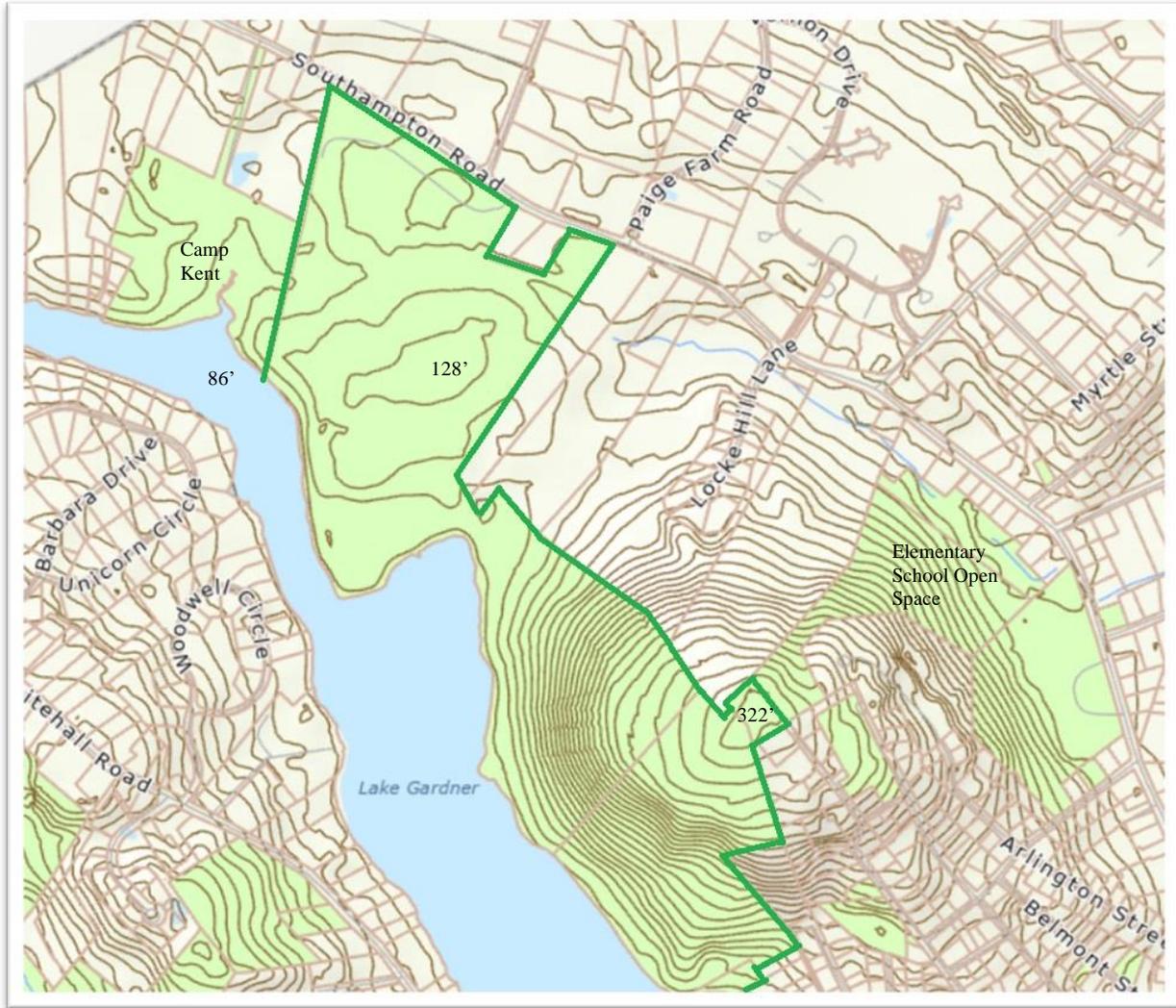


FIGURE 4 - TOPOGRAPHY

Natural Communities

Natural communities are divisions in plant communities based on conditions determined by the entire landscape. Soil composition, slope, aspect, elevation, and land use history are all factors that determine the distribution of natural communities on a site.

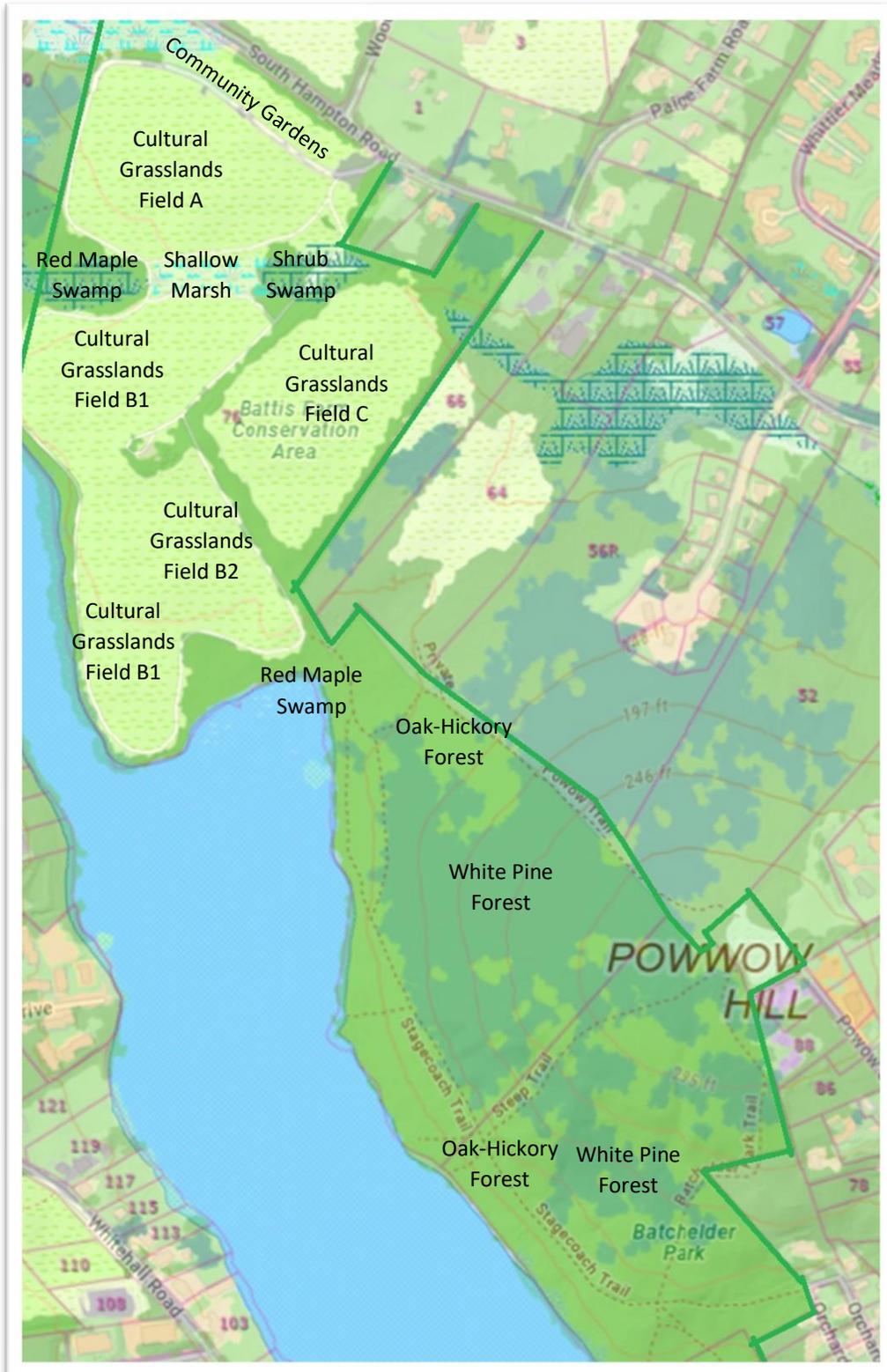


FIGURE 5 -NATURAL COMMUNITIES

Battis Farm and Powow Hill

According to the MassGIS Land Cover Land Use (2016) layer and DEP Wetlands layer, the natural communities at Battis Farm and Powow Hill are comprised of approximately 38.5 acres of cultural grasslands, 25.8 acres of white pine forest on the slopes of Powow Hill, about 43 acres of oak-hickory forest mostly on the slopes of Powow Hill, about 2 acres of shallow marsh, about 1 acre of shrub swamp, about 4 acres of forested wetlands (red maple swamp), and about 1.8 acres of community gardens.

Cultural Grassland Community¹

The areas at Battis Farm that are classified as a cultural grassland community (36.7 acres) by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) require mowing and are primarily of conservation interest as habitat for grassland birds, including **Bobolink** (*Dolichonyx oryzivorus*) and **Savannah sparrow** (*Passerculus sandwichensis*) that have displayed and nested there for several years; and for pollinators – insects that are food for many species of birds and mammals.

The hayfields are dominated by non-native agricultural grasses such as timothy (*Phleum pratense*), **orchard grass** (*Dactylis glomerata*), **alfalfa** (*Medicago satina*), smooth brome (*Bromus inermis*), and redtop (*Agrostis gigantea*). Hayfields provide different habitats and support different species of plants and animals than other cultural grasslands that are likely to have a greater variety of species of plants and insects.

Bold text indicates species that have been noted at or near the Powow River Conservation Area. Species in **red** are listed as Species of Greatest Conservation Concern in the 2015 Massachusetts State Wildlife Action Plan – see section on State Wildlife Action Plan on page 18.



FIGURE 6 - MOWED (HAY) FIELDS AT BATTIS FARM

¹ See Mass. NHESP factsheet <https://www.mass.gov/doc/cultural-grassland-0/download>

Grassland birds are found in a variety of habitats: for example, **Bobolinks** (*Dolichonyx oryzivorus*) in taller grasses most often found in hayfields and **Eastern Meadowlarks** in shorter grasses often found in pastures. Other grassland birds include **Killdeer** (*Charadrius vociferus*), **Savannah sparrows** (*Passerculus sandwichensis*), and **Horned Larks** (*Eremophila alpestris*). Meadow voles (*Microtus pennsylvanicus*), meadow jumping mice (*Zapus hudsonius*), and northern short-tailed shrews (*Blarina brevicauda*) would be expected in most grasslands. They would be hunted by **garter snakes** (*Thamnophis sirtalis*), long-tailed weasels (*Mustela frenata*), **American Kestrels** (*Falco sparverius*), and wintering **Northern Harriers** (*Circus cyaneus*), Snowy owls (*Nyctea scandiaca*), and **Short-eared owls** (*Asio flammeus*).

Small mammals such as **eastern cottontail** (*Sylvilagus floridanus*) and skunks use the habitat along with foxes, coyotes (*Canis latrans*), and an abundance of butterflies and songbirds.

Threats to these field habitats include invasive non-native plant species and edge encroachment – the growth of shrubs and trees along the edges that reduce the size of the fields. Invasive non-native plant species including **Multiflora rose** (*Rosa multiflora*), **Oriental bittersweet** (*Celastrus orbiculatus*), **Autumn olive** (*Elaeagnus umbellata*), and **buckthorns**, among others, are also present especially along the edges of the fields.

Upland Forest Communities

The upland forest communities include Oak – hickory Forest and Successional White Pine Forest. Most of these forest communities have been classified as Prime Forest Land based on their potential for timber growth/harvest (an indication of their ecological vigor and importance) by the University of Massachusetts. Prime 1, 2, 3, Statewide Importance Forests cover almost all Powow Hill and the field edges of Battis Farm Conservation Area (see Fig. 7).

OAK-HICKORY FOREST²

Most of the deciduous forest can be classified as Oak-hickory Forest (36.5 acres). The canopy is dominated by one or several **oaks** (*Quercus rubra*, *Q. alba*, and *Q. velutina* with *Q. coccinea* and/or *Q. montana*). Mixed in are lower densities of one or several **hickories** (***Carya ovata***, *C. tomentosa*, *C. glabra*, or ***C. cordiformis***). Occasionally other trees include white ash (*Fraxinus americana*), black birch (*Betula lenta*), sassafras (*Sassafras albidum*), and **red maple** (*Acer rubrum*). If present, conifers (**white pine** (*Pinus strobus*) and/or eastern hemlock (*Tsuga canadensis*)) constitute <25% cover. A subcanopy/tall shrub layer (usually 25-50% cover) commonly includes hop hornbeam (*Ostrya virginiana*), flowering dogwood (*Benthamidia florida*), downy shadbush (*Amelanchier arborea*), American chestnut (*Castanea dentata*), and witch-hazel (*Hamamelis virginiana*). Low shrubs are often diverse and generally sparse, but dense in patches: maple-leaved viburnum (*Viburnum acerifolium*), **blueberries** (*Vaccinium angustifolium* and *V. pallidum*), beaked and American hazelnut (*Corylus cornuta* and *C. americana*), and gray dogwood (*Swida racemosa*) may be present. The herbaceous layer is also richer than in many oak forests. Plants typical of the herbaceous layer include silverrod (*Solidago bicolor*), tick-trefoils (*Desmodium glutinosum* and *D. paniculatum*), wild sarsaparilla (*Aralia nudicaulis*), rattlesnakeweed (*Hieracium venosum*), false Solomon's seal (*Maianthemum racemosum*), **pink lady's**

² <https://www.mass.gov/doc/oak-hickory-forest-0/download>



FIGURE 7 - PRIME UPLAND AND WETLAND FOREST LAND

slipper (*Cypripedium acaule*), and patches of long-beaked Pennsylvania sedge (*Carex lucorum*) or Pennsylvania sedge (*C. pennsylvanica*).

No animal species are restricted to Oak-hickory Forest. Animals are those of typical coastal oak areas such as the birds, **Eastern towhee** (*Pipilo erythrophthalmus*), **gray catbird** (*Dumetella carolinensis*), **common yellowthroat** (*Geothlypis trichas*), **ovenbird** (*Seiurus aurocapillus*), and **black-and-white warbler** (*Mniotilta varia*). Small mammals, such as meadow voles (*Microtus pennsylvanicus*), and white-footed mice (*Peromyscus leucopus*), are common, with **gray squirrels** (*Sciurus carolinensis*) abundant in mainland forests. **Eastern box turtles** (*Terrapene carolina*) use Coastal Forest/Woodlands as parts of their habitats. Moths, butterflies, and other insects of the southeastern oak and oak-pine forest occur in Oak-hickory Forest, including some uncommon species. High **white-tailed deer** (*Odocoileus virginianus*) densities may have an impact on the abundance of native species, particularly woody seedlings such as oaks, as well as on herbaceous plants.

The major threats to Oak-hickory Forest are the proliferation of invasive non-native plant species such as **glossy buckthorn** and **Morrow's honeysuckle** and development.

SUCCESSIONAL WHITE PINE FOREST³

Most of the evergreen forest can be classified as Successional White Pine Forest (23.2 acres). This forest type has a near monoculture of **white pine** (*pinus strobus*, >75% cover) in the canopy, with scattered associates that vary with geography and prior land use, including White oak (*Quercus alba*), Red oak (*Quercus rubra*), Red maple (*Acer rubrum*), and early successional trees such as **birches** (*Betula spp.*) and **aspens** (*Populus spp.*). The shrub layer is variable, from sparse to thick, and may include Black elderberry (*Sambucus canadensis*), **black cherry** (*Prunus serotina*), maple-leaved viburnum (*Viburnum acerifolium*), and non-native species such as **glossy buckthorn** (*Rhamnus frangula*), **bush honeysuckles** (*Lonicera spp.*), and/or **multiflora rose** (*Rosa multiflora*). Blackberry (*Rubus spp.*) vines may form thickets, and **poison ivy** (*Toxicodendron radicans*) often covers the ground near openings or in formerly open disturbed areas. Lowbush blueberries (*Vaccinium angustifolium*) form patches mixed with black huckleberry (*Gaylussacia baccata*) on sites with less disturbed soil. Bracken fern (*Pteridium aquilinum*) may be in the shrub layer. The herbaceous layer is variable; large patches of Canada mayflower (*Maianthemum canadense*) and **northern starflower** (*Trientalis borealis*), with **clubmosses** (such as ground-pine, southern ground-cedar, and staghorn clubmoss), are particularly common on formerly plowed soil. **Partridgeberry** (*Mitchella ripens*), fringed polygala (*Polygala paucifolia*), and **pink lady's-slipper** (*Cypripedium acaule* Aiton) grow in many longer established sites.

Blackburnian warblers (*Dendroica fusca*) are probably the bird species most closely associated with dense white pine forests. Other birds of the community include **ovenbird** (*Seiurus aurocapillus*), **yellow warbler** (*D. dominica*), **Cooper's hawk** (*Accipiter cooperii*) and **northern goshawk** (*Accipiter gentilis*), as well as generalists such as the **black-capped chickadee** (*Poecile atricapillus*), and **white-breasted nuthatch** (*Sitta canadensis*).

³ www.mass.gov/doc/successional-white-pine-forest/download

The major threat to the Successional White Pine Forest is the proliferation of invasive non-native plant species such as **glossy buckthorn** and **Morrow's honeysuckle**.

Shallow Emergent Marsh⁴

Most of the unforested wetlands are classified as Shallow Emergent Marshes (1 acre). Short grasses, sedges, and rushes mixed with scattered forbs (broad-leaved herbaceous plants) dominate Shallow Emergent Marshes. Tussock-forming species such as tussock sedge (*Carex stricta*) and Canada bluejoint (*Calamagrostis canadensis* var. *canadensis*) may form a hummock-hollow topography over broad areas. Forbs often include sensitive fern (*Onoclea sensibilis*), marsh fern (*Thelypteris palustris*), swamp-candles (*Lysimachia terrestris*), **marsh St. John's-wort** (*Hypericum elodes*), **Joe-Pye-weeds** (*Eutrochium* spp.), bonesets (*Eupatorium* spp.), and water-horehound (*Lycopus* spp.). Low shrubs such as **spirea** (*Spiraea* spp.), **red osier dogwood** (*Swida sericea*), leatherleaf (*Chamaedaphne calyculata*), and sweet gale (*Myrica gale*) may be present with <25% coverage. Areas with shallow water between or instead of tussocks typically have a mixture of bur-reeds (*Sparganium* spp.), sedges (*Carex* spp.), and rice cut-grass (*Leersia oryzoides*). Areas with more permanent open water often support floating-leaved plants like waterlilies (*Nymphaea odorata* and *Nuphar* spp.) and submerged plants like pondweeds (*Potamogeton* spp.). **Duckweed** (*Lemna* spp.) is abundant in still water. It is common to see tussock sedge-dominated marshes in old beaver flowages mixed with scattered **alder** (*Eupatorium* spp.) and **spirea** (*Spiraea* spp.). Sites with a history of severe disturbance may be dominated by or include an abundance of exotic species including **purple loosestrife** (*Lythrum salicaria*), reed canary-grass (*Phalaris arundinacea*), phragmites (*Phragmites australis*), or Japanese knotweed (*Fallopia japonica*). **Cattails** (*Typha* spp.), phragmites (*Phragmites australis*), and wool-grass (*Scirpus cyperinus*) (the dominants of Deep Emergent Marshes) often occur, but do not dominate. Tall shrubs and tree saplings are uncommon and when present are often clustered together.

Shallow Emergent Marshes are an excellent habitat for muskrats. Shallow Emergent Marsh habitat supports many species of frogs and salamanders, especially leopard, **pickerel**, **green**, and **bull frogs**, and some vernal pool obligate species, such as **wood frogs** (*Lithobates sylvaticus*) and spotted salamanders (*Ambystoma maculatum*), may use areas of Shallow Emergent Marsh for egg-laying if they are fish free.

Shrub Swamp⁵

The species composition of Shrub Swamps (1.2 acres) is highly variable within and among sites. Possible dominant and codominant shrub species include speckled alder (*Alnus incana* ssp. *rugosa*), smooth alder (*A. serrulata*), **meadowsweet** (*Spiraea alba* var. *latifolia*), steeplebush (*S. tomentosa*), **buttonbush** (*Cephalanthus occidentalis*), maleberry (*Lyonia ligustrina*), swamp azalea (*Rhododendron viscosum*), **silky dogwood** (*Swida amomum*), **winterberry** (*Ilex verticillata*), sweet gale (*Myrica gale*), willows including pussy willow (*Salix discolor*) and black willow (*S. nigra*), **arrowwood** (*Viburnum dentatum*), and poison sumac (*Toxicodendron vernix*). Shrub swamps in areas with neutral pH water often have abundant **spicebush** (*Lindera benzoin*). Low-growing, weak-stemmed shrubs include dewberry (*Rubus hispidus*), water-willow (*Decodon verticillatus*), and Canadian burnet (*Sanguisorba canadensis*). Trees tend to be scattered and stunted and may include **red maple** (*Acer rubrum*), **gray birch** (*Betula*

⁴ www.mass.gov/doc/shallow-emergent-marsh/download

⁵ www.mass.gov/doc/shrub-swamp/download

populifolia), **white pine** (*Pinus strobus*), or other species found in either forested swamps or adjacent uplands. In general, a shrub community will have <25% cover of tree canopy. Since shrubs often form dense thickets, the herbaceous layer of shrub swamps is often sparse and species-poor. A mixture of the following species is typical: common arrowhead (*Sagittaria latifolia*), **skunk cabbage** (*Symplocarpus foetidus*), ferns (especially cinnamon fern (*Osmundastrum cinnamomeum*), sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), and marsh fern (*Thelypteris palustris*)), sedges (*Carex* spp.), bluejoint grass (*Calamagrostis canadensis*), bur reed (*Sparganium* spp.), virgin's-bower (*Clematis virginiana*), swamp candles (*Lysimachia terrestris*), clearweed (*Pilea pumila*), and **turtlehead** (*Chelone glabra*). While nonvascular flora is not a major component, sphagnum has been recorded in substantial abundance in some occurrences. Invasive species include reed canary-grass (*Phalaris arundinacea*), glossy buckthorn (*Frangula alnus*), **common buckthorn** (*Rhamnus alnifolia*), and **purple loosestrife** (*Lythrum salicaria*).

Many Shrub Swamps provide high-quality vernal-pool habitats. Relatively long wet periods ensure that amphibian larvae have plenty of time to develop, and the diverse vegetation structure provides both cover for larvae and egg-attachment substrates for breeding adults. Many species of migratory birds use the dense shrub thickets as protected nesting habitat. In the winter when the surface is frozen, browsers, including **New England cottontail** (*Sylvilagus transitionalis*) have easy access to the shrubs and protection in the dense thickets. The larvae of many rare and common moth species feed on a variety of shrubs and associated herbaceous plants in Shrub Swamps throughout Massachusetts.

Forested Wetlands⁶

Most of the Forested Wetlands (4 acres) at the Powow River Conservation Area can be classified as Red Maple Swamp. **Red maple** (*Acer rubrum*) is strongly dominant in the overstory, and often provides more than 90% of the canopy cover. A variable mixture of sub-dominant tree species co-occurs with **red maple**, including **yellow birch** (*Betula alleghaniensis*), black gum (*Nyssa sylvatica*), **green ash** (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), **white pine** (*Pinus strobus*), American elm (*Ulmus americana*), **hemlock** (*Tsuga canadensis*), pin oak (*Quercus palustris*), and swamp white oak (*Quercus bicolor*). The shrub layer of Red Maple Swamps is often dense and well-developed, generally with >50% cover, but it can be variable. Other common shrubs include **sweet pepperbush** (*Clethra alnifolia*), and swamp azalea (*Rhododendron viscosum*), often dense and bound together by **greenbriers** (mainly *Smilax rotundifolia* and **highbush blueberry** (*Vaccinium corymbosum*) and **common winterberry** (*Ilex verticillata*), which are often dominant, along with **spicebush** (*Lindera benzoin*). In richer areas, northern arrow-wood (*Viburnum lentago*), speckled alder (*Alnus incana* ssp. *rugosa*), nannyberry (*Viburnum lentago*), and poison sumac (*Toxicodendron vernix*) may also occur. The herbaceous layer is often highly variable, but ferns are usually abundant. Cinnamon fern (*Osmundastrum cinnamomeum*) is common; other ferns include **sensitive fern** (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), marsh fern (*Thelypteris palustris*), and spinulose wood fern (*Dryopteris carthusiana*). **Skunk cabbage** (*Symplocarpus foetidus*) is one of the most common herbaceous species. Graminoids (grasses and grass-like plants such as rushes and sedges) are common, mixed with a variety of herbaceous species.

⁶ www.mass.gov/doc/red-maple-swamp/download

Red Maple Swamps contribute variation to the habitats of many wide-ranging wildlife species. Songbirds of swamp forest are like the birds of structurally similar upland forests, but the dense shrub layers provide excellent nesting locations for birds of thickets. The amount of escape cover and water availability makes swamps an important habitat for many species of small mammals. Ground-dwelling species, such as reptiles and amphibians, are affected by the presence of wet or moist soils in swamps and tend to use them for breeding and feeding. Parts of Red Maple Swamps that have two or three months of ponding and lack fish can function as vernal pools; these sections provide an important amphibian breeding habitat.

The major threat to Red Maple Swamp is the proliferation of invasive non-native invasive plant species such as **glossy buckthorn** (*Frangula alnus*) and **Japanese barberry** (*Berberis thunbergia*). Some of the areas of the Red Maple Swamp at the Powow River Conservation Area have dense tangles of **Oriental bittersweet** (*Celastrus orbiculatus*) and other invasive plants.

BioMap Areas

Most of Powow Hill Conservation Area is designated as Critical Natural Landscape and Core Habitat in BioMap, a joint program of MassWildlife and the Massachusetts Chapter of The Nature Conservancy (TNC) with the goal of protecting the diversity of species and natural ecosystems within the Commonwealth. BioMap is an important tool to guide strategic protection and stewardship of lands and waters that are most important for conserving biological diversity in Massachusetts. Designated areas are essential to safeguard the diversity of species and their habitats, intact ecosystems, and resilient natural landscapes.

Critical Natural Landscape identifies large landscapes minimally impacted by development and buffers to core habitats, both of which enhance connectivity and resilience. The riverfront areas and much of the uplands are designated as **Core Habitat** – critical for the long-term persistence of rare species, exemplary natural communities, and resilient ecosystems. The core habitat area includes Aquatic Core along the Powow River and Lake Gardner that contains freshwater habitats with the highest fish and freshwater mussel diversity, aquatic rare species habitat, and habitats most resilient to a warming climate. These areas represent the most structurally and functionally intact freshwater ecosystems in the state. The 100 ft. buffer area along Lake Gardner and the river are designated as Massachusetts Natural Heritage and Endangered Species Program (NHESP) as Priority Habitat for Endangered Species (PH2155).

2015 State Wildlife Action Plan⁷

The Massachusetts State Wildlife Action Plan (SWAP), as required by Congress, presents the 570 Species of Greatest Conservation Need (SGCN) in the Commonwealth, the 24 types of habitats that support these species, and the actions necessary to conserve them. Each SGCN is described at the footnoted website.

The residents of Massachusetts have a long history of working together to conserve our state's biodiversity. Federal and state government agencies, local and regional non-profits, colleges and

⁷ <https://www.mass.gov/info-details/state-wildlife-action-plan-swap>

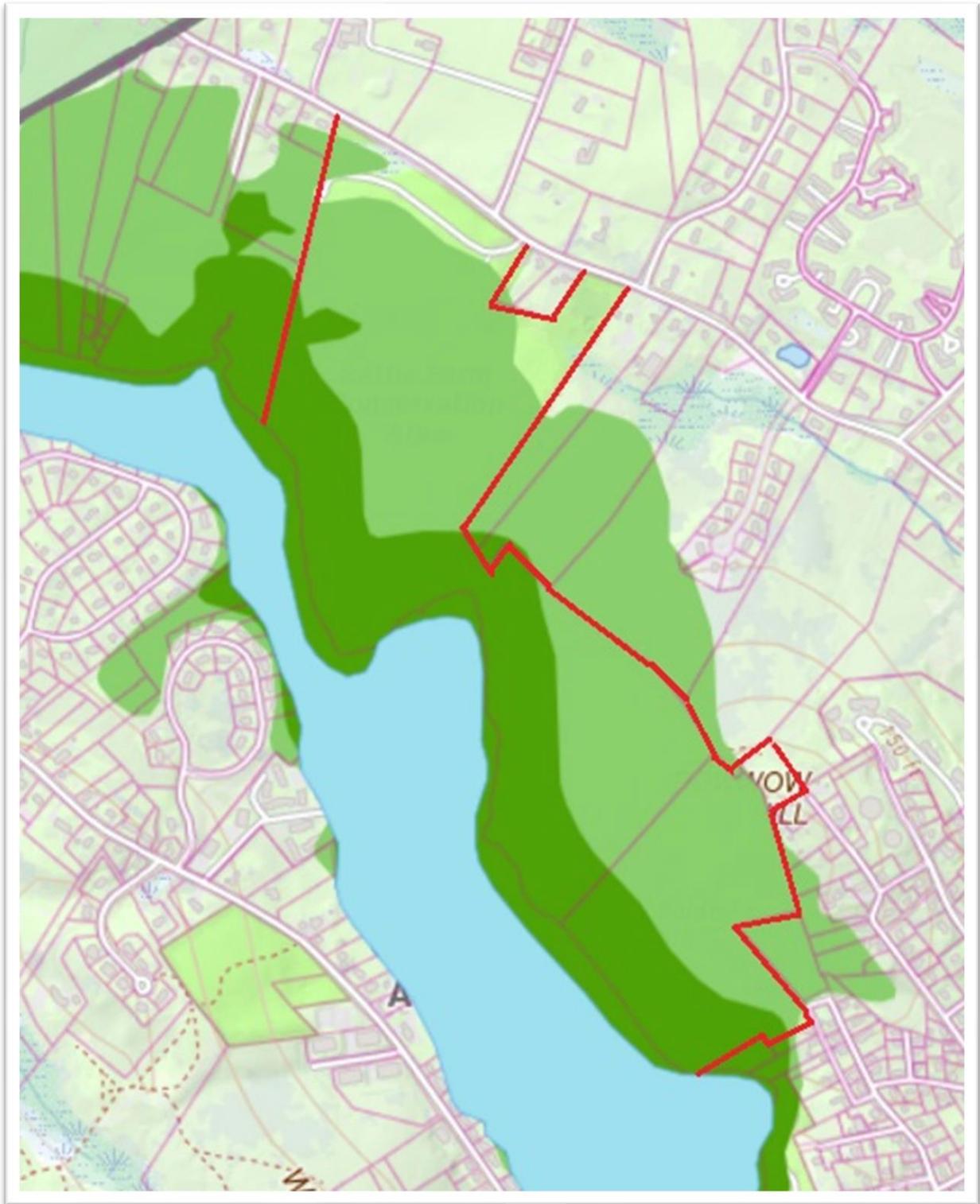


FIGURE 8 - BIOMAP CORE HABITAT (DARK GREEN) AND CRITICAL NATURAL LANDSCAPE (LIGHT GREEN)

universities, Native American tribes, municipalities: all coordinate and collaborate toward this shared goal. The Massachusetts SWAP is an important source of information to guide conservation actions.

Wildlife

The Powow River Conservation Area is a haven for wildlife including birds, amphibians, reptiles, mammals, and insects. Its natural communities contribute to the diversity of wildlife at the sites and in the surrounding areas.

Birds

Like nearby Woodsom Farm, areas within the almost 40 acres of grassland are used for breeding by **bobolink** (*Dolichonyx oryzivorus*) and **Savannah sparrow** (*Passerculus sandwichensis*), species which have faced steep population declines in the past decades because of more frequent and early harvesting of hay and are noted as Species of Conservation Concern in the Massachusetts State Wildlife Action Plan.

Battis Farm is a Cornell University eBird “hotspot” and birdwatchers have reported more than 101 species of birds from the site (see Appendix A for the entire list). Sixty-one species have been observed during the breeding season and are likely to breed at Battis Farm, nearby, or are non-breeders – birds that for a variety of reasons are not breeding during the breeding season.

Migratory bird species use a mix of forest, edge, and field habitats that are available within the sites and surrounding habitats. The loss of natural habitats through conversion to other land uses, residential development or through succession, is resulting in the decline and disappearance of some wildlife. See Mass Audubon’s report on the State of The Birds⁸ and the Cornell Lab of Ornithology⁹ for more details on these declines.



FIGURE 9 - BOBOLINK - MALE

⁸ https://www.massaudubon.org/content/download/21633/304821/file/mass-audubon_state-of-the-birds-2017-report.pdf

⁹ <https://www.birds.cornell.edu/home/bring-birds-back>

ABOUT BOBOLINKS

Bobolinks breed only in open, unforested areas across the northern United States and southern Canada (blue), preferring large fields with a mixture of grasses and broad-leaved plants like legumes and wildflowers where they can find insects and seeds to feed their young. They historically nested in midwestern tallgrass and mixed prairie of the United States and south-central Canada. While they still nest in this area, 99% of the prairies have been converted to crops or pasture. They now also nest in eastern hayfields and grasslands, which became available as eastern forests were cleared. Such areas are now declining largely due to the development of former farmland. After breeding, bobolinks move to freshwater marshes and coastal areas to molt before migrating more than 5,000 miles to their wintering areas in the southern interior of South America (red), where they forage in grasslands, marshes, rice fields, and sorghum fields before returning to North America in the spring – travelling up to 10,000 miles per year.



Amphibians and Reptiles

Wetlands and forests provide good habitats for a variety of amphibians and reptiles. The Massachusetts Herpetological Atlas Project¹⁰, a seven-year effort, running from 1992 through 1998, reported 23 species of amphibians and reptiles in the vicinity of Amesbury. Likely species at the Powow River Conservation Area include American toad (*Anaxyrus americanus*), **bullfrog** (*Lithobates catesbeianus*), gray treefrog (*Hyla versicolor*), eastern red-backed salamander (*Plethodon cinereus*), eastern newt (*Notophthalmus viridescens*),



FIGURE 10 – GREEN FROG (*LITHOBATES CLAMITANS MELANOTA*)

common snapping turtle (*Chelydra serpentina*), eastern garter snake (*Thamnophis sirtalis sirtalis*), Eastern milk snake (*Lampropeltis triangulum triangulum*), four-toed salamander (*Hemidactylum scutatum*), Fowler's toad (*Anaxyrus fowleri*), **green frog** (*Lithobates clamitans melanota*), **Jefferson/blue-spotted salamander** (*Ambystoma* spp.), northern black racer (*Coluber constrictor constrictor*), **Northern leopard frog** (*Lithobates pipiens*), northern redbelly snake (*Storeria occipitomaculata occipitomaculata*), northern ringneck snake (*Diadophis punctatus edwardsii*), northern two-lined salamander (*Eurycea bislineata*), northern water snake (*Nerodia sipedon*), painted turtle (*Chrysemys picta*), pickerel frog (*Lithobates palustris*), red-backed salamander (*Plethodon cinereus*), **spotted salamander** (*Ambystoma maculatum*), **Spotted turtle** (*Clemmys guttata*), **spring peeper** (*Pseudacris crucifer*), and **wood frog** (*Rana sylvatica*). An inventory of amphibians and reptiles would be a good community science project.

¹⁰ Jackson, S.D., R.M. Richmond, T.F. Tynning and C.W. Leahy (eds). 2010. Massachusetts Herpetological Atlas 1992-1998, Massachusetts Audubon Society & University of Massachusetts (massherpatlas.org).

Mammals

Because of the rich forest and river edge the site also provides habitat for several mammal species. Mammals that have been documented by iNaturalist or are likely to occur within the area include: Virginia opossum, **eastern gray squirrel** (*Sciurus carolinensis*), **red squirrel** (*Tamiasciurus hudsonicus*), **Eastern chipmunk** (*Tamias striatus*), **groundhog** (*Marmota monax*), eastern meadow vole (*Microtus pennsylvanicus*), North American river otter (*Lontra canadensis*), American beaver (*Castor canadensis*), northern short-tailed shrew (*Blarina brevicauda*) White-footed deer mouse (*Peromyscus leucopus*), **Bobcat** (*Lynx rufus*), fisher (*Pekania pennanti*), common raccoon (*Procyon lotor*), gray fox (*Urocyon cinereoargenteus*), Eastern cottontail (*Sylvilagus floridanus*), coyote (*Canis latrans*), muskrat (*Ondatra zibethicus*), red fox (*Vulpes vulpes*), long-tailed weasel (*Neogale frenata*), striped skunk (*Mephitis mephitis*), North American porcupine (*Erethizon dorsatum*), and white-tailed deer (*Odocoileus virginianus*).

Invertebrates

Butterflies, bees, and other insects help pollinate wildflowers and are food for many of the small mammals and birds that use the habitats at Powow River Conservation Area. Fifty species of insects have been reported by iNaturalist including **eastern pondhawk** (*Erythemis simplicicollis*), **monarch** (*Danaus plexippus*), **blue dasher** (*Pachydiplax longipennis*), **Carolina grasshopper** (*Dissosteira carolina*), **common whitetail** (*Plathemis lydia*), **green-striped grasshopper** (*Chortophaga viridifasciata*), and **red milkweed beetle** (*Tetraopes tetraphthalmus*) are among the others reported (see Appendix C for the full list).

Declines in the health and population of pollinators pose what could be a significant threat to the integrity of biodiversity, to global food webs, and to human health. At least 80% of our world's crop species require pollination to set seeds. A 2021 study estimated that without pollinators, fertility would be reduced by 80% in half of all wild plant species and one-third of all wild plant species would fail to produce any seeds at all.



FIGURE 11 – EASTERN PONDHAWK (*ERYTHEMIS SIMPLICICOLLIS*) PHOTO BY MICHAEL J. PAPAY

Land Stewardship Recommendations

There are many choices concerning how we steward our common land – land held for the benefit of us all. Some of those choices are determined by the nature of the land itself. For example, many parks are managed for their scenic beauty and/or for active recreation. Some forests are managed primarily for timber harvest. Aldo Leopold¹¹, sometimes referred to as the father of wildlife ecology, was an advocate for the conservation of land to preserve its natural assets as wildlife habitat and recommended that some land be designated as “wilderness”. In short, not every site is the same. There are competing uses for public land, and it is in the interest of everyone to maintain a variety of stewardship activities.

The Powow River Conservation Area is managed as an important natural area to benefit wildlife and provide an area to be enjoyed for a variety of passive activities. Passive recreation generally means leisure activities commonly practiced by an individual or small group that are usually unorganized and noncompetitive, including, but not limited to, picnicking, birdwatching, cross-country skiing, snowshoeing, nature observation, and walking. These activities have a minimal impact on the site’s natural assets.

Powow River Conservation Area Goals and Objectives

Stewardship goals for the Powow River Conservation Area are based on the Principles and Policies for the Stewardship of Amesbury Conservation Land (June 2023) as well as the goals from the 2020-2027 Amesbury Open Space and Recreation Plan.

The mission of the Conservation Commission is:

- To protect Amesbury’s natural resources in accordance with the state law and the City’s Wetlands Protection Ordinance and
- To act as trustees in perpetuity of the City’s conservation land

From the 2020 – 2027 Amesbury Open Space & Recreation Plan:

Open Space and Recreation Plans help guide the protection and management of open space and recreational facilities within municipalities. Parks and open space enhance quality of life, and a growing body of evidence emphasizes that parks and related programming are a critical part of a community’s public health infrastructure. This role has been made even more prominent by the COVID-19 pandemic, with local parks and open space providing much-needed respite from quarantine when social distancing is necessary. In addition to these social and public health benefits, open space planning can provide ecological, climate resiliency and economic benefits by minimizing the misuse or mismanagement of a community’s natural resources, preserving or enhancing ecosystem services provided by natural systems, and by proactively managing natural resources for these multiple co-benefits. From protecting water resources through nature-based solutions, land conservation, and green infrastructure to reducing urban heat island effect by providing urban tree canopy, open space, natural areas, and parks also play a critical role in building climate resilient communities. The purpose of this document is to help ensure that investments in land protection benefit not only natural resource protection, landscape

¹¹ Aldo Leopold Foundation (<https://www.aldoleopold.org/about/aldo-leopold>)

connectivity, and the recreational needs of the Amesbury community but also incorporate other aspects of resilience to climate change. [pg. 6].

2020-2027 Amesbury Open Space & Recreation Plan Goals [pgs. 75-76]:

1. Preserve, restore, enhance, and acquire natural resources that increase Amesbury's resilience to the effects of climate change, protect Amesbury's drinking water supply, and expand opportunities for passive and active recreation.
2. Maintain, enhance, and create recreational facilities for the enjoyment of Amesbury residents and visitors of all ages, abilities, and interests.
3. Improve care, management and awareness of existing protected land, natural resources, and recreational facilities.
4. Improve access to and connectivity among open spaces, recreational facilities, and other important city resources for all members of the Amesbury community, including low-income neighborhoods, English language learners (ELL), persons with disabilities, and older residents ("socially vulnerable populations").
5. Improve coordination and collaboration among departments, committees, and local organizations working toward common goals for open.

From the 2023 Principles and Policies for Stewardship of Amesbury Conservation Land:

The overarching goal for the stewardship of Amesbury's conservation land is to build resilience to climate change by actively managing, restoring, maintaining, and protecting healthy ecosystems, to manage recreational use such that sensitive wildlife and habitat is not impaired, and to ensure that people of all ages, abilities, and backgrounds can enjoy, experience, and learn about Amesbury's conservation lands.

Objectives to accomplish this for the Powow River Conservation Area are:

1. Identify and protect sensitive habitats and rare species.
2. Manage and minimize the spread of invasive species.
3. Protect water resources, including the Powow River, drinking water (Tuxbury Pond and Lake Attitash) Lake Gardner, other river and stream buffers, and wetlands.
4. Improve site accessibility for people with disabilities by creating all-access trails and providing signage for the sight impaired.
5. Make readily available for the public, information about the city's natural and cultural history, resources and recreational opportunities through multi-lingual signage, trail markers, freely available maps, and other information disseminated on the City's website, social media, and available at trailheads.
6. Build local and regional partnerships to help accomplish these goals.
7. Create property use regulations consistent with these goals and objectives and identify monitoring and enforcement entity(-ies).

The Powow River Conservation Area has some unique qualities that influence its stewardship. These include:

- Large size and varied topography
- A treasured agricultural landscape
- Use for community gardens
- Use for disposal of water treatment plant sediment
- Ecologically important and sensitive areas

Recommendations for addressing these objectives are detailed below.

Rules and Regulations for Use of Amesbury Conservation Lands (DRAFT)

Land stewardship requires a careful balance of economic, social, and ecological values and goals. The allowable and prohibited uses of conservation land, which should be adopted by Conservation Commission (and reflected in City ordinance if necessary), are centered on protecting Amesbury's natural assets, conservation values, and visitor safety. Visitors are welcome to use conservation properties for passive recreation during daylight hours, with permission required for evening picnics, overnight camping, or large group activities (see Parks and Recreation Commission's Park and Facilities Rules and Regulations available online as a PDF¹²).

Allowable uses of conservation land are as follows:

- Walking, hiking, trail running, and the like,
- Non-commercial dog-walking (dogs shall be on-leash only in certain areas during grassland-bird nesting season); all off-leash dogs shall be voice-controlled,
- Non-motorized boating,
- Picnicking,
- Birdwatching and other nature observation,
- Skiing and snowshoeing,
- Fishing,
- Bicycling on designated trails,
- Equestrian use on designated trails,
- Authorized community gardening activity as permitted by the Commission,
- Parking on designated roads, parking areas, or trails,
- Authorized maintenance or construction work.

Prohibited uses of conservation land in Amesbury are as follows:

- Possession of alcoholic beverages,
- Hunting or discharging firearms (except as part of a deer population control program),
- Trapping, except as authorized for the purpose of habitat conservation or invasive species removal,

¹² <https://www.amesburyma.gov/DocumentCenter/View/1994/Parks-and-Recreation-Facility-Rules-and-Regulations-PDF?bidId=>

- Cutting, defacing, removal of trees, bushes, plants, flora, or deadwood, except as part of an approved habitat management project,
- Dumping of any material, including yard waste such as leaves and brush,
- Littering or trash disposal,
- All motorized vehicle types, except as authorized. Permits for motorized vehicle use may be granted to visitors with qualified disabilities who show appropriate documentation.
- Fires and campfires, except as authorized,
- Paintball or “war” games,
- Construction of off-road bicycle BMX-style trails and jumps,
- Additional trail construction except by specific authorization of the Conservation Commission and/or Mayor and City Council.

Safety Concerns

There are few concerns about public safety relating to the condition of the properties. The open fields could host stinging insects and ticks. Some poison ivy was observed both in the forest understory and along the edges. Given that the trails are along the field edges and within the forest, special efforts should be made after high wind events to survey the trails for fallen trees and hanging branches overhead and remove any hazards identified.

Concerns have been raised about aggressive or uncontrolled dogs. The Town of Weston in cooperation with the Sudbury Valley Trustees recruited volunteer “Bark Rangers” to walk some of the town’s trails and spread the message about the negative impacts dogs can have on wildlife, water quality, and other visitors. Bark Rangers encouraged trail walkers to keep dogs under their command and on the trails and to “scoop the poop.”

Threats and Opportunities

Invasive species pose one of the main threats to the ecological integrity of the area. **Glossy buckthorn, common buckthorn, Oriental bittersweet, bush honeysuckle, and multiflora rose** edge the forest and grassland interface and some of the hedgerows separating fields. **Glossy buckthorn** is likely the main invasive growing in the forest understory.

Woody species like **buckthorns, Oriental bittersweet, and multiflora roses** are found along the edges of the fields. All these invasive, non-native species benefit from late cutting (after Sept. 15) because they have had the opportunity to produce seeds and store energy for the next season. Measures to maintain the fields will be addressed in the section on management.

Enforcing the regulations on dogs is another challenge. It is important to ensure that dogs are kept on leash during the bird breeding season. Measures to improve enforcement will be addressed in the section on management.

The Powow River Conservation Area is popular for passive recreation in all seasons. This is an important opportunity to engage the public in a variety of ways including public media, interpretive signage, or guided walks.

Stewardship Recommendations

The following recommendations will address management with regard for climate change, past management efforts, management of the fields, recommendation on forest management, trails, efforts to control invasive species, other wildlife enhancement opportunities, and management of passive recreation uses.

Stewardship of Natural Areas with Regard for Changing Climate

The management of natural resources has largely assumed a stable climatic background. Now there is widespread agreement among scientists and the public that the climate is changing because of human activities – largely attributed to the burning of fossil fuels resulting in the production of carbon dioxide. Massachusetts is already experiencing the effects of climate change, from hotter summers with more periods of drought, warmer winters with less snow cover but more precipitation, rising sea levels, more frequent severe weather events, and inland flooding in winter and spring.

Climate impacts that may affect conservation land and how it is managed are predicted to:

- Increase the number of extremely hot days and degraded air quality,
- Compromise infrastructure like trails (e.g., more erosion, blowdowns, and flooding),
- Increase the risks from storm events,
- Changes in the composition of species,
- Increase non-native plants and pests,
- Increase vector-borne illnesses (like West Nile and Lyme disease).

All of this affects how Amesbury and other towns will need to manage their land in the future. Manomet Center for Conservation Science and the Massachusetts Division of Fisheries and Wildlife have published a study¹³ promoting two primary objectives for the management of sites and habitats – managing resilience and managing change.

Management for Resilience and Managing Change

Mass Audubon generally pursues four principles for increasing the resilience of conservation land.

1. **Reduce non-climate stressors** – for example, controlling invasive plants and pests.
2. **Restore form and function** – for example, removing a dam to promote spawning of diadromous fishes.
3. **Increase complexity** – for example, increasing diversity and microclimates.
4. **Create linkages** – for example, connecting to adjacent land and creating corridors.

¹³ www.manomet.org/wp-content/uploads/old-files/Climate%20Change%20and%20Massachusetts%20Fisheries%20and%20Wildlife%20Reports,%20Vol.%203%20April%202010.pdf

FORESTED HABITATS

The maps show recent and projected dominant forest types. Major changes are projected for many regions. For example, in the Northeast, under a lower emissions scenario, the currently dominant maple-beech-birch forest type (red shading) is projected to be completely displaced by the oak-hickory forest type in a warmer future. Source: USGCRP (2009). To respond to climate change:

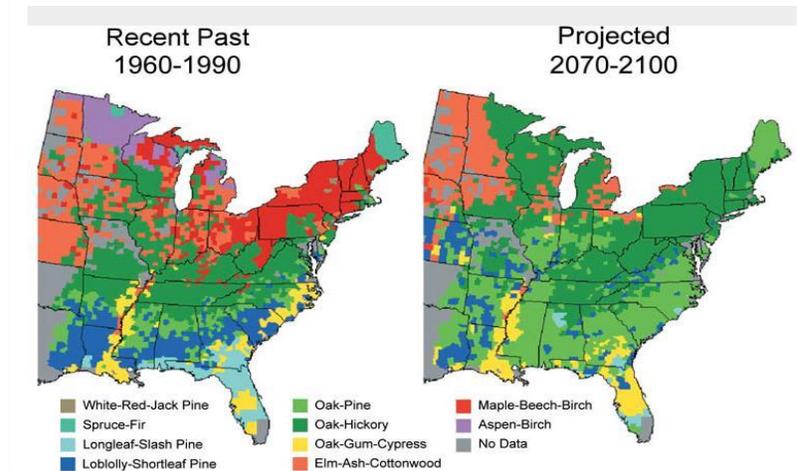


FIGURE 12 - PROJECTED CHANGE IN FOREST TYPES

- **Diversifying the age structure and species composition** of the forested landscape in advance of climate change, this could increase resilience of forested ecosystems and overall resistance to the impacts of a changing climate.
- **Control of white-tailed deer densities.** High levels of browsing by white-tailed deer have adversely affected the structure, composition, and functioning of Massachusetts forested ecosystems, particularly through the elimination of preferred food species such as red oak, and thereby reduced their diversity and resilience. Also, overgrazing by deer has opened the way for increased rates of infestation by non-native plants.
- **Control invasive species and pests.** Damage caused by non-native plants and insect pests will become more serious under climate change. Forest managers will need:
 - to detect and track infestations and outbreaks in their early stages, and
 - to take aggressive actions to eliminate these problems before they escape control.
- **Manage change.** In the past management was primarily guided by the concept of preserving natural habitats and associated species. Adaptive management is recognizing that preserving the status quo may not always be possible. When preservation of a habitat or species is no longer feasible, we will need to adapt management practices to guide change. One strategy may be to plant more southern species that will help maintain diversity or other ecological values.

FRESHWATER WETLANDS

The main threats to freshwater wetlands in Massachusetts are likely to be impaired hydrology and habitat loss, and ecological injuries caused by non-native pest species, the same threats that currently affect wetland quality and function. The regulations that currently protect wetlands have been extraordinarily successful. However, climate change may require us to rethink how these regulations are applied. Active management of wetlands may be an important tool under climate change. If such management is impeded by the way some regulations are currently applied, they may have to be modified to reflect changing circumstances.

Control of Invasives. It is likely that the problems that are currently posed by invasive plant species to wetlands will be exacerbated by the higher levels of environmental stress introduced by climate change (droughts, extreme events, etc.). To continue to protect valued wetlands will require three things:

- **More active monitoring.** It will be essential to detect pest outbreaks in their earlier stages, rather than later when they have secured a foothold. This can only be accomplished if active detection and monitoring schemes are implemented.
- **Aggressive control activities.** More resources will be needed to eliminate or control outbreaks of pests in their early stages.
- **Education on and enforcement of best management practices.** Many pests are transported from site to site by humans. To reduce this hazard, it will be necessary to educate users of wetland resources (e.g., anglers, hunters, nature viewers) about the dangers posed by invasives and to provide them with guidance and facilities to reduce off-site transport.

Description of Past Management

After Battis Farm was acquired in 1985 it continued to be used for agriculture by contract farmers mowing the fields for hay. Trails along the edges of the field were mowed and largely maintained by use.

In 2007, the Lake Gardner Association completed an improved trail network including the construction of boardwalks along wet portions of the Stagecoach Trail. These continue to be maintained by volunteers. Some trails on Powow Hill are steep and not suitable for all uses and are prone to erosion. Motorized vehicles are prohibited on all trails and boardwalks are for pedestrian use only.

In 2015 the Massachusetts Department of Environmental Protection (MassDEP) approved that sediment collected from the municipal water treatment plant could be stored and spread once a year, prior to tilling the soil. The sediment has been approved for land application by MassDEP, and the application provides a cost-effective means of disposal for the material. All costs associated with the operation of Battis Farm are currently covered by the Amesbury Water Department. The DEP permit specified that the sediment material could be stored at Battis Farm for up to 48 hours before it was spread and tilled to prevent the migration of material during rain events.



FIGURE 13 - SEDIMENT PILE

GZA GeoEnvironmental, Inc. prepared a 2020 Bobolink Management Plan for Battis Farm for the Conservation Commission in response to the “city’s interest in developing an equitable mixed use of the site for passive recreation, continued agricultural activity, city operations and maintaining Bobolink/grassland bird nesting habitat.” Prior to this plan the contracted farmer indicated that mowing frequency is determined by prime cutting periods: late May, late July and late September (with fertilizer application) for peak hay height, nutritional quality, and optimal economic benefit for both the farmer and the city without regard for Bobolink nesting. GZA’s site assessment in May of 2020 found that the

property employed a field rotation scheme wherein three fields are planted, one is harvested for hay early in the season (before mid-May), two are allowed to grow to the end of June and one is left fallow.

The 2020 plan recommended a mowing regime that would allow the ground nesting bobolinks and other grassland birds to fledge before the harvest of hay (no mowing between May 15 and August 15 for some of the fields). The details of its recommendations included:

1. Continue use of field rotation between fields A, B1, B2 and C (see Fig. 5, page 11); one field to be left fallow, 3 fields to be planted/managed for hay every year.
2. Splitting of Field B1 and B2 to continue in its current state. Field B2 or C can be aggressively managed (3 cuttings per year) due to a lack of observed Bobolink nesting during May 2020.
3. To maximize haying operations, one field (A, B1 or C) that is planted should be aggressively managed (cut) three times per year, allowing the two other planted fields to grow until July 15 before cutting.
4. Recommend cutting all planted fields prior to September 15 to control invasive species and thatch buildup. Routine mowing, at the end of the nesting season, promotes Bobolink nesting habitat.
5. Continue sediment application to active fields as currently managed (prior to tilling); currently the sediment is stored outside and uncovered. GZA recommends a simple covered facility to prevent migration of the material during rain events. Additional informational signage on the storage facility for the public is also recommended to explain content and use of the material on site.
6. Install informational signage on the property to describe grassland bird habitat and use, discourage unrestrained dog walking around fields slated for Bobolink habitat, and encouraging pedestrians to remain on walking paths around fields serving as habitat for that year.
7. Recommend that a signed agreement between the city and farmer be acquired with stated dates for mowing. Recommend that the farmer confirm with the city before mowing operations are conducted.
8. Recommend updating the City's Battis Farm website with information highlighting Bobolink and Bobolink habitat information.
9. Partner with non-government organizations like Mass Audubon and The Bobolink Project to provide funding for restriction of haying activities and/or educational opportunities such as birding walks, informational signage or other educational items.
10. Consider working with local schools to monitor Bobolink on the property as part of science classes.

Current Management

Currently the city engages a contract farmer to manage the fields on a two-year contract. The four fields are on a four-year rotation with three fields being managed for hay with no cutting during the nesting season, between May 15 and August 15. The fourth field is used to till in the water treatment plant sediment annually after which it is picked of stones and seeded for haying in the following year when another field is used for the disposal of the sediment. Also, the Conservation Commission has some limitations on the property defining working areas for hay production to protect wetland habitats.

Recommendations for Future Management

Recommendations for the stewardship of each natural community (cultural grassland, shrubland, forested communities, and unforested wetland communities), trails, wildlife enhancements, control of non-native invasive plants, and passive recreation management will follow.

Stewardship of Natural Communities

Each natural community requires different stewardship activities.

Cultural Grassland Community

Periodic mowing of the vegetation is necessary to maintain open fields. Grasslands can range from grass-dominated, frequently mown hayfields to infrequently mown, wildflower-dominated fields. Most of the fields at Battis Farm have been maintained by frequent mowing and are dominated by cool

There are two types of grasses.

Cool-season grasses—grow best in spring and fall when cool nights follow warm days. Kentucky bluegrass, fescue, timothy, and orchard grass, all introduced species, are commonly grown, and are often planted with cool season legumes like alfalfa and clover. June grass, bluejoint and Canada wildrye are native cool-season grasses. These grasses form a dense cover that provides poorer habitat for some ground-nesting birds.

Warm-season grasses—develop most rapidly during the warm summer months. They include native prairie and Northeast species such as big bluestem, little bluestem, Indiangrass and switchgrass and often include wildflowers such as aster, black-eyed Susan, and blazing star to increase diversity and to provide additional food and cover. They grow in summer when cool season grasses are inactive, and they can be harvested (or mowed) later in the year providing a long period of time for ground-nesting birds to fledge.

season grasses. This open habitat type has become less common in Massachusetts as agricultural land has grown into forest or been developed for housing or commercial use. As a result, remaining grasslands are valuable habitat for a range of plants and animals that are also becoming less common. Several rare birds make use of grassland for nesting. However, they prefer very large fields, generally 50 acres or larger with the most uncommon grassland birds found only on sites over 100 acres. Fields as small as 10 acres may host breeding bobolinks and other ground nesting species and should be managed for both bird habitat and for pollinators – insects that transmit pollen from one plant to another.

Challenges to grassland management that favors grassland birds include succession, encroachment by shrubs (especially along the edges), and invasive species. In the absence of some form of disturbance like mowing or fire, most New England grasslands will naturally transition to an old field, a young forest, and eventually a mature forest. This process is termed succession. Edge encroachment is a more insidious form of succession where even well-tended fields slowly shrink as shrubby vegetation on the field edge grows further into the field year-by-year.

Grassland management is generally limited to mowing. Grazing can be an appropriate method for grassland management; however, it requires a dedicated farmer willing to take on all aspects of animal husbandry including erecting and maintaining fencing and providing water for the animals. A field being

actively grazed would be inaccessible to the general user, and conflicts between livestock and dogs may arise. For these reasons, mowing will be the more appropriate grassland management technique at Battis Farm.

Mowing variables include timing, frequency, type of equipment, blade height, and fate of the mown material.

- Timing and Frequency – A field that is mown earlier in the season and more frequently in a season will tend to be dominated by cool season grasses. This more frequent mowing regime is appropriate for working farms, more park-like areas for recreational or event uses, or active recreation and is generally not recommended for conservation areas.
- Fields mown once every two or even three years and later in the fall or early spring will tend to have a higher component of warm season grasses and wildflowers and be appropriate for grassland nesting birds. These fields can be mown in late fall or early spring to provide nectaring plants and over wintering habitat for invertebrates.
- Leaving patches un-mowed and moving those patches from year to year (rather than every year) helps to create structural diversity and provide overwintering locations for invertebrates.
- Mowing at the highest cutting height possible also helps preserve overwintering areas for invertebrates, a minimum of 8 inches is ideal.
- Fields that are managed for hay and grassland birds should be mowed before May 15 and after July 24¹⁴ and before Sept. 15 to allow grassland birds to nest and the chicks to fledge and reduce setting of seeds by undesirable species of plants.
- Fields that are not managed for hay can have the thatch removed every three years to prevent a build-up of a thatch layer that will impede the movement of the nesting birds. These fields too should not be mowed until after August 15. A flail mower that turns the cuttings into mulch can also eliminate the build-up of thatch.



FIGURE 14 - BREEDING SEASON - NO MOW

Type of equipment – Fields can be mown with a rotary deck mower, a flail mower, or a sickle bar mower. A rotary deck mower (bushhog) is especially good for pushing back edge encroachment but tends to leave clumped material which can inhibit re-sprouting in the spring and may smother some insect larvae. A flail mower chops the cuttings into a fine mulch that reduces the build-up of thatch.

How the mowing is done also influences wildlife. Mowing from the outside toward the center has the potential to trap small mammals, fledgling birds, reptiles, and amphibians in the center. Mowing from the middle and working outward allows more wildlife to have a chance to escape (see Figure 15).

¹⁴ See Bobolin Project <https://www.bobolinkproject.com/farmers.php>

Another measure to assure the maximum area for the ground nesting birds is to keep pushing back the field edges and/or removing tree lines and trails that fragment, separate, or reduce the fields. Trees and shrubs along the interface between the fields and the forests are always seeking more sun by trying to grow out into or overhang the field edges. It is important to keep this from happening by trimming back the branches of the trees and shrubs. Trails at the edges of fields can help prevent this kind of encroachment.

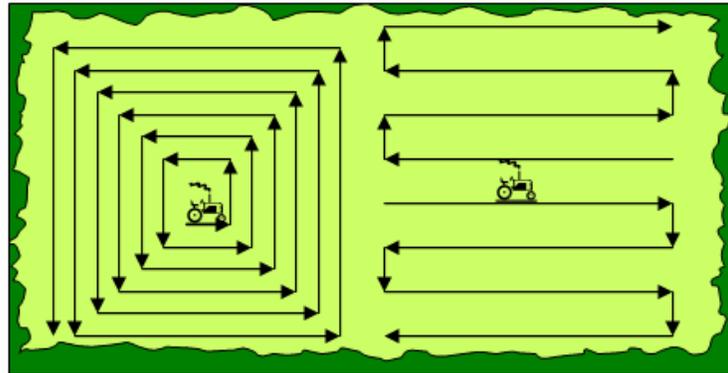


FIGURE 15 - WHEN MOWING START IN THE MIDDLE AND WORK OUTWARD

Another means to improve the fields for pollinators and to benefit wildlife in general is to eliminate trails that fragment the fields. The trails at Battis Farm are on the edges of the fields and are not fragmenting the field habitat.

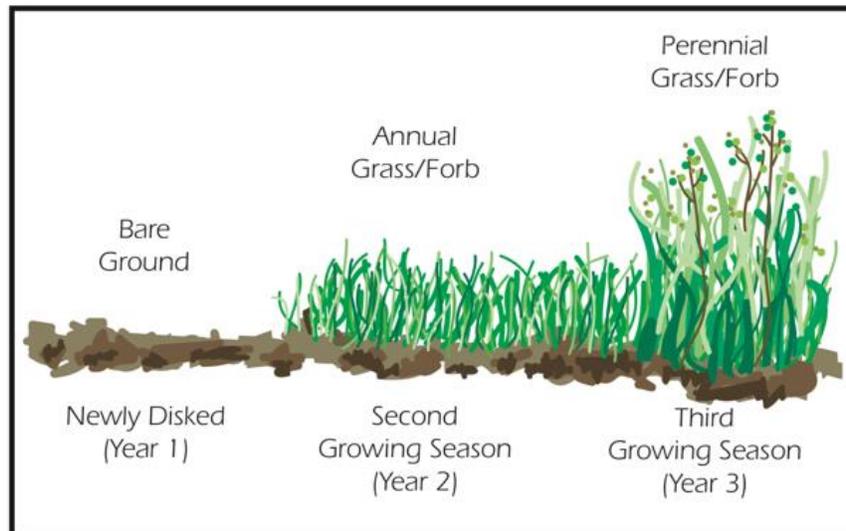


FIGURE 16 - A THREE-YEAR STRIP DISKING ROTATION PRODUCES DIFFERENT STAGES OF GROWTH IN CLOSE PROXIMITY FOR USE BY WILDLIFE.

Strip disking can provide the ground disturbance necessary for maintaining a diverse combination of annuals and perennials within the grassland. Disking as a means of wildlife habitat improvement can provide numerous benefits. It sets back natural succession by cutting up grassy vegetation, thus

preventing an area from maturing into briars and shrubs. It can eliminate or reduce a thick mat or carpet of grass, such as fescue, which is a barrier to movement and feeding for many species of wildlife.

Strip disking simply involves creating ground disturbances to release grass-bound fields, reduce litter accumulation, create bare ground, stimulate germination of desirable seed-producing plants, and increase insect populations for birds to feed upon. Strip disking should be done in long linear strips (10-15 feet minimum width and as long as possible) and always adjacent to good escape cover. To prevent erosion, strips should follow the contour of the land and be separated by un-disked strips 2-3 times the width of the disked area. The ground is simply disked deep enough to kill the existing vegetation (3-4 inches is usually adequate) and then left alone. If the sod is too heavy to allow adequate soil disturbance with a disk, then plowing can be used to remove the thick mat of growth. After initial removal of the sod or litter layer, periodic disking prevents thick mats of vegetation from forming again and stimulates the growth of desirable annual plant species. Strip disking can be done after October 1 or in the early Spring before May 15. For more on strip disking see <https://fw.ky.gov/Wildlife/Documents/stripdisking.pdf>.

SPECIFIC GRASSLAND MANAGEMENT RECOMMENDATIONS FOR BATTIS FARM

The general recommendations included above leave choices for exactly how the grasslands at Battis Farm should be managed. The fields managed for grassland birds and hay should not be mowed between May 15 and July 24. Hay fields should be mowed no later than September 15 to prevent undesired plant species from setting seeds.

As noted above, the spreading and tilling of the sediment from the city's water filtration process requires rotating fields. The sediment is trucked to the farm and stored, sometimes for several days. The Department of Environmental Management approval for disposal of the sediment limited the storage of the sediment to no more than 48 hours before being tilled and the 2020 GZA GeoEnvironmental, Inc. plan recommended "a simple covered facility to prevent migration of the material during rain events".

Harvesting hay or removing thatch takes nutrients out of the system. Prescribed burning would be a better method of removing thatch as it returns some of the nutrients to the soil and benefits a variety of wildlife. The fields at Battis Farm could be easily divided into sections to burn. Prescribed burning is highly regulated and would require careful planning and permits. Therefore, it is not recommended at the present time. See the Mass. Division of Fisheries and Wildlife's [Prescribed Fire Management Handbook](#)¹⁵.

In summary, continuing to engage a contract farmer to till in the drinking water treatment plant sediment and harvest hay on a schedule that protects grassland nesting birds is recommended. It is also possible to use portions of the fields at Woodsom Farm for the disposal of the treatment plant sediment.

See the section on Wildlife Enhancement Recommendations beginning on page 39 for ideas on how to attract more wildlife to the area.

¹⁵ www.mass.gov/doc/prescribed-fire-management-handbook/download

Forest Communities

The Powow River Conservation Area includes oak-hickory forest, forested wetlands, and successional white pine forest. Forest management activities are constantly changing to accommodate new challenges, and it is becoming increasingly important that forest and land management planning intentionally consider a changing and uncertain climate. The major threats for the three types of forested communities, Oak-hickory Forest, Successional White Pine Forest, and Forested Wetlands, are the proliferation of invasive species, especially glossy buckthorn, deer browse, and the effects of climate change.

Forests provide many ecological services including wildlife habitat, flood and erosion control, public health benefits, recreational opportunities, and carbon absorption and sequestration. In addition to forest protection, there are various ways to steward/manage forests to retain or at times enhance their benefits to the community. This includes passive management, a mostly hands-off approach, and active management to create a particular habitat type or benefit a species of conservation need.

PASSIVE MANAGEMENT OF FORESTS

A passive approach to forest management lets forests continue to mature. Allowing forests to naturally mature has inherent values, including:

- Encouraging old growth forests – one of the rarest habitats in Massachusetts. These forests have a unique multi-layered structure of vegetation and provide particularly high-quality habitat for some wildlife species. Old growth conditions can only develop with time, usually after 200–300 years.
- Sequestering carbon forest growth plays a significant role in combatting climate change. Currently, carbon sequestration in our forests offsets about 14% of annual emissions in New England.
- As forest managers and scientists study the various benefits and implications of active forest management, it is important to have untouched sites for comparison.

ACTIVE FOREST MANAGEMENT

The thoughtful application of forest management practices can help restore habitat conditions found within young and old growth forests. Most of Amesbury was cleared for agriculture in the middle of the 19th century, and woodlands were regularly harvested for various purposes. As farmers moved west for better land, forests began to regrow about 80–120 years ago and are now considered “middle-aged.” This means we have very few acres of young forests (0-20 years) or old growth forests (200+ years). Any active forest management should begin with a consultation with a Forester.

Young forests occur in relatively open conditions and are dominated by dense growth of shrubs and sapling trees. This type of habitat used to occur naturally due to large-scale disturbances such as beaver activity and fires. These disturbances are now less frequent and are controlled to protect human lives and resources. Removing older trees from small areas of the forest is an effective way to recreate this type of habitat for wildlife species that depend on young forest habitat, including several warblers and white-throated sparrows.

Middle-aged forests often have a less complex structure than common old growth forests and provide poorer habitat for some species. Habitat management can be used to mimic the unique features of old growth forest, and bolster wildlife species of conservation concern.

The two upland habitats, Oak-hickory Forest and Successional White Pine Forest would benefit from a forest stewardship plan following the principles of two programs developed by Mass Audubon in partnership with the Massachusetts Department of Conservation and Recreation (DCR) and others – Foresters for the Birds and Climate Smart Forestry.

FORESTERS FOR THE BIRDS¹⁶

The Foresters for the Birds program is the result of a partnership between Mass Audubon, the Massachusetts Department of Conservation and Recreation (DCR), and the Massachusetts Woodlands Institute. Based on a similar initiative by Audubon Vermont, the program provides education, expertise, and limited funding to private landowners to enable them to manage their woodlands in a way that meets their own land management goals while also supporting forest bird species and other wildlife.

The program connects towns and private landowners with licensed foresters trained and certified in conducting Bird Habitat assessments. Together, they evaluate the land to determine what types of habitats are present and which species are likely to utilize the habitats already. The forester also makes recommendations for improving or creating new bird habitats. If a forest management plan is to be done for the Pow River Conservation Area (as is recommended) it should be done by a forester that has been certified by the program.

CLIMATE SMART FORESTRY¹⁷

Management actions that promote climate adaptation and mitigation are sometimes referred to as climate-smart forestry. The Forest Climate Resilience Program, another partnership between Mass Audubon and the Massachusetts Department of Conservation and Recreation, has identified four climate-smart forestry strategies that will promote both forest adaptation and mitigation that are appropriate for the forest habitats at the Powow River Conservation Area. Tactics that fall within one of these four practices may be eligible for funding. Practice manuals are available for each practice.

- **Plant Trees to Increase Forest Stocking**

Some forested areas may be stressed and are not adequately growing or “stocked.” This practice involves planting tree species that can cope with climate change and requires that stressors, like deer browse and invasive plants, be addressed. The U.S. Forest Service has developed a guide that provides a step-by-step process to help consider climate change when selecting a tree for planting and provides a framework to help learn about the projected habitat suitability of trees in your area under climate change.¹⁸ The Forest Service has also assembled a Climate Change Atlas that projects the ability of tree species to adapt to future climate

¹⁶ <https://www.massaudubon.org/news/latest/foresters-for-the-birds-managing-forests-for-trees-and-birds-alike>

¹⁷ <https://www.massaudubon.org/our-work/resilient-lands/climate-smart-forestry-resources>

¹⁸ [Considering Climate Change in Tree Planting](https://search.nal.usda.gov/discovery/delivery/01NAL_INST:MAIN/12403567970007426), USDA Northern Forests Climate Hub White Paper—June 2023: https://search.nal.usda.gov/discovery/delivery/01NAL_INST:MAIN/12403567970007426

conditions in Massachusetts.¹⁹ For example white oak, red oak, and hickory are predicted to be adaptable while swamp white oak and Atlantic white cedar will do poorly.

- **Protect Seedlings and Saplings from Deer Browse**

Forests with high deer populations often lack healthy young trees because of herbivory. Measures like temporary tree tubes and fencing can protect young trees, allowing the forest to better respond to climate change in the long-term.

- **Climate-Informed Forest Access and Forestry Operations**

Harvests, including those for wildlife habitat and forest resilience, often use heavy machinery and can have negative impacts on soil and water. Forestry best management practices are already used to reduce those impacts. However, climate change is causing more extreme storms and shortened winters, creating the need for additional protections such as the use of additional water bars and bridge mats that protect soil and water quality.

- **Remove Invasive Vegetation**

Invasive species can prevent young trees from becoming established and can impact water quality. They can also threaten the success of other management efforts. Treating invasive species where they are preventing new generations of trees from growing can help ensure the success of other forest management actions and can build resilience to climate change.

DCR's Forest Stewardship Program has funds available to municipalities for preparing new stewardship plans and upgrading existing plans. We recommend that the town engage a forester to do a forest stewardship plan with improving wildlife habitat as a goal.

MANAGING FORESTS FOR RESILIENCE AND ADAPTATION

Strategies to promote resilience and adaptation include:

- More rain and more intense storms can cause soil erosion and nutrient loss. Avoid steep trails and design trails for erosion control.
- Enhance species diversity and structural complexity. In a mature forest creating a few canopy gaps can promote structural diversity and encourage a diversity of species.
- Increase deadwood. Standing dead trees and downed logs protect soils, help retain water and cycle nutrients as well as provide habitats for wildlife.
- Managing stressors such as controlling invasive species and deer populations.

UNFORESTED WETLAND COMMUNITIES

Wetland communities that are not forested include shallow emergent marsh and shrub swamp. Both these areas are threatened by non-native invasive plants. Any activities to control invasives in wetlands require permission from the Amesbury Conservation Commission. Some commissions allow invasives control under "administrative approval" or under a Request for Determination of Applicability (RDA) without going through the full procedure for a Notice of Intent and an Order of Conditions.

¹⁹ Climate Change Atlas for Massachusetts:

www.fs.usda.gov/nrs/atlas/combined/resources/summaries/states/Massachusetts.pdf

Trails

A well-designed, comfortable, and safe trail network facilitates enjoyment of an area and protects the conservation values of the site. The existing trail network is an integral part of the site's passive recreational value, providing visitors with a means for exploring and enjoying the site. Trails should be located to minimize redundancy and enhance the visitor experience by not exceeding the capacity of the site to accommodate trails. To the greatest extent possible, all trails should be located outside of sensitive natural resource areas, such as habitat for sensitive wildlife, steep slopes, or soils that are too wet or prone to erosion.

Sustainable Trails

Climate change is having a big impact on trails because of more intense weather events. Northeastern U.S. saw a 55% increase in the amount of rain or snow falling in the heaviest 1% of storms between 1958 and 2016. Some climate models project monthly precipitation between December and April will increase 1 inch by the end of this century. Both the Appalachian Mountain Club and the Long Trail Club have noted the impacts on trails of extreme weather events. Trail managers have noted more erosion, more frequent blowdowns, and more wet trail areas that stay wet longer. These factors can all have a big impact on the visitor experience and on maintenance.

The US Forest Service defines a sustainable trail as one that will:

- withstand the impacts of normal use and natural elements,
- cause negligible soil loss,
- encourage users to stay on the trail,
- not adversely affect area's natural or cultural resources, and
- require minimal maintenance.

Trail Assessment

Periodic assessment of trails is recommended. A trail assessment for Amesbury trails has been completed in 2024. Trail assessments provide a detailed evaluation of tread conditions that can be used for planning and budgeting purposes. They provide detailed information of each section of trail which is useful in developing trail restoration plans as well as seeking funds for the restoration of trails. They can help managers see the larger picture so that sound restoration or maintenance priorities can be developed. Like buildings, trails should be viewed as assets which depreciate and thus need periodic refurbishment or structural upgrading. Any structures on trails such as benches, guardrails, and viewpoints will deteriorate over time and will need regular inspection to ensure that they are sound. Comprehensive trail assessments are usually done every 5 to 10 years to evaluate conditions.

A trail assessment evaluates the existing trail network, section by section. Problem areas are identified and alternatives for solving those problems are presented for discussion. Based on that discussion each solution can be described in detail (i.e., width, linear feet of trail, materials, permitting requirements, and costs, etc.).

Design, construction, and maintenance of the trail network should be guided by the standards and guidelines in *Trail Solutions: IMBA's Guide to Building Sweet Singletrack*²⁰ and the *U.S. Forest Service Trail Construction and Maintenance Notebook*. The particulars of trail design will vary based on site conditions and use. Nevertheless, the staff and volunteers should pursue the following principles in trail design.

Trail width – Major trails should be 4-6 feet wide in areas of heavy use and other favorite destinations so that visitors can walk side by side or pass. Many lesser used trails should be 3-4 feet wide to minimize impacts to natural resources and to encourage a closer experience with nature, with the expectation that some width expansion may be inevitable with use. Dense vegetation along the edge of trails should be regularly clipped back (or mowed with a Weed Wacker) 2 feet beyond the tread width to accommodate use so that it does not grow into the trail and present an opportunity for ticks to attach to visitors. Selected trails through rapidly encroaching vegetation may need to be trimmed wider or more frequently.

Trail Layout – avoid trails running perpendicular to the contours. These “fall line” trails almost guarantee erosion if they are more than 10% grade. Trails should cross contours at an angle and have “out-slope” and “grade reversals” to move water off the trail treadway. “Trail anchors”, and “corralling” should be used to help keep users on the trails.

Trail surface – trails should normally retain a natural soil surface. Trails through grasslands should be maintained with periodic mowing and need not be cleared down to mineral soil. In rare circumstances where the existing substrate cannot be made into a sustainable surface, supplemental surfacing material may be used. Accessible trails, if any, should meet standards set by the *U.S. Forest Accessibility Guidelines Service*²¹.

Trails and Wildlife – layout should preserve large areas of habitat without trails, avoid habitat fragmentation, and protect wetlands and sensitive areas. Consider reducing or eliminating trails especially in sensitive areas.

Wildlife Enhancement Recommendations

There are several actions that can enhance wildlife habitat quality and make the conservation area a more interesting destination.

Brush piles

Strategically placed piles of brush in the forested areas or at the edges of the fields can be assembled to provide resting/escape cover and den sites for wildlife. Brush piles are used for cover by eastern cottontails and other small mammals. Songbirds may use brush piles for perch sites, especially if the piles are located near feeding or nest sites. Also, if brush piles are adjacent to a water source, amphibians and reptiles may use them for breeding, feeding, or resting. See

²⁰ For an on-line version of much of the same information see <http://www.crgov.com/DocumentCenter/View/1430/Sustainable-Trail-Development-Guidelines-PDF?bidId=>

²¹ <https://www.fs.usda.gov/sites/default/files/FSORAG-2013-Update.1.pdf>

<https://extension.psu.edu/management-practices-for-enhancing-wildlife-habitat> for more information on steps for enhancing wildlife habitat.

Snags

Leaving dead or partially dead standing trees provide several important benefits to a variety of wildlife. Snags provide cavities for nesting and resting, perches for hunting and displaying, and an abundant supply of food for insect eaters. There are numerous species of birds and mammals that use snags at some point in their life cycles. The best method to provide snags for wildlife is to retain existing snags in places where they will not create a dangerous situation for people using the nearby area for outdoor activities.

Nest boxes

Nest boxes, platforms, and other types of nesting structures provide nest sites for wildlife in areas where natural nest sites (particularly cavities) are absent or available only in low numbers. They are also used to attract wildlife to specific areas even when nest sites are not limited. Nest boxes can be used to provide nest sites for birds such as bluebirds, tree swallows, wrens, and wood ducks. Nest boxes also provide nest sites for mammals like squirrels and bats. Platforms and other structures are used to provide nest sites for species like the ospreys, eastern phoebe, barn swallow, and some waterfowl. Special colonial nest boxes can be erected for purple martins. Bat boxes can also be erected along the field edges. See Mass Audubon's website <https://www.massaudubon.org/learn/nature-wildlife/birds/birdhouses> for instruction for building and placing nest boxes.

Pollinator plantings

Pollinator-friendly plantings support numerous kinds of native bees, as well as honeybees, butterflies, hummingbirds, and other pollinators. Planting a diverse mix of flowering plants that provides a sequence of blooms from early spring to late fall will have the most impact. Even a small patch of the right flowers can help, as it adds to the larger landscape mosaic in which the pollinators live and search for food. For a list of plants and guidelines for planting see https://extension.unh.edu/resources/files/Resource005973_Rep8387.pdf.

Non-native Invasive Plants

Like many open spaces, the Powow River Conservation Area has become infested with non-native invasive plants. Non-native plants are species introduced since the Colonial Period. More than 2,200 plant species have been documented in Massachusetts, and some 725 of them are non-natives that are considered naturalized (established). Of those, 72 plant species have been categorized by the Massachusetts Invasive Plant Advisory Committee (MIPAC) as "Invasive," "Likely Invasive," or "Potentially Invasive."

Why Are Non-native Invasive Plants a Problem?

Non-native invasive species cause or are likely to cause economic harm, environmental harm, or harm to human health. The term "invasive" is used for the most aggressive species. These species grow and reproduce rapidly, causing major disturbance to the areas in which they occur.

- Invasive plants are one of the greatest threats to the nature of Massachusetts (Mass Audubon)
- These non-native plants can out-compete, displace, and kill our native species.
- They grow fast and produce a lot of seeds.

- They're often the first plants to leaf out in the spring, and the last to lose their leaves in the fall.
- They often grow in dense patches and use up moisture and nutrients that are then not available for more desirable plants.
- They also lack the insects or diseases of their place of origin that might keep them in check.

Why Does It Matter?

Invasives compete with native plants and wildlife for resources, disrupt beneficial relationships, spread disease, cause direct mortality, and can significantly alter ecosystem function. We may lose some of the things we love about our natural places, such as:

- Native forest types,
- Rare plants – think of New England wildflowers,
- Wildlife that depends on native species – think of Monarch butterflies that depend on native milkweed plants.

It's been shown that our native bird species that evolved over thousands of years eating the insects that feed on our native plants (and their seeds) do not obtain the same nourishment from non-natives. Many insects are only able to feed on native plants and the presence of the invasive non-natives reduces the abundance of food sources for our birds²².

Non-native Invasive Plants at the Powow River Conservation Area

As noted in the natural communities' descriptions, invasive species are present in many areas of the Powow River Conservation Area. Some of the worst actors are **Oriental bittersweet, autumn olive, winged euonymus, garlic mustard, Japanese knotweed, multi-flora rose, honeysuckles, and buckthorns.**

Management of Invasive Species²³

There are many ways to deal with this threat including initial prevention, early detection, and control through manual removal, mechanical treatment, judicious use of herbicides, biological control, grazing and fire. Invasive species are difficult to eradicate and without multiple seasons of dedicated management, infestations will rebound despite one's best efforts. Prioritization of targeted management is essential to successfully managing an area for invasive species. Any effort to control invasives in regulated areas subject to the Wetlands Protection Act requires submitting a Request for Determination of Applicability or Notice of Intent to the Conservation Commission. Some Conservation Commission will provide "Administrative Approval" for invasives removal in regulated areas.

The goals for invasive species management at the Powow River Conservation Area should be:

- Establishing invasives-free zones,
- Restricting the spread and reducing the extent of heavily invaded zones.

²² Tallamy, Douglas w., Nature's Best Hope, Timber Press, Portland, Oregon, 2019 pp. 110-117

²³ See Mass Audubon's "invasive Plants of Massachusetts", <https://www.massaudubon.org/nature-wildlife/invasive-plants-in-massachusetts> , Website includes resources on identification of non-native invasive species and management.

Management of invasive species should follow an adaptive approach – a continuous process that allows for flexibility in management based on the inclusion of the most recent management options. As new information becomes available on plant biology and treatment methods, it will be incorporated into future management decisions. An adaptive approach will also allow property managers to learn from the efficacy of current treatment methods and adjust future management actions.

PREVENT SPREAD OF EXISTING INVASIVES AND INTRODUCTION OF NEW INVASIONS

The primary element of a proactive prevention plan is limiting the introduction of new invasive species. The spread of existing invasives will be reduced by limiting soil disturbance and implementing restoration when soils are disturbed and by implementing practices to reduce the likelihood of seed spread by individuals working on invasives control projects. Soil disturbance from plowing, tree removal, trail building, etc., should be limited and all disturbed soil should be covered with leaf litter at the very least with larger areas restored with a fast-growing native seed mix. All equipment used for maintenance operations in heavily invaded areas should be cleaned (e.g., with a leaf blower) before moving to non-invaded areas; and staff and volunteers should take special care to pat down, wipe, and/or rinse clothes and shoes after working with invasive plants.

EARLY DETECTION/RAPID RESPONSE

Any comprehensive invasive species control program must also include early detection (ED) of new invaders and rapid response (RR) to eliminate new invasions before they become well-established. ED efforts will be directed at the list of early detection species identified by the Massachusetts Invasive Plants Advisory Group (MIPAG). MIPAG’s current ED list is presented in Table 1, and updates can be found on the MIPAG website: <http://www.massnrc.org/mipag/>. Land stewards should be trained to identify the ED species which are not yet well-known in this part of the state such as Japanese stiltgrass

Table 1. Early Detection (ED) invasive plants as identified by the Massachusetts Invasive Plant Advisory Group (MIPAG).

Common name(s)	Species	Comments
Flowering Rush	<i>Butomus umbellatus</i>	Aquatic perennial herb
Brazilian waterweed	<i>Egeria densa</i>	Submerged aquatic
Tall mannagrass, Reed mannagrass	<i>Glyceria maxima</i>	Perennial grass
Giant Hogweed	<i>Heracleum mantegazzianum</i>	Biennial or short-lived perennial herb
Hydrilla	<i>Hydrilla verticillata</i>	Submerged aquatic
Parrotfeather	<i>Myriophyllum aquaticum</i>	Submerged aquatic
Yellow floating heart	<i>Nymphoides peltata</i>	Floating-leaved perennial aquatic herb
Mile-a-minute	<i>Persicaria perfoliate, Polygonum perfoliatum</i>	Once established this species spreads rapidly; annual herbaceous vine
Kudzu	<i>Pueraria montana ssp. lobata</i>	Woody vine
Tansy ragwort, Stinking willie, Stinking Billy	<i>Senecio jacobaea</i>	injurious to livestock; biennial herb
Tall pepperweed, Broadleaved pepperweed	<i>Lepidium latifolium</i>	Perennial herb
Japanese stiltgrass	<i>Microstegium vimineum</i>	Annual grass

and mile-a-minute vine. The stewards should be prepared to collaborate on planning and implementing the rapid response element to eliminate new invasions as quickly as possible.

LIMIT SPREAD OF HIGHLY NOXIOUS INVADERS

Special attention should be paid to particularly aggressive invaders, such as those species with wind-dispersed seeds, aggressive root suckering, allelopathic characteristics, rapid growth, and high resistance to control. Species in this category are shown in Table 2.

Table 2. Particularly aggressive invasive species. (Bold indicates species noted at the Powow River Conservation Area.)

Common name	Latin Name
Black swallowwort	<i>Cynanchum louiseae</i>
Common reed	<i>Phragmites australis</i>
Garlic mustard	<i>Alliaria petiolata</i>
Japanese knotweed	<i>Fallopia japonica</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
Purple loosestrife	<i>Lythrum salicaria</i>
Tree of heaven	<i>Ailanthus altissima</i>
Water chestnut	<i>Trapa natans</i>
Porcelain-berry	<i>Ampelopsis brevipedunculata</i>

CONTROL RELATIVELY EASILY MANAGED SPECIES

Japanese barberry and garlic mustard are examples of species that can be controlled with dedicated manual effort. Such species should be the focus of eradication efforts before they spread.

LIMIT EXPANSION OF HEAVILY INVADED AREAS

An area that is completely covered in invasive species or has several species of invasive plants growing in the same location should be contained to prevent further spread of the infestation. This can be done by identifying the boundary of the heavily invaded area(s) and creating a treatment area buffer zone (e.g., 50 feet around the perimeter of infestation) for targeting management efforts. This allows conservation stewards to prevent encroachment of invasives in cleaner areas without getting overwhelmed or tackling a project that is too big for the available resources.

If highly noxious species are present in the densely invaded area, extra measures may need to be taken to really prevent **further spread of the infestation**. Some options include increasing the treatment area to a 100-foot buffer zone or hiring outside contractors to treat the infestation by mechanical means (whole plant removal) or chemically.

Treatment Methods

Different invasive species respond to different management techniques, several of which are summarized here and detailed in Appendix F (page 64). Manual control, pulling plants by hand or with light tools such as loppers or weed wrenches, is preferred and



FIGURE 17 - WEED WRENCH

may be effective for small infestations and where volunteer capacity permits repeated effort. Large infestations and certain problematic species may require more intensive management, sometimes involving the use of herbicides as a last resort. Herbicides can only be applied by an individual duly licensed by the Department of Agricultural Resources. Because licensure requires liability insurance coverage, while volunteers could obtain this license, it is more likely that herbicide will be applied by a contracted professional. Management plans should identify infestations and recommend approaches for control. The property managers should plan and budget for the involvement of professionals as necessary. Table 3 provides information on species that can be managed at various times of year.

Table 3: Season-specific Management for Commonly Found Invasive Plant Species.

Common Name	Spring	Summer	Fall
Autumn Olive	manual		chemical
Black swallowwort		chemical/manual	
Burning Bush	manual		chemical
Bush honeysuckle	manual	chemical	
Common reed (Phragmites)			chemical
Garlic mustard	chemical/manual		
Glossy Buckthorn	manual		chemical
Japanese Barberry	manual		chemical
Japanese knotweed		chemical	
Japanese stiltgrass		chemical/manual	chemical
Multiflora rose	manual	chemical	
Asiatic Bittersweet	manual		chemical
Purple loosestrife		biological	
Porcelain-berry	manual	manual	
Spotted knapweed		chemical/manual	
Tree-of-Heaven	manual		chemical

Disposal of Removed Invasives

Invasive plants that have been hand pulled or cut can be piled on site to decompose or bagged and brought to an area for invasive plant containment. The site(s) used to dump invasives should be monitored to ensure that invasive plants are not establishing themselves from the materials deposited there. Staff and volunteers should take extreme care to avoid spreading seed or other material from which plants can resprout, (e.g., Japanese knotweed and phragmites can sprout from any stray plant part).

If berries/seeds are not involved, removed plants can be placed in brown paper yard bags. If berries/seeds are involved, removed plants should be placed in black plastic bags. The bagged plants with berries/seeds should be placed in a sunny spot for a month to kill the plants and then disposed in the Town’s trash compactor for incineration. Plants in paper yard bags can also be placed in the Town’s compactor. Pulled buckthorns without seeds will be left in brush piles.

Restoration

Many of the invasive species are adapted to pioneer disturbed soils. For this reason, all control efforts and general site work that results in exposed soil should incorporate restoration with fast-growing native species. Small patches of exposed soil, for example from root wrenching a shrub, should be tamped down by foot, and covered with leaf litter from on-site. Non-forested sites such as fields, should be seeded with a grass mix including annual rye (*Lolium perenne*) which can provide a quick cover to open soils and allow non-invasives time to self-germinate (see <https://newp.com/product/new-england-erosion-control-restoration-mix-for-dry-sites/> for a recommended seed mix) .

Record-Keeping

All invasive plant species management actions (contractor, or volunteers) should be documented with a field datasheet and records kept in a central file (a shared Google drive). Information collected should include the location, date, species targeted, phenology of plant (vegetative, flowering, fruiting), type of management used (manual, mechanical, chemical), the size of the infestation and an estimate of what percent of the area was managed (See Appendix F, page 75 for a sample field sheet). Recording these data allows Town staff and volunteer stewards to track progress in management efforts, adapt tactics in future years if needed, and have a sense of the expanse of targeted invasive species.

Recreation Management Recommendations

The Powow River Conservation Area is a popular destination for birders, walkers, and folks just looking for a break without distractions. For the most part these activities and the conservation area's values for wildlife are in harmony. An exception is dogs, especially off-leash.

Dogs

It is a city-wide policy that dogs be kept on leash. Not all visitors observe this regulation and the person-power for enforcement is limited. Mass Audubon has long had a "no pets" policy and some other conservation areas restrict dog access because of the detrimental impact on wildlife and other conservation goals. In addition, there is sometimes conflict between dogs, and between some dogs and people that can result in serious injury to both dogs and people.

How do dogs affect Wildlife? The scientific community and conservation land managers generally agree that dogs negatively affect some species of wildlife. This happens through the direct effects of dogs chasing and harming or killing wildlife, or indirect effects from flushing a bird from its nest, scaring it from an area that it needs to gather food or from protecting its young, or wildlife avoiding areas that have been scent-marked by dogs (thus reducing available habitat). There have been reports of off-leash dogs being bitten by mother coyotes defending their young. As our population grows, and there are more dogs using trails, wild animals have fewer places to live safely. People also see more wildlife in places where dogs are not allowed.

Dog waste has another negative impact on the environment. There are many health and environmental issues associated with dog waste. Nitrogen from dog waste can cause significant changes to soil chemistry, killing native plants and encouraging noxious weed growth. Dogs have a wide variety of intestinal bacteria that may harbor parasites including roundworms, whipworms, hookworms, tapeworms, parvovirus, giardia, salmonella, and *E. coli*. Roundworms are one of the most common parasites and can remain in soils for years. Dog waste carried in

storm runoff can also contribute to water pollution. Dog waste is also unpleasant, smells bad, and detracts from the positive experience of enjoying conservation lands.

Battis Farm is one of the town’s premier conservation areas and a place where dogs should be on leash – especially during the nesting season. Other areas are available for people to walk their dogs in accordance with the city’s leash law.

Education will be important to achieve compliance with the leash regulations. Signs can be helpful. Several elements of a program to encourage keeping dogs on leash are recommended:

1. Install interpretive signs on the precarious state of ground nesting wildlife and the adverse impacts of loose dogs at the information kiosk and trailheads.
2. Signs can also mention how other visitors may fear off-leash dogs or have an unfriendly dog that may not wish to be approached by another animal.
3. Recruit volunteer docents during busy weekends to educate visitors about the site’s wildlife and remind them of the importance of keeping their pets on-leash.
4. Consider a volunteer program like the “Bark Ranger” initiative that began in Weston with the Sudbury Valley Trustees.
5. Install “symbolic fencing” and/or reminder signs along the trails at Battis Farm. The fencing can be no more than simple posts perhaps with rope between.

Public Education

Education is key to compliance with stewardship objectives. Battis Farm has a kiosk at the entrance near the parking lot that provides an opportunity to provide information on the following. Also provide the information on the Battis Farm website:

- Grassland birds
 - Highlight/summarize information from Bobolink Project²⁴ on declines in grassland birds



FIGURE 18 - SAMPLE OF A SIGN PROHIBITING DOGS



FIGURE 19 - EXAMPLE OF A "DOGS ON LEASH" SIGN

²⁴ <https://www.bobolinkproject.com/index.php>

- Emphasize the city’s efforts to manage the fields to encourage the nesting and survival of grassland birds
- Emphasize the importance of keeping dogs on leash between May 15 and August 15.
- Install signs along the trails (Fig. 19) to promote compliance
- Drinking water treatment plant sediment disposal
 - Explain the source of the sediment and how it is tilled into the soil under a Massachusetts Dept. Environmental Protection permit



FIGURE 20 - BATTIS FARM ENTRANCE KIOSK

Summary of Stewardship Priorities

The following list is a summary of the above recommendations broken into three priority levels – first, second, and third. All the recommendations are important, but priorities may be helpful when resources are limited.

First Priority

Grassland stewardship and public education – the stewardship of the grasslands in Amesbury are important for the survival of several State designated Species of Greatest Conservation Need. The recommendations include:

- Continue to have the Amesbury DPW work with a contract farmer to maintain the hayfield habitat
 - Mow only before May 15 and after July 24 and before Sept. 15
- Continue to have the farmer till the drinking water treatment plant sediment into the soil of 1 of the 4 fields each year on a rotating basis
 - Explore using some of the fields at Woodsom Farm for disposal of the sediment
 - If the sediment is stored for more the 48 hours, it should be stored in a covered shelter to prevent run-off
 - Provide the farmer with the section on grassland stewardship in this report (beginning on page 31)
- Provide public education (sign at the entrance kiosk and on website) on the city’s stewardship of grassland habitat
- Provide public education (on the website, a sign at the entrance kiosk and signs along the trails) on the importance of keeping dogs on leash during the nesting season (from May 15 to Aug. 15)
- Provide public education (sign at the entrance kiosk and on the website) on the use of the hayfields for disposal of drinking water treatment plant sediment disposal
- Installing some nest boxes in the hayfields is a visible and low-cost (no-cost if undertaken by volunteers) demonstration of the City’s efforts to be good stewards. They will attract tree swallows and blue birds. May require efforts to remove house sparrows.
- Any issue that creates a hazard or is a safety concern must be a first priority.

Second Priority

While second priority recommendations are less critical, they are still important.

- Engage a forester that has been trained in the “Foresters for the Birds” and “Climate Smart Forestry” programs to do a forest management plan for Powow Hill and the Town Forest
- Develop a “weed warriors” program for volunteers to begin working to combat non-native invasive species (see section on Non-Native Invasive Plants beginning on page 40 for details)
- Work on wildlife enhancement projects (brush piles, snags, nest boxes, and pollinator plantings) in forested areas and at the edges of the fields. See section beginning on page 39 for details.
- Work on re-routing trails that are prone to erosion.
- Maintain boardwalks and other trails.

Third Priority

Third priority recommendations are still important.

- Monitor wetland habitats for non-native invasives and work to combat them.

Schedule of Management Activity

The following matrix is proposed for yearly management activities. Quantities and estimated costs will be shown in Appendix G.

Yearly ongoing Activities

	Winter	Spring	Summer	Fall
	Dec-Feb	Mar-May	Jun-Aug	Sep-Nov
Permitting for Planned Projects				
Monthly Property Visits				
Annual Work Plan with Staff and Stewards				
Safety Meeting with Staff, Stewards, Police and Fire Dept.				
Trail Walk/Clean Up (downed limbs, drainage issues, signage needs)				
Repair Equipment and tools				
Building Projects (kiosks, signposts, etc.)				
Invasive Plant Management				
Wildlife Enhancement Projects				
Mowing of Hayfields (Before May 15 and after July 24 th)				
Expand grassland by cutting back shrubs and overhanging limbs along edges				
Trail mowing/maintenance				
Boundary Walk (monitoring for encroachments, signage, etc.)				

Short-term Projects

Field Management

- Continue haying/mowing bird habitat fields before May 15 and after July 24 and before Sept. 15
- Explore using fields at Woodsom Farm for disposal of drinking water treatment plant sediment

- Install some nest boxes in the hayfields

Public education recommendations:

- Prepare and install signs (and website information) explaining grassland bird stewardship efforts
- Implement a “dogs on leash” policy – signs and symbolic fencing
- Prepare and install interpretive signs at the entrance kiosk and trail heads to educate visitors about rationale for the dog policy
- Prepare and install interpretive signs explaining the use of the fields for the disposal of water treatment plant sediment

Invasive plant management recommendations:

- Obtain an herbicide applicator’s license by staff if use of herbicides is considered
- Work with volunteers to do invasive plant management

Wildlife enhancement management recommendations:

- Dependent on volunteer and staff resources

Passive recreation management recommendations:

- Mow trails
- Walk trails after storm events to clear tree hazards and make repairs to boardwalks

Long Term Projects

Field Management

- Continue haying/mowing fields after July 24 and before mid Sept.

Invasive plant management recommendations:

- Maintain an herbicide applicator’s license by staff
- Strategically treat invasive plants within the property:
 - Treat invasive plants along the trail system
 - Treat invasive plants along the edges of the fields
 - Treat invasive plants within the forested areas of the property working from the trail system towards the interior of the property.

Wildlife enhancement management recommendations:

- Actions dependent on volunteer and staff resources
- Install more nest boxes, brush piles, snags, and pollinator plantings

Passive recreation management recommendations:

- Mow trails
- Walk trails after storm events to clear tree hazards and make repairs to boardwalks

Appendix A – Battis Farm eBird Hot Spot

The following list of 101 species was generated using eBird (ebird.org). It includes birds seen in the fields, forests, wetlands, and flying over the area. Underlined species (61) have been observed during the breeding season and are likely to breed at Battis Farm or nearby or are non-breeders. Species in red are listed as Species of Greatest Conservation Need in the Massachusetts Statewide Wildlife Action Plan (SWAP).

Waterfowl

Canada Goose
Mute Swan
Mallard
Ring-necked Duck
Greater Scaup
Lesser Scaup
Bufflehead
Hooded Merganser
Common Merganser
Red-breasted Merganser
Pied-billed Grebe

Grouse, Quail, and Allies

Wild Turkey

Pigeons and Doves

Rock Pigeon
Mourning Dove
Common Nighthawk

Swifts

Chimney Swift

Hummingbirds

Ruby-throated Hummingbird

Shorebirds

American Woodcock

Gulls, Terns, and Skimmers

Ring-billed Gull
Herring Gull

Hérons, Ibis, and Allies

Great Blue Heron

Vultures, Hawks, and Allies

Turkey Vulture
Osprey
Golden Eagle
Northern Harrier
Sharp-shinned Hawk
Cooper's Hawk
Bald Eagle
Red-shouldered Hawk
Broad-winged Hawk

Red-tailed Hawk

Owls

Barred Owl

Woodpeckers

Red-bellied Woodpecker
Downy Woodpecker
Hairy Woodpecker
Pileated Woodpecker
Northern Flicker

Caracaras and Falcons

American Kestrel

Flycatchers

Eastern Wood Peewee
Willow Flycatcher
Eastern Phoebe
Great-crested Flycatcher
Eastern Kingbird

Vireos

Blue-headed Vireo
Warbling Vireo
Red-eyed Vireo

Crows and Jays

Blue Jay
American Crow
Common Raven

Tits, Chickadees, and Titmice

Black-capped Chickadee
Tufted Titmouse

Martins and Swallows

Tree Swallow
Purple Martin
Barn Swallow

Kinglets

Ruby-crowned Kinglet
Golden-crowned Kinglet

Nuthatches

Red-breasted Nuthatch
White-breasted Nuthatch
Brown Creeper

Gnatcatchers

Blue-gray Gnatcatcher

Wrens

House Wren
Carolina Wren

Starlings and Mynas

European Starling

Catbirds, Mockingbirds, and

Thrashers

Gray Catbird
Brown Thrasher
Northern Mockingbird

Thrushes

Eastern Bluebird
Hermit Thrush
Wood Thrush
American Robin

Waxwings

Cedar Waxwing

Old World Sparrows

House Sparrow

Finches, Euphonias, and Allies

House Finch
Purple Finch
American Goldfinch

New World Sparrows

Chipping Sparrow
American Tree Sparrow
Dark-eyed Junco
White-crowned Sparrow
White-throated Sparrow
Savannah Sparrow
Song Sparrow
Swamp Sparrow
Eastern Towhee

Blackbirds

Bobolink
Orchard Oriole
Baltimore Oriole

Red-winged Blackbird
Brown-headed Cowbird
Common Grackle
Wood-Warblers
Ovenbird
Common Yellowthroat
American Redstart

Northern Parula
Yellow Warbler
Pine Warbler
Yellow-rumped Warbler
Cardinals, Grosbeaks, and
Allies
Scarlet Tanager

Northern Cardinal
Rose-breasted Grosbeak
Indigo Bunting
Dickcissel

Appendix B - Species of Plants at Powow River Conservation Area

Bold indicates species reported in iNaturalist (Research Grade). Normal text indicates species that are also likely to occur. Red text indicates species on the Massachusetts invasive species list.

Plants

Grasslands & Edges

Timothy (*Phleum pratense*)

Red clover (*Trifolium pratense*)

Alsike clover (*Trifolium hybridum*)

Orchard grass (*Dactylis glomerata*)

Smooth brome (*Bromus inermis*)

Redtop (*Agrostis gigantea*)

Curly dock (*Rumex crispus*)

Alfalfa (*Medicago sativa*)

Reed canary grass (*Phalaris arundinacea*)

Common milkweed (*Asclepias syriaca*)

Orange hawkweed (*Pilosella aurantiaca*)

Common ragweed (*Ambrosia artemisiifolia*)

Canada goldenrod (*Solidago canadensis*)

Field goldenrod (*Solidago nemoralis*)

Flat-topped goldenrod (*Euthamia graminifolia*)

Wild bergamot (*Monarda fistulosa*)

Partridge pea (*Chamaecrista fasciculata*)

Multiflora rose (*Rosa multiflora*)

Black swallowwort (*Vincetoxicum nigrum*)

Common self-heal (*Prunella vulgaris*)

Thyme-leaved speedwell (*Veronica serpyllifolia*)

Dame's rocket (*Hesperis matronalis*)

Climbing false buckwheat (*Fallopia scandens*)

Garden yellowrocket (*Barbarea vulgaris*)

Panicled aster (*Symphotrichum lanceolatum*)

Hedge bindweed (*Calystegia sepium*)

Field penny-cress (*Thlaspi arvense*)

White avens (*Geum canadense*)

Yellow Rattle (*Rhinanthus minor*)

Hedge bedstraw (*Galium mollugo*)

Virginia pepperweed (*Lepidium virginicum*)

Oriental bittersweet (*Celastrus orbiculatus*)

Autumn olive (*Elaeagnus umbellata*)

Herb robert (*Geranium robertianum*)

Jimsonweed (*Datura stramonium*)

Wild geranium (*Geranium maculatum*)

Shepherd's purse (*Capsella bursapastoris*)

Common buckthorn (*Rhamnus cathartica*)

American elm (*Ulmus americana*)

Mile-a-minute weed (*Polygonum perfoliate*)

Solomon's plume (*Maianthemum racemosum*)

Tall meadow rue (*Thalictrum pubescens*)

Black-eyed Susan (*Rudbeckia hirta*)

Poison ivy (*Toxicodendron radicans*)

Spreading dogbane (*Apocynum androsaemifolium*)

Ground ivy (*Glechoma hederacea*)

Wild carrot (*Daucus carota*)

Greater celandine (*Chelidonium majus*)

Sweet William catchfly (*Atocion armeria*)

Yellow archangel (*Lamium galeobdolon*)

Great mullein (*Verbascum thapsis*)

Bull Thistle (*Cirsium vulgare*)

Staghorn sumac (*Rhus typhina*)

Yellow wood sorrel (*Oxalis dillenioid*)

Bittersweet Nightshade (*Solanum dulcamara*)

Broadleaf enchanter's nightshade (*Circaca canadensis*)

Tansy (*Tanacetum vulgare*)

Black raspberry (*Rubus occidentalis*)

Purple-flowered raspberry (*Rubus odoratus*)

Box elder (*Acer negundo*)

Common jewelweed (*Impatiens capensis*)

American pokeweed (*Phytolacca americana*)

Wild cucumber (*Echinocystis lobata*)

American burnweed (*Erechtites hieracifolius*)

Common mugwort (*Artemisia vulgaris*)

Chicory (*Cichorium intybus*)

Ribwort plantain (*Plantago lanceolata*)

Oxeye daisy (*Leucanthemum vulgare*)

Morrow's honeysuckle (*Lonicera morrowii*)

Orpine (*Hylotelephium telephium*)

Blue vervain (*Verbena hastata*)

Silvery cinquefoil (*Potentilla argentea*)

Dwarf cinquefoil (*Potentilla canadensis*)

Sulphur cinquefoil (*Potentilla recta*)

Azure bluet (*Houstonia caerulea*)
White campion (*Silene latifolia*)
White meadowsweet (*Spiraea alba*)
Common yarrow (*Achillea millefolium*)
Field horsetail (*Equisetum arvense*)
Lesser burdock (*Arctium minus*)
Calico aster (*Symphotrichum lateriflorum*)
Fortune's spindle (*Euonymus fortunei*)
American black elderberry (*Sambucus canadensis*)
White mulberry (*Morus alba*)
Northern arrowwood (*Viburnum dentatum*)
Northern bayberry (*Morella pensylvanica*)
Common dandelion (*Taraxacum officinale*)

Forests

Scarlet oak (*Quercus coccinea*)
Red oak (*Q. rubra*)
Black oak (*Q. velutina*)
White oak [*Q. alba*]
Chestnut oak (*Q. montana*)
Basswood (*Tilia americana*)
American hophornbeam (*Ostrya virginiana*)
Bitternut hickory (*Carya cordiformis*)
American elm (*Ulmus americana*)
American holly (*Ilex opaca*)
Sweet birch (*Betula lenta*)
Gray birch (*Betula populifolia*)
American sycamore (*Platanus occidentalis*)
Sugar maple (*Acer saccharum*)
Green ash (*Fraxinus pennsylvanica*)
White ash (*Fraxinus americana*)
American beech (*Fagus grandifolia*)
Black gum (*Nyssa sylvatica*)
Bigtooth aspen (*Populus grandidentata*)
Trembling aspen (*Populus tremuloides*)
Winged euonymus (*Euonymus alatus*)
Black locust (*Robinia pseudoacacia*)
Striped wintergreen (*Chimaphila maculata*)
Winterberry holly (*Ilex verticillata*)
American wintergreen (*Pyrola americana*)
Eastern hemlock (*Tsuga canadensis*)
Bluebead lily (*Clintonia borealis*)
Sassafras (*Sassafras albidum*)
Red maple (*Acer rubrum*)
American hornbeam (*Carpinus caroliniana*)
Maleberry (*Lyonia ligustrina*)
Black cherry (*Prunus serotina*)

Shagbark hickory (*Carya ovata*)
Paper birch (*Betula papyrifera*)
Yellow birch (*Betula alleghaniensis*)
Beech (*Fagus grandifolia*)
Pitch pine (*Pinus rigida*)
New York fern (*Amauropelta noveboracensis*)
Sheep laurel (*Kalmia angustifolia*)
Hay-scented fern (*Dennstaedtia punctilobula*)
Beaked hazelnut (*Corylus cornuta*)
Broadleaf enchanter's nightshade (*Circa canadensis*)
Whorled loosestrife (*Lysimachia quadrifolia*)
Eastern white pine (*P. strobus*)
Red cedar (*Juniperus virginiana*)
Sweet pepperbush (*Clethra alnifolia*)
Lowbush blueberries (*Vaccinium pallidum*, *V. angustifolium*)
Striped maple (*Acer pensylvanicum*)
American witch-hazel (*Hamamelis virginiana*)
Ghost pipe (*Monotropa uniflora*)
Sweet fern (*Comptonia peregrina*)
Yellow trout lily (*Erythronium americanum*)
Northern highbush blueberry (*Vaccinium corymbosum*)
Broomsedge bluestem (*Andropogon virginicus*)
Black huckleberry (*Gaylussacia baccata*)
Pennsylvania sedge (*Carex pensylvanica*)
Bracken fern (*Pteridium aquilinum*)
Wintergreen (*Gaultheria procumbens*)
Wild sarsaparilla (*Aralia nudicaulis*)
Poison ivy (*Toxicodendron radicans*)
Virginia creeper (*Parthenocissus quinquefolia*)
Fox grape (*Vitis labrusca*)
European barberry (*Berberis vulgaris*)
European lily of the valley (*Convallaria maialis*)
Grape (*Vitis spp.*)
Greenbriers (*Smilax spp.*)
Fire cherry (*Prunus pensylvanica*)
Maple-leaved viburnum (*Viburnum acerifolium*)
Glossy buckthorn (*Rhamnus frangula*)
Bush honeysuckles (*Lonicera spp.*)
Sensitive fern (*Onoclea sensibilis*)
Canada mayflower (*Maianthemum canadense*)
Wood anemone (*Anemonoides quinquefolia*)
White woodaster (*Eurybia divaricate*)
Northern starflower (*Trientalis borealis*)
Jack-in-the-pulpit (*Atisaema triphyllum*)

Partridgeberry (*Mitchella ripens*)
Clubmosses
Fringed polygala (*Polygala paucifolia*)
Pink lady's-slipper (*Cypripedium acaule* Aiton)
Nannyberry (*Viburnum lentago*)

Wetlands

Silver maple (*Acer saccharinum*)
Swamp aster (*Symphyotrichum puniceum*)
Bitter wintercress (*Barbarea vulgaris*)
Poison sumac (*Toxicodendron vernix*)
Broadleaf caattail (*Typha latifolia*)
Purple loosestrife (*Lythrum salicaria*)
Bog myrtle (*Myrica gale*)
Pickeralweed (*Pontederia cordata*)
Buttonbush (*Cephalanthus occidentalis*)
Water hemlock (*Cicuta maculata*)
Gray alder (*Alnus incana*)
Common reed (*Phragmites australis*)
Carolina fanwort (*Cabomba caroliniana*)
Water smartweed (*Persicaria amphibia*)
Marsh marigold (*Caltha palustris*)
Broadleaf arrowhead (*Sagittaria latifolia*)
Northern lady fern (*Athyrium angustum*)
Cinnamon fern (*Osmundastrum cinnamomeum*)
Sensitive fern (*Onoclea sensibilis*)
Royal fern (*Osmunda regalis*)
Marsh fern (*Thelypteris palustris*)
Spinulose wood fern (*Dryopteris carthusiana*)
Red-osier dogwood (*Cornus sericea*)
Creeping buttercup (*Ranunculus repens*)
Small-flowered buttercup (*Ranunculus abortivus*)
Skunk cabbage (*Symplocarpus foetidus*)
American white waterlily (*Nymphaea odorata*)
Swamp milkweed (*Asclepias incarnata*)
Japanese barberry (*Berberis thunbergia*)
Tussock sedge (*Carex stricta*)
Canada bluejoint (*Calamagrostis canadensis* var. *canadensis*)
Swamp-candles (*Lysimachia terrestris*)
Common St. John's wort (*Hypericum perforatum*)
Common duckweed (*Lemna minor*)
Marsh St. John's-wort (*Hypericum elodes*)
Coastal Plain Joe-Pye weed (*Eutrochium dubium*)
Bonesets (*Eupatorium spp.*)

Water-horehound (*Lycopus spp.*)
Leatherleaf (*Chamaedaphne calyculata*)
Sweet gale (*Myrica gale*)
Bur-reeds (*Sparganium spp.*)
Sedges (*Carex spp.*)
Rice cutgrass (*Leersia oryzoides*)
Swamp dewberry (*Rubus hispidus*)
Meadowsweet (*Spiraea alba* var. *latifolia*)
Steeplebush (*Spiraea. tomentosa*),
Swamp azalea (*Rhododendron viscosum*)
Silky dogwood (*Swida amomum*)
Pussy willow (*Salix discolor*)
Black willow (*S. nigra*)
Spicebush (*Lindera benzoin*)
Water-willow (*Decodon verticillatus*)
Canadian burnet (*Sanguisorba canadensis*)
Virgin's bower (*Clematis virginiana*)
Clearweed (*Pilea pumila*)
Turtlehead (*Chelone glabra*)

Appendix C – Insects at Powow River Conservation Area iNaturalist Project

Research Grade 10/18/2024

Monarch (*Danaus plexippus*)
Blue Dasher (*Pachydiplax longipennis*)
Carolina grasshopper (*Dissosteira carolina*)
Common Whitetail (*Plathemis lydia*)
Black Swallowtail (*Papilio polyxenes*)
Eastern Giant Swallowtail (*Papilio cresphontes*)
Common Ringlet (*Coenonympha californica*)
Red Milkweed Beetle (*Tetraopes tetraphthalmus*)
Double-banded Grass-Veneer (*Crambus agitatellus*)
Viceroy (*Limenitis archippus*)
Isabella Tiger Moth (*Pyrrharctia isabella*)
Eastern Amberwing (*Perithemis tenera*)
Bronzed Tiger Beetle (*Cicindela repanda*)
Silver-spotted Skipper (*Epargyreus clarus*)
Peck's Skipper (*Polites peckius*)
Bicolored Striped Sweat Bee (*Agapostemon virescens*)
Oriental Beetle (*Exomala orientalis*)
Great Golden Digger Wasp (*Sphex ichneumoneus*)
Green-striped Grasshopper (*Chortophaga viridifasciata*)
Fragile Forktail (*Ischnura posita*)
Dot-tailed Whiteface (*Leucorrhinia intacta*)
Widow Skimmer (*Libellula luctuosa*)
Chickweed Geometer Moth (*Haematopsis grataria*)
Red-spotted Admiral (*Limenitis arthemis*)
Colorado Potato Beetle (*Leptinotarsa decemlineata*)
Fall Webworm Moth (*Hyphantria cunea*)
Eastern Pondhawk (*Erythemis simplicicollis*)
Variable Dancer (*Argia fumipennis*)
Willow Pinecone Gall Midge (*Rabdophaga strobiloides*)
Bibio lanigerus
Common Flower Flies (Genus *Syrphus*)
Small White (*Pieris rapae*)
Common Bagworm Moth (*Psyche casta*)
Leaf-footed bug (*Acanthocephala terminalis*)
Golden Net-winged Beetle (*Dictyoptera aurora*)
Japanese Beetle (*Popillia japonica*)
Promethea Silkmoth (*Callosamia promethea*)

Large Lace-border Moth (*Scopula limboundata*)
Pale Beauty (*Campaea perlata*)
Brown Marmorated Stink Bug (*Halyomorpha halys*)
Willow Beaked-gall Midge (*Rabdophaga rigidae*)
Slender Lizard Beetle (*Acropteroxys gracilis*)
European Paper Wasp (*Polistes dominula*)
Slender Bluet (*Enallagma traviatum*)
Slender Spreadwing (*Lestes rectangularis*)
Odontomyia cincta
Physocephala tibialis
Common Idia Moth (*Idia aemula*)
Dark Phalaenostola Moth (*Phalaenostola eumelusalis*)

Appendix D – Amesbury Massachusetts Endangered Species List

Common Name	Scientific Name	Taxa	Status	Last Observed
Atlantic Sturgeon	<i>Acipenser oxyrinchus</i>	Fish	Endangered	2016
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Bird	Threatened	2020
Blue-spotted Salamander (complex)	<i>Ambystoma laterale</i>	Amphibian	Special Concern	2018
Dwarf Scouring Rush	<i>Equisetum scirpoides</i>	Vascular Plant	Special Concern	1903
Eastern Meadowlark	<i>Sturnella magna</i>	Bird	Special Concern	2017
Eastern Pondmussel	<i>Ligumia nasuta</i>	Mussel	Special Concern	2000
Eaton's Beggar-ticks	<i>Bidens eatonii</i>	Vascular Plant	Endangered	1928
Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	Fish	Endangered	2016
Twelve-spotted Tiger Beetle	<i>Cicindela duodecimguttata</i>	Beetle	Special Concern	2015
Vasey's Pondweed	<i>Potamogeton vaseyi</i>	Vascular Plant	Endangered	2002
Wood Turtle	<i>Glyptemys insculpta</i>	Reptile	Special Concern	1992

Appendix E – Control of Invasive Plants²⁵

Several species of invasive plants are currently found within the Powow River Conservation Area and we have described their management as it pertains to specific goals and objectives outlined in this plan. In general, we recommend that the stewards assess threats from invasive species during annual monitoring and implement treatment according to specifications outlined by the town.

If herbicide is used, the exact concentration, chemical, and type of application should be decided by the applicator and approved by the city. The applicator should develop an Invasive Plant Management plan for the area and make recommendations to the town that is best suited for the site.

Glossy and Common Buckthorn

Manual, mechanical, and chemical means are effective in controlling glossy buckthorn and is most effectively controlled by recognizing its appearance early and removing isolated plants before they begin to produce seed. With large infestations, remove the largest seed-producing plants first. Currently no means of biological control is available for controlling buckthorn. Hand pulling is effective in small infestations. Remove the entire root section or re-sprouting will occur. Weed wrenches can be very effective in uprooting buckthorn.

Chemical treatment is also an option. The type of herbicide determines the best time of year to apply based on how the chemicals disrupt the biological process of the plant. Triclopyr herbicides are much more effective early in the growing season. Glossy buckthorn retains its leaves late into the fall, so you can apply herbicide fairly late in the season. However, the application should not be too late, or the leaves will no longer be photosynthetically active (or minimally so) and will easily fall from the twigs without affecting the roots. During the growing season, cut the stems near ground level and apply a 20%-25% herbicide mixture to the stumps. Re-sprouts should be cut and treated again or sprayed with a hand sprayer of 1.5%. Foliar applications over non-water sites can also be used. Foliar application of herbicides using a backpack sprayer is effective, but less selective.

Common Reed – Phragmites

Control with herbicides is effective for controlling areas with large, established, populations of phragmites. Other options include mowing and prescribed burning. New stands of phragmites commonly occur when new wetlands are created, or the soil is disturbed. Minimizing land disturbances and water pollution helps deter this invasive species. Land management practices that guard against erosion, sedimentation, fluctuating water levels, and nutrient loading in wetlands are the best long-term solution.

Control of phragmites is difficult. Repeated cutting can slow its growth and possibly hinder its spread but will not eliminate it altogether. The best method to eliminate phragmites is the foliar application of a systemic herbicide when the plants are actively growing. Currently no means of biological control is

²⁵ See Mass Audubon's Invasive Plants of Massachusetts (<https://www.massaudubon.org/nature-wildlife/invasive-plants-in-massachusetts>)

available for treating phragmites infestations. Manual or mechanical cutting or pulling has been used successfully to control phragmites. Treatments usually need to be repeated annually. The best time to cut phragmites is at the end of July. Cutting at other times may increase stand density. Phragmites stems should be cut below the lowest leaf, leaving a 6" or shorter stump. Hand-pulling is an effective technique for controlling phragmites in small areas with sandy soils.

Repeated mowing is effective at slowing the spread of established stands but is unlikely to kill the plant. Excavation of sediments may also be effective, but root fragments left in the soil may lead to re-establishment. Prescribed burning after the plant has flowered, either alone or in combination with herbicide treatment, is also effective. Burning after herbicide treatment also reduces standing dead stem and litter biomass which may help to encourage germination of native plants in the following growing season. Do not burn plants in the spring or summer before flowering as this may stimulate growth. Chemical treatments are effective in controlling established populations. If a population can be controlled soon after it has been established the chances of eliminating the infestation are much higher because the below-ground rhizome network will not be as extensive. Herbicides are best applied in late summer/early fall after the plant has flowered either as a cut stem treatment or as a foliar spray. Repeat treatments are required for several years to prevent any surviving rhizomes from re-sprouting.

Multiflora Rose

Mechanical and chemical methods are effective methods for managing multiflora rose but may need to be combined with chemical treatment in large or persistent infestations. The most important steps to controlling multiflora rose are to destroy existing plants and begin a yearly program to control seedlings as they appear. Biological control is not yet available for management of multiflora rose. However, researchers are investigating several options, including a native viral pathogen (rose-rosette disease), which is spread by a tiny native mite, and a seed-infesting wasp, the European rose chalcid.

Manual and mechanical control consisting of frequent, repeated cutting or mowing three to six times per growing season for two to four years is effective in achieving high mortality of multiflora rose. In high quality natural communities, cut the individual plants to minimize habitat disturbance. Herbicides are successful in controlling multiflora rose, but follow-up treatments are required because of the long-lived stores of seed in the soil. Apply systemic herbicides (such as glyphosate) late in the growing season to freshly cut stumps or to regrowth. In wetlands, where multiflora rose may occur, make sure to use a wetland-formulated concentrate. Use an active ingredient concentration of 25-35% when you apply herbicide to the cut stem. Plant growth regulators control the spread of multiflora rose by preventing fruit set.

Oriental Bittersweet

A combination of cutting followed by application of concentrated systemic herbicide to rooted, living cut surfaces is an effective approach for removing Oriental bittersweet. For large infestations spanning extensive areas of ground, a foliar herbicide is recommended over manual or mechanical methods, which would create soil disturbance to minimize soil disturbance. Manual, mechanical and chemical control methods are effective in removing and killing Oriental bittersweet. A combination of methods often yields the best results and may reduce potential impacts to native plants, animals and people. The method selected depends on the extent and type of infestation, the amount of native vegetation on the

site, and the time, labor and available resources. No biological controls are currently available for this plant.

Manual Control of small infestations can be achieved by hand-pulling, but the entire plant should be removed including all the root portions. If fruits are present, collect, bag, and dispose of them in heavy garbage bags. Always wear gloves and long sleeves to protect your skin from poison ivy and barbed or spiny plants. Plants can also be controlled by cutting climbing vines near the ground at a comfortable height to kill upper portions and to relieve the tree canopy. Vines can be cut using pruning snips or a pruning saw for smaller stems, or a hand axe or chain saw for larger vines. Minimize the damage to the bark of the host tree. Rooted portions will remain alive and should be repeatedly cut to the ground or treated with herbicide. Cutting without herbicide treatment requires vigilance and repeated cutting because plants will re-sprout from the base. Begin treatment early in the growing season and repeat the treatment every two weeks until autumn.

Systemic herbicides are absorbed into plant tissues and carried to the roots, killing the entire plant within about a week. This method is most effective if the stems are first cut and herbicide is applied immediately to the cut stem tissue.

Fall and winter applications will avoid or minimize impacts to native plants and animals. Repeated treatments will be required. Any herbicide applications should be carefully targeted to avoid damage to native, non-target species. If native grasses are intermingled with the bittersweet, triclopyr is better to use than glyphosate because it is selective for broad-leaved plants and will not harm grasses. Follow-up monitoring is required to ensure effective control.

Cypress Spurge

There are 2 Cypress spurge types. The most common type is a sterile diploid, which does not produce seeds. The other type, a fertile tetraploid, can produce seeds. In North America, seed-producing Cypress spurge is relatively rare but can form large populations. Sterile Cypress spurge is much more widely dispersed but generally produces smaller populations. In North America, the sterile type was introduced and has been widely cultivated as an ornamental. The high potential for regrowth from the extensive root and rhizome system of both fertile and sterile types make Cypress spurge difficult to control. Persistent seed banks and the potential for long-distance seed dispersal make control of fertile types even more difficult. Prioritization in the control of Cypress spurge is important. Seed-producing stands should receive priority, since they have the greatest capacity for spread. Seed-producing stands will likely require more vigilant posttreatment monitoring and follow-up treatments than sterile stands. Because of the need for more aggressive treatment and monitoring, treating fertile stands will likely be more costly and time consuming than treating sterile stands. Shoots can develop from deeply buried root fragments, and fragmentation and movement of root or rhizome pieces can be important to cypress spurge dispersal. Some studies indicate that "almost any broken part of this plant is capable of reproducing vegetatively."

Manual, mechanical, biological, and chemical means have shown limited effectiveness in controlling Cypress spurge. Recognizing its appearance early and removing isolated plants before they begin to produce seed can be effective for small infestations. Cypress spurge may be controlled by frequent and repeated hand-pulling or mowing, and cypress spurge does not tolerate prolonged cultivation. With

large infestations, mowing every 21 days can be effective. Fire may be useful in conjunction with other control methods. Herbicides may be more effective on postfire sprouts than on full-sized plants.

Biological control: Since 2002, there have been 7 European insects released in the eastern United States and 10 released in Canada to control Cypress spurge. Spurge hawkmoth (*Hyles euphorbiae*), flea beetle (*Apthona spp.*), stem- and root-boring beetle (*Oberea erthrocephala*), and gall midge (*Spurgia esulae*) populations are established in the eastern United States and Canada. Although most insects were successful in defoliating or weakening Cypress spurge in some release sites, over time researchers learned that biocontrol success can be site specific, and successful control will likely require a variety of biocontrol insects.

Control of cypress spurge with herbicides has shown variable success, which may be related to the Cypress spurge type, application method, and/or timing of posttreatment evaluation. Some studies indicate that because of Cypress spurge's waxy cuticle layer, a surfactant is required for absorption, and that a combination of herbicides may effectively control cypress spurge. There are spurge specific herbicide products.

Table B-1. General Management Options.

Method	Good for Volunteers?	Timing	General guidelines	Target Species
Cut and paint	Yes	Late August to November	Preferably done in the fall when woody plants are translocating energy towards roots. Can be done to all trees/ shrubs except black locust (signals root suckering). Preferred treatment for multiflora rose. If berries are present, take extra precaution to not spread seed. Best when left in local area and burned in brush pile. Good for volunteers working together with staff: have volunteers cut and haul brush while licensed applicator paints herbicide.	Common Reed (stem injection) Japanese knotweed (stem injection) Burning Bush Oriental bittersweet Multiflora rose (preferred) Bush Honeysuckle (fall) Glossy buckthorn Autumn olive

Method	Good for Volunteers?	Timing	General guidelines	Target Species
Hand pull	Yes	Spring and Summer	Great for herbaceous plants with taproot and shallow root system. Best for small infestations. All trees/ shrubs can be hand-pulled when in seedling stage. Garlic mustard should be hand-pulled when second year plants start sending up seed stalk and all plant parts should be bagged and kept out of the sun (seeds can still develop if sunlight is available).	Spotted knapweed Garlic mustard Cypress spurge All seedlings for trees and shrubs
Mechanical (weed wrench/ shovel)	Yes	Spring through Fall, although better before seed set.	Great for small shrubs/ trees. Best when done in early spring when leaves start coming out but before berries develop. Shovels can be used to dig up herbaceous plants with fibrous root systems (black swallowwort) care needs to be taken to make sure all root system is dug up. Soil should be tamped down after removal or native species planted soon after disturbance to keep additional invasives from re-colonizing area.	Japanese knotweed Burning Bush Japanese barberry Black swallowwort Autumn olive Tree of heaven
Basal bark herbicide	No	August through October	This method is best when done in late summer mid fall (Aug-Oct) when flow is towards roots. Can be performed on all trees/ shrubs.	Burning Bush Autumn olive
Biological	Yes	Dependent on insect.	This method of treatment works well for purple loosestrife. It is the least disruptive method of treatment currently available. Usually agents are released in July/ August. The effect the biological agent will have on the environment should be taken into consideration and the relative easiness of other forms of treatment. Depending on	Purple loosestrife (preferred) Cypress spurge Spotted knapweed (needs research)

Method	Good for Volunteers?	Timing	General guidelines	Target Species
			infestation size this could be a good way to treat spotted knapweed.	
Foliar spray herbicide	No	When leaves are out.	For trees/ shrubs best when done in the fall when flow is towards roots. Can be done any time for herbaceous plants. When spraying the least amount of herbicide at the smallest effective percentage should be used. The surrounding habitat (wetland vs upland), nesting/ breeding animals, and whether it is a necessary treatment should be considered.	All invasive species. Foliar spray is likely to kill all species (including native species) in the area sprayed.
Girdling	If certified in chainsaw safety	Fall	A chainsaw is used to create a ~2" wide cut all around the tree between knee and waist height taking care to remove only the outer layer of cambium, then the fresh cut is painted with herbicide.	Larger trees
Bloody glove	No	When leaves are out.	A rubber glove is worn on the hand with an absorbent cotton glove over it. The cotton glove is dipped in a glyphosate solution (strength depending on target species) then used to directly apply herbicide to leaves, stems, and inflorescences of target plants. Herbicide is absorbed directly into the plant via the stem and leaves, however, breaking the stem aids in more rapid absorption.	Small patches of common reed, seedlings, etc. particularly in wetlands where impacts to non-target species is a concern.

Table B-2. Species Specific Management Options.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Autumn Olive	Autumn Olive flowers in May-July (plants must be at least 3 years old to flower). Seeds are produced August – November and nuts usually ripen in September. Adults produce less seed in the shade than the sun. Autumn Olive reproduces primarily by seed.	Seedlings can be hand-pulled. Bigger plants can be removed with weed wrenches. Care should be taken to get entire root system. Plants re-sprout vigorously when cut without the use of herbicide. Resprouting may also be stopped by use of “Buckthorn Baggie”.	A foliar treatment with at 2% solution of Triclopyr or Glyphosate can be used when leaves are present. A 25% solution of Triclopyr or Glyphosate can be used for cut-and-paint. A 20% solution of Triclopyr is recommended for basal bark treatments.	3 years No information available on seed viability.
Black Swallowwort	Black swallowwort spreads vegetatively and by seed. It flowers in June-August. The seeds are released from August to October;	Plants can be dug up with a shovel. The entire root system would need to be removed and this method is very time consuming.	A 2% foliar spray of Glyphosate or Triclopyr is recommended before mid- July. Chemical treatment is recommended from May- June, this would be before the plants flower so there would not be a possibility of spreading seed.	6 years Seeds remain viable up to five years
Winged Euonymus (Burning Bush)	Burning Bush reproduces by seed and vegetatively.	Small plants can be hand pulled while a weed wrench will need to be used for larger plants. Care should be taken to remove entire root system.	A 2% foliar solution of glyphosate is recommended when leaves are present. A 20% solution of glyphosate or triclopyr is recommended for cut and paint and a 20% solution of triclopyr should be used for basal bark application.	5 years No information on seed banking,

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Bush Honeysuckles (Tartarian and Morrow' s)	The berries are mildly poisonous if eaten.	small plants can be hand pulled or removed with a weed wrench. Care should be taken to remove all roots and not to spread berries.	Foliar spraying can be done if there are leaves present a 2% solution of triclopyr or glyphosate is recommended. A 25% solution for cut and paint treatments can be used, put the solution right into the hollow stem and around the stem edge. This is best during the fall when all the plant fluids are headed towards the root system.	3 years Few seeds viable for more than one year.
Common Reed	Common Reed reproduces by seed and vegetatively. Inflorescences develop in late June.	Plants can be cut. The shoots should be removed to prevent re sprouting.	A 2% solution of Glyphosate is recommended. Since Phragmites is an aquatic species, an aquatic safe herbicide must be used. The best results are when the herbicide is applied in the late summer or early fall when Phragmites is actively growing and in full bloom. Remove dead stems, if possible, by mowing or clipping.	2 years Seed viability is typically low, although it may vary year to year.
Garlic Mustard	Garlic mustard is a biennial plant and is allelopathic.	Basal rosettes and second year plants can be hand pulled. Plants should be pulled at base near ground to ensure that the root is removed.	A 2% glyphosate solution can be sprayed in April/ May before the basal rosettes go to seed and in September/ October when other plants are dormant.	6 years The seed bank is viable for 5 or more years.
Glossy Buckthorn	Reproduces by seed.	Seedlings can be hand-pulled and larger plants can be removed with a weed wrench. "Buckthorn Baggies" can be used to prevent resprouting.	Cut and paint with a 20% solution of glyphosate or 25% triclopyr. A 2% foliar spray can be used while there are leaves. Remove dead stems, if possible, by mowing or lopping. Use care with foliar spray to not kill native species.	7 years Seeds remain viable for 5-7 years.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Japanese Barberry	Japanese Barberry spreads by seeds and vegetatively. The seeds have a 90% germination rate.	Small plants can be removed by hand pulling or using a weed wrench.	A 2% foliar spray can be used when leaves are present (April). Both glyphosate or a triclopyr solution can be used. A 25% cut and paint solution of glyphosate or triclopyr can be used, it is most effective in the fall when sap flow is towards the root system.	2 years Do not persist in seed bank.
Japanese Knotweed	Most of the literature recommends spraying after flowering; this makes it harder for the plant to have enough reserves to re-sprout that year. When the plant is in flower (August) there are a lot of bees around this species; care should be taken to avoid spraying bees when present and if possible, efforts should be made to spray multiple times a year before flowering.	Due to its extensive root system hand pulling Japanese Knotweed is not recommended as an efficient form of control.	A 2% solution of Triclopyr or Glyphosate is recommended for foliar spraying and is recommended to be done soon after flowering. For cut and paint techniques a 25% solution of glyphosate or triclopyr is recommended.	4 years Seeds do not remain viable beyond one year, but rhizomes and other plant parts can sprout up to three years after treatment.
Japanese Stiltgrass	Japanese stiltgrass emerges in late August.	Small patches can be hand pulled and bagged. Be sure to remove entire root system.	A 2% glyphosate or triclopyr solution can be used for foliar spray in August/September.	7 years Seeds remain viable for 5-7 years.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Multiflora Rose	It flowers from April to June and fruits seeds July-Dec. It reproduces by seed and vegetatively.	Hand-pulling small plants are recommended as long as all the roots are removed. It is not recommended for established plants.	Foliar application is best when near flowering time. A 2% of triclopyr or glyphosate can be used. Cut and paint or basal bark applications can also be applied in the fall. A 25% solution of triclopyr or glyphosate is recommended for cut and paint and 20% of triclopyr can be used for basal bark treatments.	20 years Seeds of multiflora rose are viable for up to 20 years.
Oriental Bittersweet	The seeds are viable for several years but can sprout from roots and runners.	Seedlings are easy to hand-pull. Bigger vines can be removed by unwinding them from their host and using a weed wrench to uproot them. This can be done year-round, but use caution when berries are present.	You can foliar spray with a 2% solution of Glyphosate or Triclopyr. A 20% solution can be used for basal bark treatment. A 25% solution is recommended for cut and paint treatments, both Glyphosate and Triclopyr can be used.	5 years Seeds do not remain viable, but resprouts from roots.
Purple Loosestrife	Galerucella spp. beetles are recommended for bio control agents.	Plants can be removed by hand pulling. All roots should be removed.	An aquatic safe herbicide (Rodeo) should be used. A 2 % foliar spray is recommended in late August and early September.	Ongoing Produces nearly inexhaustible seed bank. Bio-control will not eliminate plant.
Spotted Knapweed	Plants may contain carcinogenic compounds and skin irritation can also occur; gloves should be worn when handling	Plants can be hand pulled and bagged. Care should be taken to get the entire root system and not to distribute seeds if present.	A 2% Glyphosate foliar spray can be used. Plants are most susceptible if sprayed in the late stages of flower buds (late June).	10 years Seeds can survive for 8 or more years.

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Tree-of-Heaven	Tree-of-heaven flowers in May-June, and fruits starting in July. It reproduces by seed and vegetatively. Plants need to be 2 or 3 years old to produce viable seed. It re-sprouts vigorously when cut without herbicide.	Small plants can be removed by hand- pulling or using a weed wrench. Care should be taken to remove entire root system.	A 2% solution is recommended for foliar spray. Either Triclopyr or Glyphosate can be used. Triclopyr is recommended for cut and paint (30% solution) and basal bark (20% solution) treatments.	2 years Few seeds remain viable after one year.
Water Chestnut	Water chestnut emerges in June and sets seed in August	Small patches can be hand pulled in canoes and kayaks. Vegetation can be used as compost.	An aquatic specific herbicide would be used. Also required NPDES permits would have to be in place before control.	15 years Seeds remain viable for 12 or more years.
Norway Maple		Small plants can be hand-pulled, while a weed wrench will need to be used for larger plants. Girdling can be effective for mature trees.	Treatment with Glyphosate (G) or Triclopyr (T). -Foliar treatment on small individuals apply directly to leaves with G3% solution. -Stem injection of G20%-50% solution after drilling holes in the trunk	Leave dead trees standing in place

Species	Biology	Control Recommendations		Monitoring Period
		Manual	Chemical	
Cypress spurge	<p>2 spurge types – sterile and seed producing: Seed producing type is more difficult to control.</p> <p>Shoots emerge from established plants in early spring. Lateral vegetative shoots develop when the first flowers were produced, and buds developed on root crowns by mid-fall.</p>	<p>Frequent and repeated hand-pulling or mowing. Mowing every 21 days can be effective. First mow between May to July or when the first bloom is. Does not tolerate prolonged cultivation.</p> <p>Fire may be useful in conjunction with other control methods.</p> <p>Herbicides may be more effective on postfire sprouts than on full-sized plants.</p>	<p>It is important to apply herbicides at early bud, typically at the beginning to mid-summer or early fall. It has been shown that control with 2,4-D is quite difficult. This herbicide treatment will require at least one additional application in the same growing season.</p>	2 years

Invasive Species Treatment Record

Property:

Date:

Location:

UTM (WGS84/NAD83):

Weather (include 24 hours before and after for chemical treatment)

	Current	24 hours before	24 hours after
Temp.			
Wind speed/direction			
Cloud Cover			
Precipitation			

Method: Chemical Manual Mechanical Biological

Chemical

Chemical used: % Solution Used: Amount of solution used:

Amount of herbicide used: Mix date:

Adjuvants/Carriers etc.:

Method of Application:

Name of applicators:

Biological

Biological control agent: # Released: Stage:

Mechanical/ Manual

Equipment used:

Acres/number of plants treated:

% of infested area treated:

Growth stage of target:

Target Species:

Comments:

Date current treatment mapped w/ GPS:

Efficacy notes:

Date/type of last treatment:

ATTACH MAP OF TREATMENT AREA

or hand draw on back of this sheet

Appendix F – Estimated Costs

	Quanty	Cost
Permitting for Planned Projects	Varies	Staff/Volunteer Time
Monthly Property Visits	2 hours/month	Staff/Volunteer Time
Annual Work Plan with Staff and Stewards	4 to 8 hours	Staff/Volunteer Time
Safety Meeting with Staff, Stewards, Police and Fire Dept.	2 hours	Staff/Volunteer Time
Trail Walk/Clean Up (downed limbs, drainage issues, signage needs)	Varies	Staff/Volunteer Time
Repair Equipment and tools	Varies	Staff/Volunteer Time Materials
Building Projects (kiosks, signposts, etc.)	Varies	Staff/Volunteer Time
Invasive Plant Management	16 hours/year	Staff/Volunteer Time Materials & Tools
Mowing of Grassland (After July 24 th or March/April)	40 hours/year	Staff/Farmer Time Equipment, fuel
Expand grassland by cutting back shrubs and overhanging limbs	4 hours/year	Staff/Volunteer Time
Trail maintenance	20 hours/year	Staff/Volunteer Time
Boundary Walk (monitoring for encroachments, signage, etc.)	4 hours/year	Staff/Volunteer Time

Powow River Conservation Area should have a budge of \$10,000 to \$15,000/year

Signs may cost \$3,000 (one time cost)