

Tifft Nature Preserve Management Plan

February 2009



Tifft Nature Preserve

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Tifft Nature Preserve Management Plan

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Executive Summary

Tifft Nature Preserve is a 264-acre (107-hectare) urban nature preserve, operated by the Buffalo Museum of Science, which is dedicated to protection of the site's natural resources, scientific research, environmental education, and public enjoyment. Located in South Buffalo, the area was formerly used as a transshipment facility and dump until a group of concerned citizens successfully petitioned the city to create a nature preserve on the property in the early 1970's. Despite the industrial history of the site, this brownfield provides valuable wildlife habitat and needed greenspace within the city limits. Major habitats on the preserve include a 75-acre (30-hectare) remnant cattail marsh, woodlands, grasslands, three ponds and a small stream. In addition to the cattail marsh, which is the largest remnant wetland in Erie County and provides nesting habitat for rare marsh birds, Tifft Nature Preserve is an important stop-over site for migrating birds and is designated as an Important Bird Area (IBA) by Audubon.

Although the industrial activity has ended and the site's natural appearance has recovered, there are still several threats to the preserve's natural resources. Invasive species top this list of threats. There are many invasive species at Tifft Nature Preserve including plants, fish, and invertebrates, and the preserve is not alone in dealing with this growing environmental problem. The most urgent invasive species challenge is to prevent the remnant cattail marsh, which is still mostly native wetland vegetation, from becoming dominated by the non-native plant Common reed (*Phragmites australis*). The other major threat to the preserve comes not from an invasive species, but from the overabundance of white-tailed deer. Growing populations of deer are becoming a common problem for natural areas across the country, as well as suburban and urban communities. The many deer on the preserve heavily browse the vegetation and prevent tree regeneration which degrades habitat for other wildlife species. Large deer populations in urban areas can also create conflicts with humans by destroying ornamental plantings and through deer-vehicle collisions. In addition to addressing the threats to the preserve's natural resources, there are many improvements that can be made to increase the site's value to wildlife and biodiversity. These include replacing and repairing nest boxes, woodland and wetland native vegetation plantings, and the introduction of wildlife species that do not currently occur on the preserve, among others.

Tifft Nature Preserve's unique history, natural resources, and location within the city limits of Buffalo, make it an ideal site for scientific research and education. The Buffalo Museum of Science has a long history of conducting research on a wide variety of subjects, from archeology to zoology, and Tifft Nature Preserve will continue this tradition. Research should be conducted by not only by Tifft Nature Preserve or Buffalo Museum of Science scientists, but also through partnerships with local colleges, universities, and science institutions. Tifft Nature Preserve is the museum's "living collection" and provides an excellent field site to educate the public about natural history, ecology, the environment we live in, and the process of scientific discovery. The educational model at the preserve is to connect students and the public to authentic

research on a diversity of scientific subjects through experienced-based programs. In addition to research and education, Tifft Nature Preserve is a great place for the public to go watch birds, fish, snowshoe, picnic, hike, or just relax on a bench and enjoy nature that is only minutes away from downtown Buffalo. This green retreat makes the preserve a major asset to the community, but this public use needs to be controlled and managed so it does not impair the natural resources of the site or other's ability to enjoy the preserve.

The Buffalo Museum of Science is committed to protecting the significant natural resources on the preserve and achieving the full potential of Tifft Nature Preserve as a destination for scientific research and environmental education in western New York. The goal of this management plan is to function as a reference for information about Tifft Nature Preserve and as a resource for those interested in researching, teaching, or studying at the preserve. This management plan will also direct land management activities on the preserve to protect and enhance the important natural resources at Tifft Nature Preserve.

Acknowledgements

There were many individuals who assisted with the development of this plan and provided advice on the future of Tifft Nature Preserve. On the top of this list are the many dedicated volunteers at the preserve and the Friends of Tifft Nature Preserve, Inc. organization. The Buffalo Museum of Science is committed to the success of Tifft Nature Preserve and museum staff that offered ideas and reviewed sections include: Mark Mortenson, John Grehan, Karen Wallace, Al Parker, Matt Frawley and Caryn Corrie. Allie Hamburg kindly reviewed all sections. Very special thanks go to Dr. Robert Andrie who spent considerable time reviewing this management plan and sharing his extensive knowledge of the preserve and the natural history of the region.

Mission Statement

The mission of Tifft Nature Preserve...

...is to protect and manage the natural resources and historical value of a remnant wetland and reclaimed brownfield.

...is to connect environmental education with authentic scientific research.

...is to provide a nature preserve for public enjoyment in an urban setting.

...is to be part of a revitalized and sustainable South Buffalo community.

Tifft Nature Preserve is administered by the Buffalo Society of Natural Sciences (BSNS) through the Buffalo Museum of Science and is viewed as the Society's "living collection" that includes the site's vegetation, wildlife, hydrology, soils, natural processes, and history. The aim of the BSNS is to provide quality scientific research and education to the communities of Buffalo and western New York. The Society's goal is to develop Tifft Nature Preserve into the Museum's environmental education hub serving the region. When this is achieved, the preserve will connect students and the public to research on a diversity of environmental, ecological, and science subjects through experienced-based educational programs.

This plan will address four key aspects to achieve this mission and Tifft Nature Preserve's potential.

1. *Preserve Management* – Like the collections housed at the Museum, the "living collection" at the preserve requires "curation" or management to maintain its integrity and guarantee its long-term preservation.
2. *Research* – Partnerships with universities and colleges will be encouraged that address research needs to improve and enhance the preserve's natural and historical resources.
3. *Environmental Education* – Several ideas will be proposed for programs to increase student's and the public's understanding of their environment, as well as connect them with scientists in authentic research studies.
4. *Public Enjoyment* – Public visitation of the preserve allows people to learn about and experience their environment, but access needs to be planned and managed so it does not impair the resources of the preserve.

As specific projects or programs in these four categories are implemented at the preserve, results will be monitored and compared to goals stated prior to beginning the project. Using the paradigm of "Adaptive Management", monitoring allows actions will be modified ("*adapted*") as needed to better achieve desired goals and outcomes.

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Tifft Nature Preserve Overview

History

The land which is now Tifft Nature Preserve was formerly part of an extensive flood plain and wetland complex surrounding the mouth of the Buffalo River. This area extended along the south shore of Lake Erie from present day downtown Buffalo to the City of Lackawanna. Before 1850, a drainage ditch was constructed through the center of the property to the Buffalo River. This ditch drained the western half of the property, but the land was periodically flooded by wind-driven water from Lake Erie until the south harbor breakwater was built in 1903. The area underwent dramatic changes as Buffalo became an important center for shipping and commerce at the end of the 19th century. The 75-acre (30-hectare) cattail marsh on the east side of the preserve is the only remnant plant community remaining on the preserve.

During the late 1800's, three canals were dredged on the east side of the preserve, then known as Tifft Farm, including the City Ship Canal which connected the canals to Lake Erie at the mouth of the Buffalo River. Coal and timber were important commodities shipped to the site and railroad lines traversed the property to connect the canals to inland destinations. Buffalo's importance as a major transshipment center was coming to an end in the first half of the 1900's, and the steel industry dominated business in the area. During this time, the property had several owners including Lehigh Valley Railroad, the City of Buffalo, and Republic Steel. All of these owners used it as a dump site for slag, fly ash, foundry sand, harbor dredge spoils, and refuse. Portions of the canals, including the connection to Lake Erie via the City Ship Canal, were filled with these materials.

In the early 1970's, the city again purchased the land and had plans to relocate refuse to the property from a proposed sewage treatment plant site on Squaw Island. Concerned citizens did not want to see the remaining wildlife and habitat lost and successfully petitioned the city to restrict the refuse transfer to the southwest corner of the property and establish a nature preserve on the site. Since 1975, the site has been managed as a nature preserve, and in 1982 the Buffalo Society of Natural Sciences took charge of the city-owned property which it continues to manage to this day as its "living collection" for scientific education and research. Following a plan completed in 1975, trails and boardwalks were constructed and the Makowski Visitor Center was built in 1978. An Environmental Education Center was later added to enhance the public's enjoyment of the preserve and increase educational programming potential.

For more information on the history of Tifft Nature Preserve refer to the following: *Master Plan for the Tifft Farm Nature Preserve* prepared by Ecoplans, Incorporated, *Tifft Farm, A history of man and nature* compiled by Theresa L. Wolfe and the Tifft Farm History Committee, and *Society and Museum: A history of the Buffalo Society of Natural Sciences 1861-1993 and the Buffalo Museum of Science 1928-1993* by George F. Goodyear.

Abiotic Environment

Climate & Weather – The climate at Tifft Nature Preserve is characteristic for the region which experiences a fairly humid, continental climate, but with maritime aspects due to strong effects from the Great Lakes. Summers have plentiful sunshine with moderate humidity and temperatures, and winters are generally cold and snowy, but are variable with frequent thaws and rain occurring as well. The close proximity to Lake Erie moderates temperatures in the summer and winter and can delay the coming of spring. Situated on the southeast shore of Lake Erie, the preserve is exposed to strong winds that can occasionally exceed 70 mph (113 kph). The preserve is located where lake effect snow occurs, but due to the direction of the prevailing winds receives less snow than areas south of Buffalo, which are known for heavy snow falls.

Water & Hydrology – Surface waters of the preserve consist of the three open water ponds, a small stream, and the cattail marsh. Lisa Pond is located on the northern end of the marsh in the northeast corner of the preserve. Beth Pond is also on the northern side of the preserve and is the remnant of an unfilled shipping canal that was expanded in the early 1970's. A small stream, draining wetlands to the south, flows into Lake Kirsty which is centrally located on the preserve and connected to Lake Erie via a 4-foot (1.2 meter) culvert under Fuhrmann Blvd and Route 5. The hydrological connections, including groundwater and surface flows, with the Buffalo River and surrounding wetlands and uplands are largely unknown and could use further investigation. Water quality testing performed in 1973 found conditions within the ecological range of tolerance for a variety of species in the Buffalo area (Ecoplans 1975).

Soils – Due to past dredging and dumping on the preserve the current soil base consists of a mix of natural elements and man-made materials. Therefore, soil components and properties are variable across the preserve and can change dramatically over short distances, both horizontally and vertically. Due to this situation, current vegetation at a particular location may provide more clues to the underlying soil than past geomorphology. Following a visit in 1984, Dr. Howard S. Irwin described the soils as altered with a shallow surface profile and deep underlying mixture of coal, cinders, slag, and construction and foundry waste (Klips et al 1993). Agronomic soil testing by the Erie County Cooperative Extension in 1984 found alkaline soils (pH: 7.6-7.8) with high levels of calcium, magnesium and potassium and varying levels of phosphorus (Klips et al 1993). From 33 surface soil samples collected in 1983, the Erie County Department of Environment and Planning reported that concentrations of heavy metals were comparable to other south Buffalo sites, but some samples showed elevated levels of copper, chromium, lead, and zinc (Klips et al 1993). In contrast to the rest of the preserve, the 75-acre (30-hectare) wetland did not experience filling and dumping, and soils therefore remain largely in their native state. This consists of clay substrata with areas of organic, silt, and clay sediments at surface level. Pockets of sandy soil may still occur from sands blown and washed in from the barrier dune system that occurred along Lake Erie's shore prior to development of the area. However, soil

samples in the marsh were found to have elevated levels of lead likely as a result of atmospheric deposition from surrounding industry.

Contaminates – The industrial history of the preserve and the surrounding area has left a legacy of chemical contamination. As mentioned above, the soils are a mix of natural and man-made elements with varying soil chemistry and levels of contaminants such as heavy metals. The preserve is a designated Superfund site in the category Inactive Hazardous Waste Site. There are also several other similar Superfund sites surrounding the preserve, and the Buffalo River to the north is listed as an Area of Concern (AOC) under the Great Lakes Water Quality Agreement due to toxic contamination. In the spring of 1983 barrels of industrial waste were discovered on the preserve. A total of 116 barrels, which contained a mix of industrial byproducts including naphthalene, a polynuclear aromatic hydrocarbon (PAH) known to cause cancer, were removed from the site that summer. Following analysis of environmental samples, the preserve was deemed safe and re-opened in the fall of 1983.

Biotic Resources

Flora – With the exception of the cattail marsh, the original vegetation on the site was lost or heavily disturbed. The vegetation in the upland areas on the preserve is dominated by non-native species such as Japanese knotweed, garlic mustard, and fescue grasses, as well as early successional and hardy natives such as willow and cottonwood trees and Canada goldenrod. Deer browse and beaver activity heavily impact the woody species of trees and shrubs on the preserve. The 75-acre (30-hectare) cattail marsh is dominated by native freshwater wetland plants with the exception of common reed (*Phragmites australis*) occurring in dense stands along the edges and in small pockets in the interior of the marsh. Klips, Sweeney, and Gall (1993) identified 278 species growing naturally on site, with an additional 35 species introduced for ornamental and wildlife enhancement.

Fauna – The greatest wildlife asset on the preserve is its diverse bird community. There have been 264 bird species observed, with 62 native bird species confirmed to breed on site (NYS Breeding Bird Atlas 2007), including the New York State Threatened Least Bittern and Pied-billed Grebe. Tifft Nature Preserve is designated as an Important Bird Area (IBA) by Audubon (Burger and Liner 2005) and over sixty species listed as Species of Greatest Conservation Need (SGCN) in the New York State's Comprehensive Wildlife Conservation Strategy (NYS DEC 2006) have been documented on site.

In addition to the rich bird diversity, there are many other vertebrate species including: 20 or more mammal species, at least 23 species of fish, 10 reptile and 9 amphibian species. Species worthy of mention include the blue-spotted/Jefferson salamander species complex and a disjunct population of the short-headed garter snake both of which are SGCN's. A complete list of invertebrate species does not exist, but surveys for aquatic invertebrates, moths and butterflies have occurred, including 32 species of dragonflies and damselflies (Andrle and Bogacki 2004). Also, there are

records of the burrowing or devil crayfish on the preserve (*Cambarus diogenes*) which is a SGCN and known to only a few sites in New York (Gall and Jezerinac 1998). The preserve also has some species in abundances that can occasionally become a nuisance including: white-tailed deer, beaver, Canada Goose, and a non-native sometimes aggressive red ant (*Myrmica rubra*).

Landscape Context

The 264-acre (107-hectare) preserve is located within the city limits of Buffalo and is approximately three miles (4.8 kilometers) south of downtown. This gives Tift Nature Preserve the unique distinction of being one of the largest urban nature preserve in the country. The preserve is surrounded by mostly active and vacant industrial land and railroad properties with a few natural buffers. To the north, the preserve is bounded by several lines of railroad tracks which run along the banks of the Buffalo River. On the east are vacant lands owned by the bankrupt Lehigh Valley Railroad which continue east several hundred feet to railroad tracks. Along the north and east boundaries, there is also a power line corridor owned by National Grid, which also maintains a power line running directly through the preserve in a north-south direction. To the south, there are mostly undeveloped lands and a few city-owned ball fields separating the preserve from Tift Street. The preserve is situated on Lake Erie, but is separated from the waterfront by Fuhrmann Blvd. and Route 5 which run immediately along the western border.

Despite the preserve's relatively small size and isolation from other natural areas, it provides valuable wildlife habitat and is frequently highlighted as a natural asset to the region. The 75-acre (30-hectare) cattail marsh is the largest remnant wetland in Erie County and one of the largest in the Lake Erie coastal region. In addition to the Audubon Important Bird Area status mentioned above, the preserve is designated by the NYS Department of State as a Significant Coastal Fish and Wildlife Habitat with the very high rating of 84 out of 100 points (NYS DOS website). The preserve is located along a major migratory flyway and is strategically located to provide an important stop-over site for both land and water birds. The preserve is also listed as a priority conservation project by the 2006 New York State Open Space Conservation Plan (NYS DEC et al 2006) and is highlighted as a "Destination Park" in the city's park system and as part of the city's Green Infrastructure in the City of Buffalo's Comprehensive Plan (City of Buffalo).

Major Habitats At Tifft Nature Preserve

Cattail Marsh

The cattail marsh is the jewel of the preserve, with its native wetland plant community providing valuable wildlife habitat and a window to the natural environment of the past (Figure 1). Prior to settlement of the area and the development of commerce and industry, the cattail marsh was only a small piece of an extensive flood plain and wetland complex surrounding the mouth of the Buffalo River. Today, the 75-acre (30-hectare) cattail marsh is the largest section remaining of that former natural community and the largest remnant wetland in Erie County, and one of the largest in the Lake Erie coastal region. The marsh is designated and regulated as a wetland by both the federal and state government. Unlike other parts of the preserve, the cattail marsh is dominated by native vegetation that provides breeding habitat for threatened bird species like the Pied-billed Grebe and Least Bittern. Also, the endangered Black Tern has not nested there since the 1970's, but could return. The marsh also provides suitable habitat and a possible site for reintroduction of the threatened Blanding's turtle. Due to its regional ecological significance and habitats for native plants and rare animals, preservation of the marsh should be the highest priority for natural resource management at the preserve.

There has been little alteration to the marsh environment over time, but there have been habitat improvement projects in recent years. First, in 1977, dredging occurred along the southwestern perimeter creating Berm Pond, and Lisa Pond on the north side of the marsh was expanded and deepened to provide more open water habitat. In 1999, a series of channels were dredged throughout the marsh and in 2006 five shallow ponds with islands were created within the network of channels. The channels and ponds were designed to break up the solid stand of cattails and create a mix of open water and emergent vegetation that attracts a greater diversity of waterbirds. In conjunction with the dredging activity, the native wetland plants, bur-reed and buttonbush, were planted in shallow areas and on the created islands. The wetland is connected via a buried pipe and drains into Lake Kirsty during high water. There is also a pump that allows water to be pumped from Lake Kirsty into the wetland during low water levels. These structures allow for water level control which is very important for management of the marsh. Beetles (*Galerucella spp.*) were released for biological control of the invasive purple loosestrife and have successfully controlled and almost eliminated the plant from the marsh.

With the above habitat improvements and control of purple loosestrife, the marsh is in excellent ecological condition. The only major management challenge that remains is the threat posed by common reed (*Phragmites australis*). *Phragmites* is abundant on the perimeter of the marsh, but has not severely invaded the interior yet where it could choke out native plants, greatly diminish wildlife habitat, and reduce the viewing experience of visitors. Eradication on the edges may not be possible, but the plant should be aggressively prevented from dominating the marsh interior. Although the dredging activity improved habitat, the lowering of water levels to allow equipment

access and the soil disturbance from the dredging created the perfect environment for an invasive species like *Phragmites* to become established. The marsh should be monitored for new emergences of *Phragmites* and increased abundance where it already occurs. Small pockets should be eradicated before they become large and more difficult to eliminate (see Management Challenges section for more about invasive species). Water levels in the marsh should also be monitored and kept as high as possible to deter establishment and spread of *Phragmites*, and create more habitat for marsh species such as muskrats that require deeper water.

Woodlands

Woodlands is a general term used here to describe areas on the preserve where woody trees and shrubs are the dominant form of vegetation. The woodland habitats stretch from the north to the south boundary creating a central wooded corridor that expands out to include most of the northwest corner of the preserve (Figure 1). Although some of the trees are large, creating a tall canopy, these plant communities are relatively young. Photos from as late as 1951 show few trees on the preserve and no large patches of trees. Cottonwood trees dominate and other species include: black willow, aspen, green ash, tree-of-heaven, and a few planted species such as tulip tree and black walnut. The dominant cottonwoods are fast growing, but are short-lived. Dr. Howard S. Irwin, Director of the Clark Garden on Long Island, commented that “The vegetation on the preserve is in an early stage of secondary succession following decades of disturbance,” and described it as “a young flora” (Klips et al 1993). The woodlands vary from flooded wet woods adjacent to the cattail marsh to riparian strips along the stream channel to drier upland woods in the northwest corner. A shallow surface soil layer underlain with fill material prevents trees from establishing deep root systems and makes them susceptible to windfall. The shrub layer in the woodlands is dominated by non-native invasive species such as Japanese knotweed, buckthorn, honeysuckle, and tree-of-heaven (*Ailanthus altissima*). The herbaceous ground layer vegetation varies across the preserve, but is also comprised of mostly weedy species such as *Phragmites*, stinging nettle and garlic mustard.

Despite being young plant communities with many non-native species, the woodlands do provide habitat for several species of wildlife. Tifft Nature Preserve is a well known migratory stop-over site for songbirds and the woodlands provide important habitat for those resting birds. Forest songbirds still seem to use a habitat as long as the preferred vegetation structure occurs (e.g. presence of canopy and shrub layers, forest patch size, etc.) regardless of vegetation species composition. However, in an urban natural area outside of Chicago, American Robins experienced higher rates of nest predation in non-native honeysuckle and buckthorn than in comparable native shrubs (Schmidt et al 1999). This suggests that songbird habitat management should focus on maintaining the preserve as a migratory stop-over site, but not necessarily encourage birds to nest. Trees on the preserve also create perching and roosting sites for birds and nest sites for raptors and cavity-nesting birds. The woodlands also are habitat for mammalian species such as squirrels, bats, foxes, and others. Visitors to the preserve enjoy the many trails through the woodlands that create a feeling of isolation

by blocking views of the surrounding urban landscape and providing cooling shade on warm summer days.

Therefore, maintaining the woodlands should be a priority because of their wildlife and recreational values. Unfortunately, there are several threats to the long term health and persistence of the woodlands. The biggest and most pressing is the negative impacts of the large deer population on the preserve. As mentioned before, most of the tree species are fast growing but short-lived and will be reaching the limits of their lifespan in the coming decades. Without adequate tree regeneration, which is currently prevented by heavy deer browsing, there will not be a new cohort of trees to replace the dying older trees (see Management Challenges section for more on deer). The high numbers of beaver on the preserve and the extensive damage they can cause to trees is only exacerbating this situation (see Management Challenges section for more on beaver). With deer eating all the young trees and beaver felling the old trees, the preserve is on a track to lose its canopy layer of trees in the future without action to prevent this from occurring. Invasive species are also another major threat to the future of the preserve's woodlands since they can reduce the value of wildlife habitat, crowd out native vegetation, and prevent tree regeneration. However, any attempt at invasive species control followed by planting native trees and woodland vegetation will be futile without reducing the size of the deer herd first. These plantings could be securely fenced from the deer, but this greatly increases the cost and puts constraints on the size and scale of restoration plantings. The final issue concerning woodland management is the power line right-of-way that runs the length of the preserve along the central corridor of woodland habitat. National Grid periodically clears trees, shrubs, and other vegetation along the power line corridor to prevent damage to the lines and allow access for service and repairs. This clearing through the woodlands fragments the habitat and creates a disturbance that can facilitate the establishment and spread of invasive species. The power company has a legal easement with the city to maintain their power line so preventing this disturbance is not an option, but rather finding reasonable guidelines and best management practices is the only way to mitigate negative impacts (see Management Challenges section for more on power line management).

The Mounds

The area referred to as the mounds is approximately 42 acres (17 hectares) of rolling grass-covered hills in the southwest corner of the preserve (Figure 1). The topography of the area was created when almost 2 million cubic yards (1.6 million cubic meters) of mixed municipal refuse was transferred to the site from Squaw Island by the Buffalo Sewer Authority in 1973-1975. Unknown to many visitors, the mounds area is actually a reclaimed landfill site. The landfill was designed and compliant with the latest methods and standards of the time. A leachate drain system consisting of a series of collection pipes on top of an impervious layer of clay was installed under the fill to divert leachate into the city's sewer system for treatment. Also, an impervious barrier wall of sodium bentonite, an absorbent claylike material, was constructed around the fill site. The leachate collection system and the barrier wall function like a tub preventing

potentially contaminated water (i.e. leachate) from migrating into groundwater or nearby surface waters. The municipal waste was covered nightly with at least 6 inches (15 cm) of soil and finally with at least 2 feet (0.6 meters), 3 feet (0.9 meters) on side slopes, upon completion of transfer operations. Cover soil was obtained from excavations that expanded Beth Pond on the preserve. These highly organic soils were heavily compacted to prevent them from eroding and to reduce water flow into the fill beneath. The topography of the four mounds was designed to shed water from the landfill site, but slopes were set at a maximum of 4:1 so equipment can easily travel across them. After the waste was transferred and cover soil properly graded the site was revegetated. First the cover soil was fertilized with nitrogen, phosphorous, and potassium and disced to a depth of 2 inches (5 cm). Drainage swales and trenches were then covered with dense pasture sod and the rest of the area was seeded. Seed mixes contained the following species: creeping red fescue, red top, smooth brome grass, and empire bird's-foot trefoil, all of which are non-native species (Buffalo Sewer Authority 1972).

The mounds are currently covered with the pasture grasses established in the mid-1970's with small pockets of planted conifers and shrubs. Other plant species growing on the mounds include: teasel, vetch and thistles. Interestingly, non-native *Phragmites*, which usually invades wetlands, has recently become established on these uplands. The mowed hiking trails are used for walking and nature watching. The mounds are a favorite place for large numbers of deer to congregate, especially on the east side where they seek shelter from the wind. Also, bird houses, mostly in need of repair, are placed throughout the area.

The Master Plan for the preserve (Ecoplans 1975) recommended establishing an upland mesic forest with trails and overlooks on the landfill site. The trails are established and the topography creates excellent views of the preserve, downtown Buffalo, and Lake Erie, but planting an upland mesic forest was never pursued. A more appropriate current goal for this area would be the establishment of a diverse mix of native grasses and wildflowers. Native grasses and wildflowers provide attractive vegetation year round and would not obstruct the views from the tops of the mounds. Planting grasses and flowers instead of trees would also maintain the open character of the area which provides a nice contrast to the trails in the wooded areas of the preserve. Grassland plantings would also provide better habitat for grassland birds, which are declining nationwide (Sauer et al 2000), and wildflower species can be selected to attract butterflies and insect pollinators. The challenges to achieving this goal include: the large deer herd which will trample and eat planted vegetation, incompatible soil types, and shallow soil depths for establishing native grasses and wildflowers. Established grassland plantings also require periodic long-term maintenance such as invasive species control, mowing, or prescribed burning that should be considered prior to planting. (For more on this idea see Grassland Plantings in the Habitat Improvements section.) The Master Plan also labeled the mounds as a "High Intensity Use" area and until grassland plantings are well established this designation is appropriate due to the severe modification to the natural environment in the past. The area can currently provide an outdoor laboratory for manipulative

research projects and plant restoration experiments that would be inappropriate elsewhere on the preserve.

Ponds & Streams

Prior to development of the area the ponds on the preserve did not exist. As mentioned above, the entire preserve was part of a large wetland complex in the floodplain of the Buffalo River and only small shallow ponds would have occurred. The current composition of the three ponds is the result of dredging and borrow activities of the past (Figure 1). Lisa Pond, located on the northern end of the marsh, is the only pond that may have natural origins. Prior to dredging to expand and deepen Lisa Pond for improved wildlife habitat, it was a small and shallow (2 feet or less (0.6 meters)) pond with low oxygen levels that would be characteristic of open water in marshes. With its isolated location in the back corner of the preserve and connection with the wetland the pond provides good habitat for waterfowl and marsh birds that can be observed from a boardwalk and viewing blind extending from the west shore. Beth Pond is also on the northern side of the preserve just west of Lisa Pond and is the remnant of an unfilled shipping canal that was expanded in the early 1970's. The borrow operation that expanded Beth Pond was to obtain cover material used for the municipal waste transfer and landfill in the southeast corner of the preserve (i.e. the mounds). Water depths range from 4 to 20 feet (1.2 to 6 meters) and there is a steep littoral (shoreline) zone (Bonaventura 1988). During the borrow extraction, foundations from an old Lehigh Valley Railroad coal conveyor were discovered and the pond shape was modified from the specifications to work around these obstacles. The foundations were left in place to avoid dynamite blasting and they remain as an island in the center of the pond and a hump-shaped peninsula on the southwest shore. Lake Kirsty is the largest pond and is centrally located on the western border of the preserve. Its unique shape and small bays are the remnants of the shipping canals that used to connect to Lake Erie via the City Ship Canal. It is still connected to the Lake Erie via a 4-foot (1.2-meter) culvert under Fuhrmann Blvd and Route 5. In the 1970's, depths of 9 feet (2.7 meters) were recorded, but 2 to 6 feet (0.6 to 1.8 meters) depths were more common and there have been no major modifications to the pond since these measurements (Ecoplans 1975). Its location on the waterfront and the culvert connection to the lake causes water levels to vary dramatically depending on lake levels and the wind. With a strong wind off the lake from the west, the water will rise significantly in Lake Kirsty and then flow out to the lake again as the wind subsides. This rising and falling with the wind can dramatically change water levels on a daily basis which can pose challenges to shoreline plantings or restoration activities. The waters of Lake Kirsty are also connected to the marsh. When the marsh is high, it drains into the lake via a buried pipe, and a pump on the eastern shore allows water to be pumped into the marsh when it is low. During years of low lake water levels, the intake for the pump gets very close to the waterline and if water levels drop further the pump will become inoperable. To prevent such an event from occurring, water levels and fluctuations in Lake Kirsty should be monitored so actions could be taken before water levels drop below the pump intake. One possible solution would be to move the intake further out and deeper into Lake Kirsty. Another possibility might be installing a water control structure on the

Route 5 culvert that would allow water flow in from Lake Erie, but could be closed and thereby impound the water in Lake Kirsty. However, this solution would limit fish passage and could even potentially result in major fish kills in the lake. Fish kills could be caused by increasing water temperatures and reduced dissolved oxygen levels since blocking the culvert will prevent mixing of Lake Kirsty waters with fresh water from Lake Erie. Summer water temperatures and dissolved oxygen levels should be monitored for several years to establish baseline levels.

The small channel along Snakeroot trail flowing from the south into Lake Kirsty may be part of a stream that drained the area that is now southwestern Buffalo. This stream would have meandered through the preserve flowing into the Buffalo River to the north. Currently, the stream drains wetlands to the south following through a culvert under Old Tifft Street and then through a small channel into Lake Kirsty (Figure 1). Beavers repeatedly dam this culvert as well as attempt to block flow in the channel. This creates flooding on trails and in the surrounding woods and the beaver dams are actively removed and destroyed (see Management Challenges section for more on beaver).

Over twenty species of fish have been documented in the ponds at the preserve including largemouth bass, brown and rainbow trout, yellow perch, black crappie, carp, brown bullheads, bluegill, pumpkinseed, and several species of shiners and minnows. Based on previous and his own surveys, Dr. John Storr said of Lake Kirsty, “the area is probably a major spawning area for such fish as largemouth black bass” (Storr 1982). These ponds are an urban fishery and provide access to recreational fishing for Buffalo and surrounding communities. Fishing is permitted on the south and west shores of Lake Kirsty, and used to be allowed on Beth Pond as well. All fishing at the preserve is governed by all NYS DEC fishing regulations. Stocking of game fish has occurred to supplement the natural fishery. In the summer of 1979, 9,516 bullheads were released into Lake Kirsty to increase fishing opportunities for the targeted groups of younger, older and female anglers (Nashett 1979). Beth Pond was stocked with 3,450 rainbow trout yearlings in 1982 (Batcheller and Einhouse 1982) and with rainbow and brown trout in 1983. Lake Kirsty received approximately 300, mostly rainbow trout but also some brown trout, annually in 1995-1997.

Water quality testing performed in 1973 of the water in the stream entering Lake Kirsty indicated no abnormal stimulation in growth or any toxic response. Therefore, the evaluators of these data concluded that the levels are “...within the ecological ranges of tolerances for a wide variety of species typical of the Buffalo area waters” (Ecoplans 1975). During this same sampling period, low oxygen levels were recorded in Lisa pond and Lake Kirsty and high oxygen levels in Beth Pond. A decade later, Dr. Storr and his students reported low oxygen levels in Lisa pond and high levels in both Beth pond and Lake Kirsty (Storr 1982) with the highest water clarity in Beth Pond. Water pH's recorded from 1973 through 1988 range from 6.8 to 9.6 in the ponds, with most measurements around a pH of 8 (Ecoplans 1975, Storr 1982, Bonaventura 1988).

Buffers

Several adjacent parcels of property provide additional habitat for plants and animals and function as valuable buffers to the preserve (Figure 1). To the south, there are several parcels that create a barrier to noise and road pollution from Tifft Street, as well as visually blocking the busy road. The largest of these parcels is the city owned ball fields which have limited value for wildlife, but are still greenspace, and community recreation is a very compatible adjacent land use. There is also a mitigated wetland owned by NYS Department of Transportation (DOT) on the corner of Tifft Street and Fuhrmann Boulevard. Although *Phragmites* is abundant in this wetland, it still can provide wildlife habitat and a natural filter for water running off the adjacent roads. Active management of this wetland could also reduce the amount of *Phragmites* and improve the ecological function of the wetland. Between the ball fields and the wetland there are three narrow parcels. Two are owned by the Niagara Frontier Transit Authority (NFTA) and the other by an unknown owner. These thin strips are dominated by wet woods that flood during heavy rains, spring snow melt, or when beavers dam the culvert under Old Tifft Street. Extending from the southeast corner of the marsh to the north on the east side of the preserve is a large parcel of land owned by the bankrupted Lehigh Valley Railroad. This piece of property runs along the entire eastern side of the preserve from the bridge on Tifft Street on the south to the railroad tracks that wrap around the north along the Buffalo River. Between the Lehigh Valley land and the preserve are two parcels under the power lines owned by National Grid on the preserve's northern and eastern border. The lease agreement between the City of Buffalo and the Buffalo Society of Natural Sciences allows the Society to operate Tifft Nature Preserve on city land, and states that the city has a wetland easement on the National Grid property and grants use and possession within the lease agreement to the Society. Consolidated Railroad, as well as other railroad companies, own parcels not directly adjacent to the preserve to the north and east. Lehigh Valley Railroad also owns several parcels in the area north and east of the preserve which are separated by active railroad tracks.

Expanding Tifft Nature Preserve to include some or all of these buffer lands would increase the amount of habitat available to the preserve's plants and animals and would protect sensitive habitats, like the remnant marsh, from external threats such as pollution, invasive species, and development. Since the Society currently doesn't own the property of the preserve, outright purchase of these lands is an unlikely option. However, several other options exist for incorporation into the preserve including: acquisition by the city and inclusion in the lease agreement with the Society, separate easement or lease agreements between the Society and the current owners, or drafting Memorandums of Understanding (MOU's) designating access and uses between the Society and the current owners. The exact legal agreements may differ for individual parcels and owners, but should all be included under the umbrella mission and management of Tifft Nature Preserve.

The incorporation of all of these parcels would create a contiguous preserve, inclusive of the easement on National Grid's property, stretching from the railroad tracks

on the north and east to Tifft Street on the south and Furhmann Boulevard on the west. This would expand the preserve from its current size of 264 acres (107 hectares) to approximately 360 acres (145 hectares). Some of these parcels have higher ecological values and are more critical to protecting the preserve than others. For example the DOT owned wetland to the south would be an excellent addition to the preserve, while the ball fields are better left as recreation and greenspace managed by the city's Parks Department. The largest and most important property is the Lehigh Valley Railroad land to the east. This property consists of two parcels totaling 58 acres (23 hectares) that function as a critical buffer to the remnant marsh. The Lehigh Valley Railroad has been bankrupt for decades and therefore the transfer of this property into public ownership appears possible. The challenges to this happening are the potential cleanup costs associated with the property. The site was leased for dumping of foundry sand in the past and illegal dumping continues to occur. The property is designated as an Inactive Hazardous Waste Disposal Superfund site. Cleanup needs or cost estimates have not been assessed, which leaves the property in a state of limbo as a potential financial liability. Preventing future illegal dumping by restricting access and increased surveillance and enforcement of violators are also long-term challenges.

This management plan is not the first document to recognize the importance of these buffer properties to the integrity of the preserve. The Master Plan for the preserve (Ecoplans 1975) recommended acquisition of adjacent lands and specifically mentioned the Lehigh Valley Railroad property over 30 years ago. More recently, the City of Buffalo's Comprehensive Plan (City of Buffalo) highlighted properties surrounding Tifft Nature Preserve as "Non-protected" and "Potential" Green Infrastructure, which are areas that serve ecological purposes and might be added to the city's existing green infrastructure over time and include vacant residential, industrial and commercial properties. A plan currently in progress for economic and environmental revitalization of south Buffalo through the New York State Brownfields Opportunity Areas (BOA) program will likely highlight Tifft Nature Preserve as an asset to the region and recommend expanding or at least buffering the preserve with compatible land uses. Moving forward on initial discussions with current owners and assessing cleanup needs for any of the properties would be an excellent first step in achieving the long-term goal of expanding the preserve.



Figure 1 Major Habitats on the preserve and surrounding lands

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Management Challenges

Invasive Plant Species

Invasive plants, animals and diseases have the potential to dramatically change natural environments and negatively affect wildlife habitat and outdoor recreational activities. Invasive species are usually non-native species that were intentionally or accidentally released. They create problems by becoming extremely abundant, spreading to new areas, out competing native species and altering ecosystem processes. Examples of well known invasive species include: chestnut blight, zebra mussels, gypsy moths, and kudzu vine. As the world becomes more connected through global commerce and travel the potential for new invasive species continues to grow.

The negative effects of invasive species are well known and efforts to control these species are increasing. Invasive species can affect all types of ecosystems and are the second leading cause for species extinction and endangerment in the US (Pimentel 2002). The price of invasive species is not only in natural resources, but also financial with an estimated cost for non-native species in the US at over \$120 billion annually (Pimentel et al 2005). Invasive species are being addressed across the country by federal agencies like the US Fish & Wildlife Service and the National Parks Service, as well as by nearly all state agencies and conservation organizations such as The Nature Conservancy. In New York the Department of Environmental Conservation has an Invasive Species Task Force and recently created an Office of Invasive Species. Another recent effort to address invasive species in New York is the creation of regional PRISM's (Partnership for Regional Invasive Species Management). The western New York PRISM is still in the developmental stage, but should become active in the coming years.

Due to the past industrial land use and dumping at Tifft Nature Preserve and the subsequent hands-off management approach for the past 30 years, invasive species are abundant on the preserve. Invasive species on the preserve include: insects like the *Myrmica rubra* ant, plants such as Japanese knotweed and garlic mustard, and aquatic species like the round goby fish and zebra mussel. Eradication of all invasive species at Tifft Nature Preserve is not a realistic goal and even reasonable control will be a difficult and ongoing job. However, invasive plants pose one of the biggest threats to the natural resources and recreational opportunities at the preserve so control efforts need to be a top priority for land management.

Common Reed (*Phragmites australis*)

Common reed, or *Phragmites* as it is often called, is a tall perennial grass that invades coastal and inland marshes and wetlands (Kiviat 2006). *Phragmites australis* has a cosmopolitan distribution and is native to North America, but the plants that become invasive are non-native genetic variants (haplotypes). *Phragmites* haplotype M, which is closely related to European and Asian haplotypes, has become widespread across North America and native haplotypes are uncommon in wild populations

(Saltonstall 2002, Lambert and Casagrande 2006). Native *Phragmites* haplotypes are not invasive and occur as one of many plant species in wetland ecosystems. However, the non-native haplotype is very aggressive and invades many types of wetland communities where it forms a dense monotypic stand and displaces native vegetation, changes hydrology, and alters habitat for fish and wildlife. *Phragmites* flowers (“tassels”) late in the summer and produces many seeds per plant, but most are not viable and reproduction is mainly through belowground rhizomes.

At Tift Nature Preserve, *Phragmites* is abundant on the edges of the cattail marsh, and along the shores of Lake Kirsty and Beth Pond. Uncharacteristically, it even grows in upland patches on the mounds and under a canopy of trees in the woodlands west of the marsh. In the past several years, it has advanced east of both Heritage and Mosquito Junction boardwalks where it grows so tall it blocks the view of the marsh. *Phragmites* has been present at the preserve for over 30 years (Emmanuele 1980, Klips et al 1993) and “control of giant reedgrass invasions in the marsh areas” was suggested as a habitat improvement in the Master Plan for the preserve (EcoPlans 1975, page 124). Although *Phragmites* surrounds the cattail marsh, it has not severely invaded the interior of the wetland and only a few pockets and scattered individuals occur. However, the recent dredging of channels and ponds in the marsh, and the subsequent lowering of water levels to allow equipment access for the dredging, is just the type of disturbance that allows an invasive species like *Phragmites* to get established. Monitoring and management to prevent it from spreading and eradicating it where it occurs in the marsh interior should be a high priority for land management at the preserve. Tift Nature Preserve is currently part of a Habitat Improvement Project (HIP) funded by the New York Power Authority (NYPA) for control of *Phragmites* in the marsh. Environmental consultants have already visited the preserve and been in communication with the preserve ecologist and a plan for control should be completed sometime in 2009. In addition to the efforts of the HIP, below are options for controlling *Phragmites*.

- *Cutting* – Cutting the *Phragmites* with a mower, brush cutter, or hand clippers will kill the above ground plant, but not the belowground rhizomes which will resprout. Cutting by hand can have less collateral damage than broadcast herbicide application, but is very labor intensive since several cuttings a year will need to be made to reduce the population of *Phragmites*. Cutting at intervals of 8, 4 or 2 weeks had increasing success at reducing the abundance of *Phragmites* over the course of a summer, but all cutting cycles were less effective at reducing abundance the following year than one herbicide application (Deer 2008). However, cutting would be an appropriate control technique near the boardwalks where the *Phragmites* blocks the view of the marsh. Cutting can also be used effectively in combination with other techniques discussed below. Although labor intensive, cut stems should be removed to allow native wetland plants to sprout in the cleared areas and to prevent the build of large amounts of organic material in the cattail marsh, as well as for esthetic reasons.

- *Flooding* – Flooding can be used in combination with cutting. *Phragmites* stems can be cut below the water level or flooded following cutting. Cutting stems below the water level significantly reduced the population size of *Phragmites* the following year in five pools at Cape Cod National Seashore (Smith 2005). The ability to control the water level in the cattail marsh allows water levels to be lowered for cutting and then raised again to cover all cut stems with several inches of water. However, lowering water levels will affect other vegetation and wildlife in the marsh and careful monitoring should occur if cutting and flooding is used as a control technique are used.
- *Shading* – Shading is another technique that can be used in combination with cutting. After stems are cut close to the ground the treated area is covered with plastic (usually black) to prevent resprouting. This technique has the added benefit of heating the soil under the plastic to levels that will kill the rhizomes. The downside of this technique is that it is labor intensive, first to secure the plastic and then to maintain the plastic that can be damaged and torn.
- *Herbicide Application* – Controlling *Phragmites* with the use of herbicides is the most common and effective technique. Plant species diversity increased following herbicide application to freshwater nontidal wetlands in Maryland where *Phragmites* was abundant and there were no negative effects on the invertebrate community (Ailstock et al 2001). An aquatic approved formulation of the chemical glyphosate (e.g. Rodeo) is almost the only herbicide used for *Phragmites* control. Glyphosate is a nonselective herbicide and care needs to be taken to minimize damage to non-target vegetation. There are three application methods that work well for *Phragmites* and include: foliar, cut-stem, and wicking. With a foliar application, herbicide is sprayed on the leaf surface. This is the easiest application, but also has the highest risk of damage to non-target vegetation. After cutting, the hollow stems are filled with herbicide in the cut-stem application. This application is very labor intensive, but herbicide can be effectively translocated to the plant's rhizomes. The wicking application involves coating plant leaves or stems (cut or uncut) using an herbicide-soaked glove or cloth. This technique is more labor intensive than the foliar application, but less so than the cut-stem, and non-target plant damage is minimized. All individuals mixing, applying or handling herbicides need to be Certified Pesticide Applicators by the NYS DEC.
- *Biological Control* – There are currently no USDA approved biological control agents for *Phragmites*, but there is current and active research on finding suitable insects for control (Häfliger et al 2005, 2006, Lambert et al 2007).

Japanese Knotweed (*Polygonum cuspidatum* or *Fallopia japonica*)

Japanese knotweed, also called Japanese or Mexican bamboo, is one of the most aggressive and hardest to control invasive species. The plant looks like a shrub due to its large size, but it is not woody and the above ground portions die-back in the

fall and then re-grow anew each spring (up to 8 cm a day!). Japanese knotweed has invaded most of North America and has been a pest in Europe and the United Kingdom for over a century (Shaw and Seiger 2002). Once established, it forms dense monotypic stands which displace native vegetation and degrade wildlife habitat. Sugar maple seedlings experienced higher mortality in plots with dense Japanese knotweed compared to plots where it was removed or absent (Martin and Titus 2008). Plants growing in their native range reproduce by seeds, but where it is invasive it spreads exclusively through an extensive system of belowground rhizomes. It can regenerate from as little as 5 grams of root material and the rhizomes beneath a 1-m² stand can produce up to 238 new shoots (Shaw and Seiger 2002).

At Tifft Nature Preserve, Japanese knotweed is common, particularly on the southern half of the preserve, and needs to be repeatedly cut back to keep several trails open. It has been present since at least 1980 (Emmanuele 1980) and due to the length and extent of establishment, control will be challenging and expensive. A figure from the United Kingdom estimates costs to be \$1.60/m² a year for repeated herbicide application and effective control may take several years of treatments. Several control options are discussed below.

- *Hand Pulling* – This technique is almost totally ineffective for control of Japanese knotweed due to the extensive root system that readily resprouts. To be effective the entire root would need to be removed and the stems are too brittle for much of the root to be removed by pulling from above.
- *Cutting* – Where equipment can access a patch of knotweed it can be easily cut down with a mower or brush cutter. However, the root system will send up many resprouts and therefore effective control would be challenging with cutting alone. Cutting would be most effective when used in combination with herbicide application.
- *Herbicide Application* – Herbicide application is the most common technique used for control and is usually the only option for large infestations. There are several application techniques used including: cut stem-wick, cut stem-pour, stem injection, but by far foliar applications are most commonly used. Foliar applications can be made anytime before senescence of above ground tissue. However, there are trade offs between minimizing non-target plant damage by spraying when plants are small and spraying older plants with larger leaf surfaces to absorb and translocate the herbicide. Typical herbicides used for control are glyphosate (e.g. Roundup, Accord), triclopyr (e.g. Garlon) and 2,4-D, with glyphosate most commonly used. Care needs to be taken to minimize damage to non-target vegetation since these are all nonselective herbicides and all individuals mixing, applying or handling herbicides need to be Certified Pesticide Applicators by the NYS DEC.

- *Biological Control* – There are currently no USDA approved biological control agents for Japanese knotweed and research on this topic is being considered but has not begun (Shaw and Seiger 2002).

Garlic Mustard (*Alliaria petiolata*)

Garlic mustard is a biennial European plant that is rapidly invading forests and woodlands in eastern North America. Garlic mustard colonizes disturbed areas, but unlike most other invasive species, it has the ability to invade intact forest communities (Blossey et al 2005). The plant can form large near-monotypic stands that blanket the forest floor and lead to the decline of native understory vegetation. Recent research has suggested that garlic mustard suppresses the growth of native tree seedlings through antifungal phytochemistry (Stinson et al 2006) and limits tree regeneration by suppressing arbuscular mycorrhizal fungi (Matin and Titus 2008). Like all mustards, garlic mustard produces many tiny seeds that are dispersed on the fur of animals, flowing water, movement of dirt for fill or landscaping, and even on hiker's boots. These seeds can remain viable in the soil for up to ten years.

At Tifft Nature Preserve, garlic mustard is abundant in the woodlands and has been present since the early 1980's when Klips et al (1993) described it as widespread with a few dense colonies occurring. There have been no major efforts to control the plant and after flowering and setting seed for three decades the seed bank will be large and take up to ten years to exhaust. Despite the challenge of controlling garlic mustard, efforts should be made due to the negative effects the plant has on tree seedlings and the importance of improving tree regeneration on the preserve. Since the plant is a biennial and only sets seed in its second year, control efforts should target these seed producing plants. Several control options are discussed below.

- *Hand Pulling* – Hand pulling the plant is convenient since it requires no equipment and volunteers can be trained in minutes. Second year plants can be pulled early in the spring and into the summer, as long as they are pulled before the seed pods open. Efforts to pull the entire S-shaped root should be made since a broken off root will continue to grow. Pulled plants need to be bagged and discarded in the trash (do not compost) since the seeds will continue to develop. Although hand pulling works well for small infestations or around sensitive vegetation where herbicides would be inappropriate, hand pulling alone will not control garlic mustard on the preserve.
- *Herbicide Application* – Herbicides are commonly used to control garlic mustard since the extent of invasion often leaves no other option. Foliar applications of glyphosate (e.g. Roundup) or 2,4-D will kill the plant, but care needs to be taken since these are nonselective herbicides and other vegetation will be affected. However, garlic mustard greens up early in the spring when most native vegetation is still dormant and application at this time of year will reduce damage to non-target plants. All individuals mixing, applying or handling herbicides need to be Certified Pesticide Applicators by the NYS DEC.

- *Weed Torch* – Recently weed torches are being used for invasive species control and can be as effective as herbicides without the chemical side effects. A weed torch has a wand connected to a portable propane tank and produces a high temperature flame. The tongue of fire can be directed at unwanted plants. Care must be taken to minimize damage to non-target vegetation. Early spring is a good time for using a weed torch on garlic mustard since it is often the only non-dormant green vegetation, and the woods are usually wet from snow melt so fire danger is low. A permit from the fire department, law enforcement or conservation agency may be required to operate a weed torch.
- *Biological Control* – There are currently no USDA approved biological control agents for garlic mustard, but research is under way (Skinner 2005). However, wide spread release of a control agent is probably years away.

Woody Species (Buckthorns, Honeysuckles, Tree-of-Heaven)

The main woody invasive species at Tifft Nature Preserve include common buckthorn (*Rhamnus cathartica*), glossy buckthorn (*Rhamnus frangula*), honeysuckles (*Lonicera spp.*) and tree-of-heaven (*Ailanthus altissima*). Buckthorns are from Europe and the common buckthorn invades sites with drier soils and glossy buckthorn prefers wetter soils, but they grow side-by-side in some areas of the preserve. The buckthorns produce dark purple or black berries that are cathartics (laxatives) that are readily spread by wildlife but provide little nutritional value. Honeysuckles are Asian shrubs that were planted in decades past as a wildlife food and cover species. Although honeysuckles do have some value for wildlife, due to their invasive qualities they are no longer recommended to improve wildlife habitat and dense stands of honeysuckle are actually poor habitat for many species. The tree-of-heaven is an Asian tree that was originally planted in North America since it required little irrigation, created a shady canopy quickly, and was tolerant of poor soils and air pollution. However, these same characteristics make it an invasive species and very difficult to control. These species are dramatically altering forest ecosystems by displacement and competitive exclusion of native species (Webster et al 2007) and higher nest predation rates have been observed in buckthorn and honeysuckle compared to native shrubs (Schmidt and Whelan 1999).

All of these species are common at Tifft Nature Preserve and despite any species differences, control techniques are similar and they will be grouped as woody invasive species from here on. Several techniques are discussed below for control of these species, but it should be noted that for such hardy invasives, like buckthorn or tree-of-heaven, several techniques in combination will likely be needed for effective control. Using multiple control methods is part of Intensive Vegetative Management (IVM) which combines several control techniques along with restoration practices, such as planting native vegetation, to produce the desired vegetative condition (Lowe et al 2007).

- *Pulling* – Small plants and seedlings can be hand pulled, but this can be a very laborious job. Shrubs and small trees can be pulled using a weed wrench, but this is a heavy piece of equipment to carry around and can be challenging to use. Pulling can be used as a follow-up treatment after cutting or herbicide application, but it will not be possible to effectively control woody invasive species on the preserve with this technique alone.
- *Cutting* – Shrubs and trees can be cut down with a chainsaw or brush cutter (weed whip with a metal cutting blade). It is best to cut shrubs and trees as close to the ground as possible to minimize the above ground stump. It should be noted that all of these species will resprout and cutting is not a one time control technique. Cutting these species without then applying herbicide can actually make the job of control more challenging since there will be many small resprouts to treat.
- *Herbicide Application* – There are several ways that herbicide can be applied to woody species and these include: foliar, basal bark, frill and cut-stump applications. Foliar applications are only recommended for treating small plants and resprouts close to the ground where damage to non-target vegetation could be minimized. Basal bark and frill applications do not require cutting down the shrub or tree. During a basal bark application, herbicide is applied to the bark around the entire circumference of the stump creating a collar about 6 to 12 inches (15 to 30 cm) wide at the base of the tree. The herbicide will soak through the bark and kill the plant in weeks to months. The frill technique is an application of herbicide into a girdle cut with a hatchet or chainsaw around the trunk. One of the most effective techniques that has the added benefit of immediately removing the invasive species is the cut-stump application. With this technique, herbicide is applied to the stump of a shrub or tree soon after cut, making a point to cover the entire outer ring of the stump where the plant's vascular tissue is located. This technique works best with at least two people, one to cut and one to apply the herbicide, and is very labor intensive since the cut shrubs and trees will need to be removed or piled. Common herbicides used for woody invasive species are glyphosate (e.g. Roundup, Accord) and triclopyr (e.g. Garlon 4). Different adjuvants (e.g. wetting agents, dyes) may need to be added to the herbicide depending on the application technique. Always read the product label to make sure the chemical is registered for treating a particular species. All individuals mixing, applying or handling herbicides need to be Certified Pesticide Applicators by the NYS DEC.
- *Biological Control* - There are currently no USDA approved biological control agents for any of these woody invasive species, but research is under way on Buckthorn (Skinner 2005). However, widespread release of a control agent is probably years away.

Herbaceous Species

There are many non-native herbaceous plant species that grow at Tifft Nature Preserve. At the end of an extensive plant survey on the preserve in the 1980's, 43% of the plant species were non-native, mostly from Europe and Asia (Klips et al 1993). In many areas of the preserve, the invasive herbaceous species dominate the ground layer of vegetation. These species include: stinging nettle (*Urtica dioica*), Canada thistle (*Cirsium arvense*), burdock (*Arctium minus*), mugwort (*Artemisia vulgaris*) and swallowwort (*Cynanchum spp.*), among many others. Many of these non-native species are uncommon and not invasive, but species such as Canada thistle and swallowwort are very aggressive, and stinging nettle and any thistle species limit access to areas for education or recreation. Although these species may not have the same chemical effects on tree seedlings as garlic mustard, dense stands of non-native herbaceous plants shade out young trees and native vegetation. In combination with controlling Japanese knotweed, garlic mustard, and woody invasive species, an effort to reduce the abundance of herbaceous invasive species should be made to improve tree regeneration, wildlife habitat, and the esthetics of the preserve. Many of the techniques used to control other invasive species such as hand pulling, herbicide application, and a weed torch can be used on most herbaceous invasive species. Due to the extent of herbaceous invasive species at Tifft Nature Preserve, hand pulling alone is unlikely to control these species and the use of herbicides will be needed. Always read the product label on herbicides to make sure the chemical is approved for use on a particular species and use care when applying nonspecific herbicides such as glyphosate (e.g. Roundup) or 2,4-D. All individuals mixing, applying or handling herbicides need to be Certified Pesticide Applicators by the NYS DEC.

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is a perennial European plant with large attractive spikes of pink or purple flowers that aggressively invades wetlands in North America. Once established in marshes, wet meadows and along the shores of lakes and rivers, the plant forms dense stands that choke out native vegetation and degrade fish and wildlife habitat. Purple loosestrife is estimated to affect almost half a million acres (200,000 hectares) of wetlands a year creating millions of dollars in economic impact. At Tifft Nature Preserve, purple loosestrife is present but uncommon in the cattail marsh. It was more abundant in the past, but the introduction of *Galerucella* beetles (*G. calmariensis*, *G. pusilla* [Chrysomelidae]) as biological control agents effectively controlled the invader and reduced its abundance. The *Galerucella* beetles feed on the leaves of the plant, particularly the developing leaf buds, which can damage and kill the plant (Wilson et al 2004). The beetles were released at the preserve a few years ago and purple loosestrife is now uncommon in the cattail marsh. Even though the beetles have effectively controlled the plant, the marsh should be monitored for reinvasion and the need for additional releases of biological control agents.

White-tailed Deer

The white-tailed deer is one of the major wildlife attractions at the preserve, but also one of the biggest management challenges. The recovery of white-tailed deer populations across the continent from unregulated hunting and habitat loss in the past is a conservation success story, but now many communities are dealing with the reverse problem of too many deer. Deer populations in some rural, urban and especially suburban environments have expanded beyond both natural and cultural carrying capacities and are damaging natural areas and creating negative human-deer interactions. Negative impacts to the natural environment include a decrease in forest vegetation diversity (Ness 2003, Waller and Alverson 1997), reduced or absent tree regeneration (Ness 2003), and changes to bird communities due to changes in forest vegetation composition and structure (McShea and Rappole 2000). Undesirable human-deer interactions can include deer-vehicle collisions, damage to gardens and ornamental plants, and a potential increase in human disease occurrences such as Lyme disease. An overpopulation of deer harms the herd itself because animals in high density environments can be malnourished, nutritionally stressed, and susceptible to disease. The causes of these deer population increases vary by location, but are usually a combination of the following factors: 1) reforestation of formerly cleared land creating a highly fragmented habitat of woods and open areas (including grasslands, farm fields, lawns and parks), 2) lack of predators (both natural predators and humans where hunting is prohibited), and 3) supplemental food sources (both through deliberate feeding and unintentionally on agricultural crops or ornamental plants). An increasing frequency of mild winters in some areas also contributes to deer population growth since the herd is not naturally controlled through winter die-offs.

The size of the deer population at Tifft Nature Preserve is well above natural deer densities for the region and the impact on the preserve's vegetation, especially woody trees and shrubs, is apparent. Exact data on deer densities at the preserve is being collected, but observations of 30 or more deer at a time are not uncommon. The following table (Table 1) lists research studies throughout the northeast where deer densities were at levels where negative impacts were being observed. When examining the deer densities, keep in mind that the entire 264-acre preserve is approximately 1.1 km².

Table 1 – Deer Densities in the Northeast, USA

| Estimated Deer Density | Location | Desired Deer Density | Source |
|--------------------------|--|----------------------|-----------------------|
| 11 – 28/km ² | Central Massachusetts | 4/km ² | McDonald et al 2007 |
| 12 – 20/km ² | Central Appalachian Mts., West Virginia | | Campbell et al 2005 |
| 35/km ² | Smithsonian Conservation & Research Center, Maryland | | McShea & Rappole 1997 |
| 47 – 51/km ² | Bluff Point Coastal Reserve, Connecticut | 8/km ² | Kilpatrick et al 1997 |
| 4 – 35/km ² | Cuyahoga National Recreation Area, Ohio | | Shafer-Nolan 1997 |
| 35 – 136/km ² | Gettysburg National Park, Pennsylvania | 10/km ² | Frost et al 1997 |

The carrying capacity of an area is a function of the area's habitat for a particular species, and natural deer densities for western New York are in the range of 18 – 25 deer per mile² (7 – 10 per km²) (T. Spierto, *personal communication*). None of the desired densities in Table 1, or natural deer densities for the region, may be appropriate population goals for Tifft Nature Preserve, but densities on the preserve are easily in the range where negative impacts have been documented and could be many times higher than the natural carrying capacity.

To maintain the long-term integrity of the preserve's vegetation and wildlife populations, including white-tailed deer, it would be desirable to substantially reduce the size of the deer population. It is not possible to set an exact deer population level or density goal at this time since current deer densities are not known, nor have the negative impacts been quantitatively measured on the preserve. Managing a deer population on a natural area, like Tifft Nature Preserve, is challenging since the deer move on and off the site. The land uses and practices of surrounding properties can also impact the population. An example of offsite activities affecting deer occurs on the railroad tracks to the north of the preserve. These tracks lead to General Mills where deer frequently congregate and are seen eating spilled grain on the tracks. It is well known that the most successful deer population management, both to increase or decrease the population size, occurs across a region rather than in isolation at a particular site.

Since high deer densities and the associated negative natural and human consequences are so common, the NYS DEC produced a very informative publication

entitled *A Citizen's Guide to the Management of White-tailed Deer in Urban and Suburban New York* (NYS DEC 2007) to assist individuals and communities in dealing with their deer populations. Each of the potential options presented in this guide will be outlined below, as well as their applicability to Tift Nature Preserve.

No Population Control Options

Hands-off Approach – This means that no effort is taken to control deer numbers and is often the default strategy taken by landowners and communities, including Tift Nature Preserve. This approach has no costs for implementation, but does not address the negative impacts associated with high deer densities which are occurring on the preserve.

Fencing – Physically excluding deer from areas through fencing has proven effective, but requires sufficient fencing (at least 7 feet high (2.1 meters)) and can be expensive for installation and maintenance. Costs can range from \$200 to \$600 an acre or higher. With an area of 264 acres (107 hectares), fencing the entire preserve would be cost prohibitive and would reduce the connectivity of the preserve to the surrounding habitats by limiting the dispersal of other wildlife species. However, fencing portions of the preserve such as sensitive areas, restoration plantings, and research plots is a very viable option.

Repellents and Frightening Devices – Chemical repellents and frightening devices can work in small areas over short time periods, but lose effectiveness at higher deer densities and as the animals become accustomed to the disturbance. Due to the chronic high numbers of deer and the size of the preserve, limited control is expected from applying repellents or installing devices such as noise makers or scarecrows.

Alternative Plantings – Selecting ornamental plant species that are less attractive to deer can resolve some problems, but replanting large portions of the preserve to species undesirable to deer is not a reasonable alternative. However, selecting plant species that are less desirable to deer should be considered for any vegetation restoration project.

Diversion Planting and Feeding – Food plots are a proven way to attract deer, but have not shown the same success at diverting deer from other areas. Feeding is also a proven way to improve the condition of the deer herd, but again does not reduce the impact to other food resources. Also, food plots and supplemental feeding do nothing to address the high deer densities and could actually increase deer numbers. Furthermore, direct feeding of deer was prohibited in 2002 due to concerns over the potential spread of Chronic Wasting Disease.

Population Control Options

Habitat Alteration – This non-lethal approach is similar to Alternative Plantings addressed above, but applied over a broad area. To be effective this approach might

require the alteration or removal of most of the vegetation over large areas and would dramatically change the landscape at the preserve. Therefore, this approach would not be conducive to habitat for other species or public enjoyment of the preserve.

Capture and Relocation – Another non-lethal approach is where animals are captured and released to another area. In addition to the cost and logistical challenges of this approach, it is not really an option since a DEC permit is required to capture and relocate deer. Due to concerns about disease, current laws preclude issuing such permits.

Fertility Control – Effective techniques and chemical agents that inhibit reproduction in deer exist, but a practical system to treat wild deer in sufficient numbers to effect population change is not yet available. A major challenge is finding a logistically feasible and cost-effective technique to treat a large portion of the deer population (75% or more if females are the target and higher percentages for males). Also, current non-surgical contraceptives require annual treatments and a fertility control program will take several years of application until deer numbers begin to decline. Currently, the USDA has not approved any contraceptives for non-research based applications. It is possible that Tifft Nature Preserve could become a site for deer contraceptive research, but this would require substantial funding and resources. There are also no similar research programs in the region for expert consultation or where collaborations could be developed.

Predator, Parasite, or Disease Introduction – This method is analogous to releasing known insect predators of invasive plants for biological control of the species. Lack of natural predators is one reason for increasing deer populations, but the introduction of bears, wolves, or cougars into a preserve within the city limits of Buffalo is not an option for obvious reasons. Releasing known parasites or diseases is also not a possibility due to the risks of disease transmission to other wildlife or domestic species, confining the pathogen, retrieval and disposal of carcasses, and sanitizing treated areas.

Poison – Deer numbers could be reduced by this method similar to poisoning of insect or rodent pests. However, no toxins, poisons or lethal baits are registered for this use or are specific to deer. This would also pose potential risks to other wildlife and humans. Also, there may be exposure to non-target animals and humans through consuming or scavenging the meat of poisoned deer so recovery and disposal of carcasses would need to be included in this approach.

Capture and Kill – This method requires capturing deer using equipment such as drop nets, rocket nets, corral traps, box traps, and remote chemical immobilization using dart syringes, and then dispatching the deer in a humane fashion (e.g. lethal injection, bolting). The capture and kill approach may be appropriate for Tifft Nature Preserve due to the obstacles of hunting within the city limits such as discharging firearms (Charter and Code of the City of Buffalo, Chapter 180, Article I, § 180-1), but is much more costly than the three remaining control techniques.

Bait and Shoot – This technique involves baiting deer to strategic locations where an experienced shooter can safely kill the deer. Bait and shoot operations are appropriate in suburban and urban areas where there is little undeveloped land for traditional hunting. There are currently active bait and shoot programs in several communities surrounding Buffalo (T. Spierto, *personal communication*). This includes Cheektowaga where deer are being controlled this way in Stiglmeier Park adjacent to Dr. Victor Reinstein Woods Nature Preserve, which is also experiencing negative effects from high deer densities (NYS DEC 2006b). Due to regulations in the City of Buffalo (Charter and Code of the City of Buffalo, Chapter 180, Article I, § 180-1), only law enforcement, peace officers, or military personnel are permitted to discharge firearms in the city and would need to perform the shooting of deer on the preserve. For convenience and effectiveness, firearms are used instead of longbows, but an archery based bait and shoot program is a possibility for the preserve. Donation of the venison and hides to charitable organizations from bait and shoot programs is a wise use of the animals which need to be recovered anyway and can help with public acceptance of the program. Due to extensive dumping and the removal of chemical contaminants in the past, venison should be tested for health risks prior to consumption.

Traditional Hunting – This is standard hunting by licensed sportsmen and women using legal firearms or longbows and hunting seasons which are set by NYS Environmental Conservation Law or NYS DEC Regulations. The city of Buffalo is within Deer Management Zone 9c which is “closed” to hunting. The urban location, public use of the preserve, and safety concerns preclude the possibility of a traditional hunt on the preserve.

Controlled Hunt – This method uses traditional hunting techniques, but in a highly regulated fashion to account for local constraints and to achieve specific population goals. Controlled hunts can be tailored to meet a variety of local conditions and can include several restrictions such as marksmanship requirements, restrictions on who may hunt, a lottery system for permits, hunting methods (e.g. firearms, archery, etc.), hunting times and locations, and the sex, age and number of deer to be taken. The tight level of control this method allows makes it a viable option for reducing deer populations at an urban nature preserve.

Strategy for Deer Management at Tifft Nature Preserve

Although several techniques for deer population control exist, there are few viable options for the preserve due to local constraints or the feasibility of achieving a substantial reduction in the deer population. Therefore, no active population control techniques are recommended at this time. However, this does not mean the preserve should not move forward on deer management. Several steps could be initiated so that effective deer population control can be achieved in the future.

1. *Research* – Collect data to estimate deer densities on the preserve through the use of deer track and pellet surveys, wildlife cameras, and visual counts along established transects. A mark-recapture study could also be conducted to

produce more accurate estimates of deer numbers as well as data on mortality and reproduction. A radio-telemetry study with radio-collared deer would provide information on home range size and movement patterns.

2. *Fencing* – Although fencing the entire preserve, or even large sections of it, is not a realistic option, deer exclosures could be constructed at relatively low cost. Exclosures can achieve several benefits for research, education, and restoration. Control-treatment experiments to quantify the impacts on vegetation from high deer densities could be performed, students and the public could see first hand the response of vegetation when deer are excluded, and any native plantings for restoration on the preserve will need deer fenced out for successful establishment of vegetation. The size of exclosures could range from small plots (1 m²) to much larger areas (1-ha or larger) depending on uses and goals of the exclosure.
3. *Education* – Public understanding of deer impacts and acceptance of population control measures are essential for effective deer management. Involvement of students, volunteers, and citizen scientists in the research and construction of the deer exclosures mentioned above will benefit both management of the preserve and also fulfill its educational mission. Also, interpretive signs accompanying the deer exclosures, displays in the visitor center, and informative content on deer issues and management added to publications and education programs will help reach a larger audience.
4. *Collaboration on Implementing Population Control* – The three points listed above are positive steps to achieving effective deer management, but none of them help to reduce the deer population. After examining the deer population control techniques addressed above in *A Citizen's Guide to the Management of White-tailed Deer in Urban and Suburban New York* (NYS DEC 2007), the DEC recommends in preferential order the following methods: traditional hunting, controlled hunting, bait and shoot or capture and kill programs. As stated above, a controlled hunt or a bait and shoot program are the most feasible options to pursue at the preserve. Regular communication with DEC biologists will be required to develop either of these options into a program that is actually implemented to control the deer population on the preserve. Also, the preserve is owned by the City of Buffalo as a park, which is overseen by the Erie County Parks system, and involvement in planning and implementation of any population control option will involve their input and approval.

Beaver

Just like white-tailed deer, North American beaver populations have rebounded from nearly being extirpated in New York State in the early 1800's to current levels that can sometimes create human-wildlife conflicts. After regulation and habitat improvements prevented the threat of losing the beaver in the state, long trapping seasons kept populations at low levels until the 1980's. Due to the many ecological

benefits and the habitat for other wildlife species that beaver impoundments create, higher population goals were established and beaver numbers grew over the past decades. In 1993, the DEC estimated there were about 17,500 active beaver colonies in the state which exceeded the population goal by 25%. Currently, many state wildlife management units are at or above their beaver management objectives and the property damage from beavers is in the millions of dollars annually. At Tifft Nature Preserve, beavers plug the culvert under Old Tifft Street and build dams in the small stream flowing into Lake Kirsty. Beavers also create problems throughout the preserve by felling or chewing on trees, including some rather large cottonwood trees. The impact to the preserve's trees is a particularly important long term issue to address since there is little recruitment of young trees due to heavy browsing by the large deer herd.

The exact size of the beaver population on the preserve is unknown, but signs of beavers are widespread. There is evidence of beaver activity around Beth Pond, the cattail marsh, and in the stream flowing into Lake Kirsty. A beaver family may reside in each of these areas for a maximum of three beaver colonies on the preserve. In Canada, the density of beaver colonies ranges from 0.33/km² in a population where trapping occurred to a high of 3.51/km² where "nuisance beavers" were present, with an average of 1.0-1.2/km² (Müller-Schwarze and Sun 2003). The preserve is 1.1 km², which would allow only one colony of beavers on the preserve to remain with natural population levels. The average colony in western New York is four beavers, but can reach as high as ten. A colony or family consists of two adults, two young of the year (on average), and occasionally two or more yearlings which tend to remain with the family when population densities are high and there are no vacant territories to disperse into (Müller-Schwarze and Sun 2003). Assuming all three areas with beaver activity each contain one colony, a population of between 12 and 30 beavers is a rough estimate for the preserve.

Options for Preventing Beaver Damage

Beaver damage is common throughout the state and the NYS DEC has developed a Nuisance Beaver Control Techniques Manual (<http://www.dec.ny.gov/animals/6992.html>) to assist landowners in minimizing damage and conflicts. Potential options presented in this manual will be outlined with their applicability at Tifft Nature Preserve addressed. The beaver is a protected furbearer species and therefore all control of nuisance beaver or disturbance to their den or dam requires a permit under Article 11 of the New York State Environmental Conservation Law.

Protecting Trees and Shrubs – Individual trees and shrubs can be protected by loosely wrapping to a minimum height of 3 feet (1 meter) with welded wire fencing, chicken wire, or roofing felt loose enough to allow for growth. Fencing may still leave some trees vulnerable to damage if beavers are active during deep snow. Fencing must be installed before serious damage to a tree occurs since a tree that is girdled (gnawed all the way around), but not felled, will still die. Many trees on the preserve have already been wrapped with chicken wire and successfully protected from damage.

Another option for individual trees is painting the base of trees with foul tasting repellents or paints containing abrasive particles to prevent gnawing by the beavers. However, fencing may be aesthetically more appealing at the preserve than painted trees.

Habitat Alteration – Beaver can be discouraged from staying or colonizing an area if suitable habitat and food is not available. This approach requires dramatic alteration of the landscape by removing culverts and diverting water flows or felling trees to eliminate preferred food sources such as willow, aspen, and cottonwood. Such changes to the landscape or vegetation are not viable options for a nature preserve.

Fencing – Beaver can be physically excluded from areas with fencing at least 3 feet (1 meter) in height and buried 3 to 4 inches (7.6 to 10.1 cm) into the ground. This technique works best to protect trees or shrubs in small areas and would be logistically, economically, and aesthetically challenging to implement on a large scale on the preserve, but could be used to protect small areas of valuable trees.

Repellents, Toxicants and Fumigants – Repellents repel animals with strong odors and are commercially available and a variety of home remedies exist. The effectiveness of repellents diminishes over time and they need to be reapplied, and the strong odors limit their use in areas frequented by people. Toxicants and fumigants have more lethal effects than deterrence and no effective beaver specific products are available at this time.

Culvert Protection – Preventing beaver from blocking culverts is one of the most common issues to deal with in beaver management and Tifft Nature Preserve is no exception. Most techniques involve the installation of a guard, grate, or grill over the entrance of the culvert. A common type of device is referred to as a pitchfork guard and is made of heavy steel rods, welded 6 inches (15 cm) apart onto horizontal braces and secured to the end of the culvert. The strategy is to prevent the beaver from getting inside the culvert and plugging it up, however, beaver can still block water flow by packing branches and material directly on the guard. Another technique is to build a D-shaped fence in the water away from the end of the culvert preventing the beaver from blocking water flow. Several designs exist for these fences with clever names such as the “beaver deceiver” and the “beaver baffler”, but are usually most effective when used in conjunction with a Water Level Control Device.

Water Level Control Device (WLCD) – There are several designs for WLCD's, but most consist of a pipe that is protected from being blocked by beavers and is installed through a culvert, dam, or berm so that at least some water flow can always occur regardless of beaver activity (Figure 2). This structure allows beaver to impound water, but minimizes the chance of flooding after heavy rains.

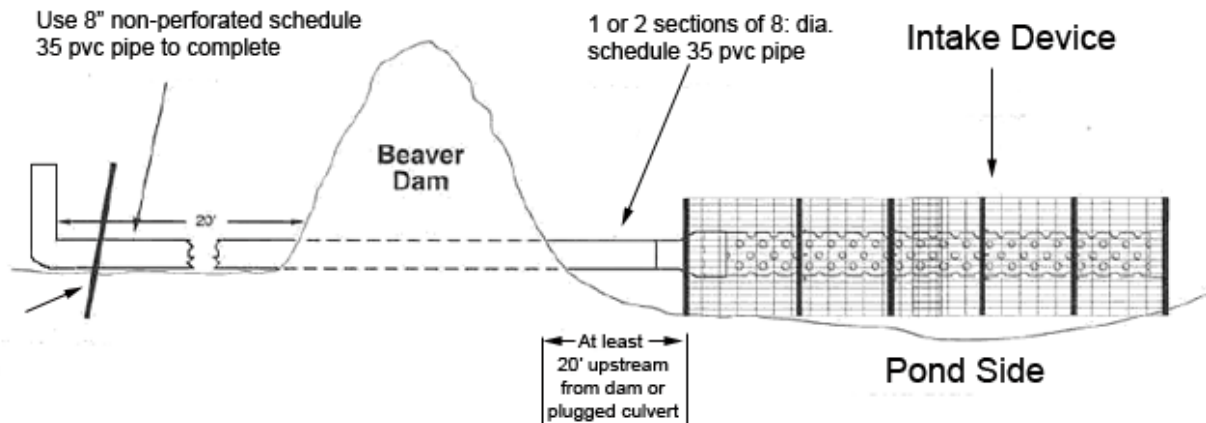


Figure 2 – Clemson Beaver Pond Leveler (an example of a WLCD)

Removal of Dams and Lodges – Destruction of a beaver's dam or lodge is a temporary inconvenience for the beaver, but rarely discourages the animal from rebuilding. Within days new dams can be constructed and no progress will be made on eliminating the original problem the beaver was causing. However, with vigilante monitoring (almost daily) a dam can be repeatedly destroyed before it becomes too large to easily break apart. As mentioned before, disturbing a beaver dam or lodge requires a permit from the NYS DEC.

Beaver Removal – This method includes both relocating animals and lethal trapping or shooting. The NYS DEC will not authorize relocation of problem beaver except under extraordinary circumstances and then only after there has been careful consideration of all other options. There is an open season for trapping beavers, but problem beaver may be trapped during the closed season with a permit. Legal methods for trapping beaver include foot-hold and bolt-gripping traps. Shooting nuisance beaver is also a legal option with a permit, but city regulations about firearms prevent this from being considered at the preserve.

Strategy for Beaver Management at Tifft Nature Preserve

Unlike white-tailed deer, the challenges created by beaver on the preserve are much less severe and there are more viable options to address these issues. The following steps can be taken leading to effective beaver management on the preserve.

1. **Protecting Trees** – To maintain the wildlife habitat created by willows, cottonwoods, and aspen as well as the natural character of the preserve, protection of trees by wrapping them with chicken wire should continue. This will require maintenance and repair of existing wire on trees and also wrapping more trees. Since beavers are active from the north to the south end, trees throughout the preserve should be wrapped starting with areas of highest beaver activity.
2. **Culvert Protection and Water Level Control Device Installation** – The only area on the preserve where beavers are creating a problem by impounding water is by blocking the culvert under Old Tifft Street. A WLCD could be placed through the

culvert and protective fencing installed on the upstream side to further prevent blockage by beavers.

3. *Dam Removal* – Beavers also build dams in the channel downstream from the culvert. To prevent flooding of the woods and trails upstream of the dam and to continue the inflow of water to Lake Kirsty, beaver dams in the channel could be destroyed.
4. *Research* – Determining beaver population numbers on the preserve would be useful information for current management and in determining if population levels should be reduced through beaver removal. Population estimates may be possible from a non-invasive observation or more accurately with a mark-recapture study. Accurate population estimates and documentation of beaver damage may be required to obtain permits for removing nuisance beaver. Nuisance beavers would mostly likely be removed by trapping and dispatching animals.

Canada Geese

Tifft Nature Preserve is known for its birds and that includes Canada Geese. A century ago, New York did not have a nesting goose population and geese seen in the state were only stopping to feed and rest during their migration. However, in the past decades the resident goose population has grown steadily due to better habitat (water impoundments, farm fields, city parks, and golf courses), milder winters, and few predators in urban environments (Conover and Chasko 1985). The current year-round population in the state is estimated at 200,000 geese (NYS DEC 2007b). Unfortunately, large numbers of Canada Geese can degrade the environmental quality and public enjoyment of places where the birds congregate and impacts are most severe in suburban and urban areas. Human-geese conflicts include: damage to turf by grazing and trampling, accumulation of fecal deposits which can be unsightly and unsanitary, water quality degradation, excessive noise from vocalizations, and attacks by aggressive and territorial geese (Conover and Chasko 1985, Smith et al 1999). The NYS DEC is attempting to cut the size of the state's population in half by expanding hunting opportunities and designing hunts that specifically target urban geese populations (Bonfatti 2008). Tifft Nature Preserve has a large resident population of Canada Geese and experiences several of the common human-geese conflicts.

Options for Controlling Nuisance Canada Geese

Since problems from a large Canada Geese population are so common-place the NYS DEC produced an informational guide on options for dealing with nuisance geese (NYS DEC 2007b). As with white-tailed deer and beaver, the most successful control plans usually implement a variety of strategies simultaneously, require multi-year commitments, and work best at a regional rather than local scale. Below several options are discussed and their potential at Tifft Nature Preserve evaluated.

Discontinue Feeding – Feeding can cause large numbers of geese to congregate, teaches geese to be unafraid of people, and often provides an unhealthy diet that increases their vulnerability to disease. Supplement of feeding is not an issue since the preserve already does not allow feeding of wildlife and posts this rule on entrance signs and trail maps.

Allow Hunting – Canada Geese are popular game birds and hunting can not only reduce the population size, but discourage birds from congregating in heavily hunted areas. However, the urban location and city regulations about discharging firearms prevent this option from being considered at the preserve.

Modify Habitat – Geese are grazing birds that prefer short, green grass or other herbaceous vegetation for feeding. Unlike city parks and golf courses, there are few areas on the preserve that are mowed grass, such as the picnic area around the visitor center and the trails, and stopping the mowing of these areas would greatly reduce public use and enjoyment. The cattail marsh provides excellent nesting habitat for geese, but also for many other bird species, so modification of the marsh should not be considered.

Install Grid Wires – A series of monofilament wires can be installed to create a grid over water bodies that prevents geese from landing and taking off. Installing this wire grid would be laborious and expensive and would interfere with fishing on Lake Kirsty. It would also prevent other waterfowl from using the ponds and aesthetically would not enhance a nature preserve.

Install Fencing – Solidly constructed fencing at least 3 feet (1 meter) tall or dense shrubs can be planted around water bodies to limit shoreline access by geese. To be effective the fencing or plantings must surround the entire water body and be well maintained. Such extensive fencing or planting to surround the ponds on the preserve would be very expensive to install and maintain. Also, limiting shoreline access would decrease the wildlife value of the ponds for other wildlife species on the preserve.

Visual Scaring Devices – Reflective Mylar tape, flagging or balloons tied along strings or to poles can deter geese from using an area. However, extensive grid networks of string would prevent people from accessing the area as well and could easily be damaged by deer. This method works well for temporarily keeping geese out of an area such as a native vegetation planting and can then be removed once the planting is well established.

Noisemakers – Shell crackers, screamer sirens, bird-bangers, and whistle bombs can be used to produce loud noises that startle geese and discourage them from congregating in an area. However, geese can quickly, with one to two weeks, become acclimated to these disturbances and periodic loud bangs or whaling sirens would greatly diminish visitors' experience of the preserve.

Goose Repellents – The US EPA and NYS DEC have approved the use of the product ReJeXiT® as a goose repellent on lawns. The active ingredient is a human-safe food flavoring derived from grapes that the geese find distasteful. It costs about \$125 per acre (\$50 per hectare) per application and several applications per year are usually necessary. Application of this product could be considered on the preserve, but a permit is needed for application within 100 feet (30.5 meters) of a regulated wetland, such as the cattail marsh.

Using Dogs to Scare Geese – The use of trained dogs to chase and scare geese is a proven technique to prevent geese from congregating. One study conducted in western New York found border collies to be the most effective method when compared to other common hazing techniques (Holevinski et al 2007). However, dogs require supervision from a trained handler and would not be compatible with the preserve's no pets allowed policy.

Control Goose Nesting – Although it is difficult to deter geese from nesting, treating the eggs to prevent hatching is still an option. This can be done by puncturing, shaking, freezing or applying 100% corn oil to all of the eggs in a nest. Treating the eggs rather than destroying the nest causes the female goose to continue incubating the eggs until the nesting season is over rather than laying a new clutch. Egg treatment may be necessary for 5-10 years before effects on goose numbers are evident. In 2005, 190 eggs on 45 nests were oiled in Dr. Victor Reinstein Woods Nature Preserve in an effort to reduce the large goose population on the preserve and in the adjacent Stiglmeier Park (NYS DEC 2006b). Just as the NYS DEC used this technique at Dr. Victor Reinstein Woods Nature Preserve, goose nests could be oiled at Tifft Nature Preserve. Treating eggs is allowed under the Nest and Egg Depredation Order (50 CFR § 21.50) and does not require a state or federal permit, but persons must register on-line (<https://epermits.fws.gov/eRCGR>) before initiating treatment and report actions following treatment.

Capture and Remove Geese – Geese can easily be rounded up and captured during their summer molt when they cannot fly and could then be relocated or dispatched. Relocation is not an option since there are no locations in New York State that will accept nuisance geese. Meat from captured birds could be donated to local charities which can help with public acceptance of the program, but due to extensive waste dumping and the removal of chemical contaminants in the past, meat should be tested for health risks prior to consumption.

Strategy for Controlling Nuisance Canada Geese at Tifft Nature Preserve

Canada geese currently do not create as serious conflicts or management challenges on the preserve as white-tailed deer or beaver, but there are several steps that could be taken to reduce any negative impacts

1. *Continue Current Policies* – Tifft Nature Preserve is already taking active steps to minimize human-geese conflicts such as rules banning the feeding of wildlife and

mowing few grassy areas. Both of these policies should continue at the preserve into the future.

2. *Control Goose Nesting* – In early spring, goose eggs could be oiled to prevent hatching and should continue for several years (5 to 10 years) to reduce the size of the goose population. Oiling eggs is a simple, inexpensive, non-intrusive, and effective way to reduce goose populations and is much less controversial than capturing and killing geese.

***Myrmica rubra* Ants**

A population of non-native *Myrmica rubra* ants occurs on the preserve and can cause problems when ants become aggressive and attack with a painful sting. The red colored ant, native to Europe where it causes few problems, lives under stones, fallen trees, and sometimes in the soil, often along woodland edges and riverbanks. The species is currently established in portions of Japan and North America where it is considered invasive and a nuisance. The ants were discovered on the preserve in the mid-1980's and soon became such a serious pest that sections of the preserve needed to be closed to the public at times. Most problems occurred in the south central portion of the preserve where the population was largest (Brasure 1996). Several specialists have been consulted on controlling the species, including a visit by the famed entomologist and author E.O. Wilson.

Since 1992 Tifft Nature Preserve has been actively trying to control the *Myrmica rubra* ant populations. At first (1992-94), boric acid in peanut butter or sugar water bait were used, but were not effective in reducing ant numbers. In 1995, the preserve started applying the insecticide Amdro (active ingredient: 0.73% Hydramethylnon), which is dispensed in soybean oil on corn grits, following the emergence of ants in the spring (Brasure 1996). Monitoring after application has shown the insecticide to be effective at controlling the ants to levels where they are not a major concern. Effects from the insecticide on non-target organisms have not been observed. The active ingredient in Amdro has low toxicity for both oral and dermal exposure and is not listed as a carcinogen, but is toxic to fish and should not be applied directly to water. Therefore, due to the effectiveness of the product and its low toxicity, it is recommended that spring and summer applications of Amdro continue as needed to control *Myrmica rubra* ants on the preserve. Amdro is designated as a restricted use pesticide in New York State and product application requires Pesticide Applicator Certification by the NYS DEC, Division of Solid and Hazardous Waste, Bureau of Pesticides.

Power Line Management

There are two sets of National Grid power lines running through or adjacent to the preserve. The set of large high voltage (115,000 volts) lines along the eastern edge of the cattail marsh are not located on City of Buffalo land (i.e. the preserve), but are on property owned by the power company. A lease agreement between the City of Buffalo and the Buffalo Society of Natural Sciences allows the Society to operate Tifft Nature Preserve on city land. In this lease, the city has a wetland easement on the National

Grid property and grants use and possession within the lease agreement to the Society. This makes the land under these power lines an unofficial addition to the preserve and it functions as an undeveloped buffer to the cattail marsh. There are no conflicts with the maintenance of these lines. The preserve benefits from the fence constructed by the power company because it limits access and deters illegal dumping in the marsh. It is hoped that a cooperative relationship can be established with the power company to manage *Phragmites* in the cattail marsh since this invasive species is abundant under these power lines.

The other set of power lines that runs through the center of the preserve creates a more challenging situation for balancing the goals of the preserve with the maintenance needs of National Grid. This set of 34,500 volt lines services the industries north of the preserve such as General Mills and ADM. These customers require reliable service and even short power outages can be costly. Therefore, the power company is interested in a right-of-way free of hazards and taking preventive steps to avoid unexpected problems. National Grid has an easement with the City of Buffalo for access and maintenance of their lines and the preserve needs to honor that agreement and find an appropriate land management strategy for this area that does not conflict with the power company's needs. Below are general guidelines National Grid uses for maintaining their power lines.

- Maintain an 80 to 100 foot (25 to 30 meter) wide right-of-way along the power line corridor (Figure 3)
- Remove most trees and tall shrubs within the right-of-way and apply herbicide to deter re-growth
- Maintain only herbaceous ground cover directly under and to 10 feet (3 meters) on each side of the power lines
- Remove hazard trees that could fall or drop limbs onto the power lines as far out as needed
- Conduct maintenance activities of the right-of-way on no longer than a five year schedule
- Maintain vehicle and equipment access to the right-of-way

These are general guidelines and site specific management is conducted by maintenance crews. National Grid is sympathetic to the diverse goals of land around their power lines and has attempted to minimize their disturbance and impact on the preserve in the past. Within the past five years the company did extensive maintenance of the power line corridor to lengthen the re-entry interval and left many trees standing within the right-of-way that could have been removed. The large cottonwoods adjacent to the power line right-of-way create a maintenance challenge since these are soft wood trees with brittle limbs and shallow root systems that pose a risk of falling or dropping limbs onto the lines. A transition from tall cottonwoods to harder wood or shorter tree species and a wider right-of-way would reduce potential hazards to the lines. Creating

a plant community dominated by small shrubs or native grasses and wildflowers directly under the power lines would also reduce conflicts with power line management. National Grid would be supportive of any steps the preserve makes to reduce hazards to the power lines and may be willing to assist with implementing these steps. Maintaining a compatible habitat type within the right-of-way would reduce the need for maintenance re-entry and extensive tree and limb removal.



Figure 3 Power Line Right-of-Way (100 feet/30 meters) shown in blue

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Habitat Improvements

Nest Boxes and Structures

Nest boxes and bird houses create great wildlife viewing opportunities and have been valuable tools in the conservation of species such as Wood Ducks and Eastern Bluebirds. Nest boxes are important for birds when natural nest sites are scarce and also provide safe nesting sites protected from predators. There are currently many nest boxes across Tifft Nature Preserve with most placed in the cattail marsh and on the mounds. Some of these nest boxes are used by a variety of bird species, but many are severely weathered and in need of repair or replacement. A complete inventory and assessment of the existing nest boxes and then developing a well thought out nest box plan is one of the easiest and best options for enhancing wildlife habitat and viewing opportunities at the preserve. The inventory, construction of new boxes, and annual monitoring and cleaning are activities well suited for school children, scout groups and volunteers.

There are many designs for nest boxes and the most important factor in deciding on a design is to build a nest box with a bird species in mind. Different birds will use nest boxes of different sizes and shapes and there is no design suitable for all birds. A generic bird house may not fit the needs of desired bird species and they are often used by non-native species such as European Starlings or House Sparrows. All new nest boxes at the preserve should be designed and placed in appropriate habitats for a particular species. Below are some of the species that may use nest boxes at Tifft Nature Preserve:

Wood Duck
Eastern Bluebird
Tree Swallow
Purple Martin
American Kestrel
Eastern Screech Owl
Barn Owl

House Wren
White-breasted Nuthatch
Black-capped Chickadee
Tufted Titmouse
Great-crested Flycatcher
Woodpeckers

There are other important factors of a well designed nest box. Annual cleaning is part of nest box maintenance and boxes should have a way to be easily opened. Many of the current boxes can't be opened and do not allow for cleaning without disassembly. Another benefit of easy access inside the box is for monitoring. Nest boxes can be checked for use by non-native undesirable bird species, monitored for nesting success, and used for educational programs with small groups. Predator guards, either mounted on the front of the box or on the support pole, are also common features of nest boxes that successfully fledge young birds.

In addition to nest boxes and bird houses, there are other structures that can be built for birds that do not nest in boxes. There are Osprey platforms on the shores of Lake Kirsty and Lisa Pond, but Ospreys have never been documented nesting at the

preserve. Ospreys prefer secluded areas for nesting and there may be too much disturbance in and around the preserve to provide desirable nesting habitat. The Black Tern, a New York State Endangered species, has nested at Tifft Nature Preserve many years ago, but not recently. The Black Tern uses an island or floating mats of vegetation for nesting. The creation of channels and small ponds in the cattail marsh improved breeding habitat for Black Terns, and the construction and placement of nesting platforms in the wetlands would further encourage the comeback of this rare bird. Detailed designs for nesting platforms are part of a New York Power Authority (NYPA) Habitat Improvement Project (HIP) and Tifft Nature Preserve is even mentioned as a location for the placement of these platforms.

Turtle Basking Structures

Turtles are unlike mammals and birds and need to behaviorally regulate their body temperatures and they do this by basking. Installing basking structures in the ponds and the wetlands would improve turtle's ability to thermoregulate and would create excellent wildlife viewing opportunities. Midland painted turtles are attractive turtles that frequently bask and are common in the ponds and the cattail marsh on the preserve. Turtles will bask on just about any floating structure and will readily use logs placed in the water. Downed trees from the preserve could be cut to suitable size and anchored with a chain and weight to prevent them from drifting. These logs could be strategically placed near viewing blinds, boardwalks and other high visibility areas so they can be easily seen by visitors.

Woodland Tree Regeneration and Plantings

The woodlands at Tifft Nature Preserve provide nesting habitat for several bird species and are an important stopover site for migrating song birds. They also create a shady pleasing environment for visitors to walk through and enjoy. The canopy of the woodlands is dominated by cottonwood trees that are fast growing but short-lived and will be reaching the limits of their lifespan in the coming decades (see Habitats section for more on the woodlands). Without adequate tree regeneration, which is not occurring at Tifft Nature Preserve, the canopy layer of trees could be lost in less than fifty years. Improving tree regeneration to create the next generation of canopy trees would be a major improvement and is required to preserve the valuable habitat this canopy provides. There are three major obstacles preventing tree regeneration at Tifft Nature Preserve.

- *Heavy Deer Browsing* – The large herd of white-tailed deer on and around the preserve eat the tender young buds and shoots of young trees. This prevents saplings from growing into larger trees or kills them. To increase tree regeneration at Tifft Nature Preserve, the deer herd will need to be reduced or deer will must be fenced out of areas until the young trees are tall enough not to be damaged, which could be several years if not a decade or more (see Management Challenges section for more on deer).

- *Invasive Species* – The shrub layer in the woodlands is dominated by invasive species such as Japanese knotweed, buckthorn, honeysuckle, and tree-of-heaven. The herbaceous ground layer vegetation is also comprised of mostly weedy species such as *Phragmites*, stinging nettle and garlic mustard. Dense pockets of invasive species can shade out tree saplings and out compete young trees for resources. Recent research at SUNY-Fredonia (Martin and Titus 2008) found that mortality of planted sugar maple saplings was higher in plots with dense Japanese knotweed compared to plots where knotweed was removed or absent. Martin and Titus also report that plant species richness was lower in plots with Japanese knotweed than plots without knotweed, and that garlic mustard suppresses arbuscular mycorrhizal fungi, which hinders a plant's ability to grow. Without a significant reduction in invasive species in the woodlands of the preserve, increased tree regeneration is unlikely (see Management Challenges for more on invasive species).
- *Suppressed Succession* – Succession is the natural change of an ecological community through time. In forest ecosystems following a disturbance (fire, flood, human land clearing), a community is colonized by early successional species that grow well in disturbed areas and full sunlight (e.g. cottonwood, aspen). Over time (years to decades) the forest will become dominated by late successional species (e.g. maple, beech) that require more stable conditions and can reproduce in the shady understory of the forest. At Tifft Nature Preserve, the cottonwoods colonized the site following the major human disturbance of the area, but the more shade tolerant tree species are not present on the preserve. Dr. Howard S. Irwin noted that woodland succession will be relatively slow or arrested due to the dramatically altered soil conditions and the isolation of the preserve from other woodlands to provide a seed source (Klips et al 1993). Saplings and young trees of shade tolerant species such as red maple will need to be planted at the preserve since natural colonization is unlikely.

Given the above constraints, improving tree regeneration will be a challenging prospect with no guarantee of success, but due to the importance of the woodlands at the preserve, attempts should be made.

In addition and concomitant with improving tree regeneration, native woodland understory vegetation and shrubs could be planted. Herbaceous species such as wild geranium, trillium, meadow rue and wild leek, as well as ferns, grasses and sedges would all be suitable and attractive additions. Native woody shrubs include several types of dogwoods and viburnums, among others. Similar to tree saplings, woodland flowers and shrubs would also require protection from deer and control of invasive species. With the large amount of fill material and shallow soil profile, there are some species of trees, shrubs and herbaceous plants that might not grow on the preserve, despite efforts to establish them. A wide variety of native species will need to be planted to see which grow the best and results should be closely monitored. Tree species that are adapted to wet soils such as red maple, silver maple, swamp white oak, pin oak and green ash, as well as more cottonwood and black willow, are all

species that should be tried. This trial and error approach to determining the best woodland tree and plant species mix for the preserve would be an excellent opportunity to engage students and volunteers in ecological monitoring and data collection.

Wetland Plantings

The cattail marsh is an important natural asset to the preserve since it is the only plant community dominated by native wetland vegetation and it provides valuable wildlife habitat. Therefore, any efforts to maintain or enhance the quality of the marsh are a top priority for management at the preserve. The major threat to the cattail marsh is invasion by *Phragmites* (see Management Challenges section for more on invasive species) and the planting of native wetland vegetation should be part of the strategy to control this invasive species. Where *Phragmites* is established in dense pockets, the plant will need to be pulled, cut, or sprayed with herbicide to eradicate it and prevent its spread. This will create a pocket of little to no vegetation where the *Phragmites* was removed and these bare areas will be susceptible to reinvasion or colonization by other invasive species such as purple loosestrife. Following removal of *Phragmites*, the open areas should be planted with a mix of native wetland plant species. Species that could be planted in these areas include cattail, bur-reed, bulrushes, and pickerel weed, among others. Unlike native plantings in terrestrial ecosystems where seeds are most commonly planted, the use of tubers, rootstock, or plugs (small plants) is common for many wetland plant species. This requires that roots are hand planted which can be very laborious for large areas. However, soft wetland soils make planting easy and since there are few large patches of *Phragmites* in the marsh, it is not expected that large areas of wetland planting with rootstocks will be required. Only native species from as local a source as possible should be planted (McKay et al 2002). A good reference for wetland plantings is Hagen (1996).

Immediately adjacent to the cattail marsh on slightly higher, but still very wet soils, wetland plants adapted to this type of environment could be planted to buffer the marsh. Species such as blue flag, joe-pye weed, sedges and rushes could be planted in areas where *Phragmites* or honeysuckle was removed on the edge of the marsh. An area north of Beth Pond, where excess spoils were placed from the wetland pond dredging, could also be leveled and planted with an appropriate mix of wetland plant species since this area is poorly drained and now the topsoil is composed of wetland soils. In these areas, seeds or plugs could be planted, but would need to be protected from deer and waterfowl, particularly Canada Geese, that would eat the seed and trample young plants. All wetland plantings, either directly in the marsh or adjacent to it, will need to be monitored for invasive species, and controlled if necessary, especially in the first few years after planting until the plants are well established.

Grassland Plantings

Native grasslands once blanketed much of eastern North America, but currently less than 1% of the continent's native grasslands remain (Kilde 2000). Along with the loss of native grasses and wildflowers, wildlife species dependent on these plant

communities are in decline, such as grassland birds (Sauer et al 2000), and the disappearance of insect pollinators has recently been making headlines. The landfill area in the southwest corner of Tifft Nature Preserve known as the mounds provides 42 acres (17 hectares) that would be suitable for establishing native grasses and wildflowers and would create an aesthetically pleasing native plant community and provide valuable wildlife habitat. A native grassland plant community would improve habitat for Savannah Sparrows, Bobolinks, Eastern Meadowlarks and the Northern Harrier, all of which have been observed on the preserve, but are not common. This creates the unique situation where an environmental detriment like a landfill could be turned into a valuable ecological, educational, and community asset.

The number and acreage of grassland restoration or establishment projects have been increasing in the past decades along with the research and literature on the subject (e.g. Packard and Mutel 1997). Several practical guides are published that provide step-by-step guidance throughout the process (e.g. Kurtz 2001, Delaney et al 2000, Kilde 2000). There are common elements to all successful grassland plantings and they will be addressed below in relation to Tifft Nature Preserve.

- *Planning* – This step involves site selection, and the mounds are the most appropriate location for grassland plantings on the preserve. Once a site is selected, features such as climate, moisture, drainage and soil conditions should be assessed and plans developed accordingly. There is no one optimal set of conditions for establishing a grassland, but site conditions will determine which species are most appropriate to plant and would grow the best. Since native grassland plants have deep root systems, the depth of soil on the mounds should be examined carefully. Small acreage phases could also be developed if planting on all 42 acres (17 hectares) at once is too ambitious of a goal. These phases could range in size from 10 or more acres (4 hectares) to small butterfly gardens.
- *Species List* – The list of species to be planted is determined by site conditions, project goals, and the budget. Only native species from as local a source as possible should be planted (McKay et al 2002). Species that are native to western New York and would likely do well on the mounds include: big bluestem, little bluestem, indian grass, sedges, blazing stars, milkweeds, asters and sunflowers. A diverse array of wildflowers can be planted so there are species blooming all season long if aesthetics is an important goal. Plant species can also be selected to attract butterflies and insect pollinators. Species lists can include as few as ten plants or approach one hundred species if a diverse grassland is desired. However, in general, the more diverse a seed mix, the more expensive it is to purchase or time consuming to collect the seeds. Some species are also available as plugs (small plants) that can be planted for faster results, but plugs are considerably more expensive than seed.
- *Site Preparation* – Unless a grassland planting project is interseeding into an existing native grassland, the soil must be appropriate for germinating seeds

and competing vegetation must be controlled. Soil preparation can involve applying fertilizers or shallow tilling or disking. The majority of time spent on site preparation is on treating weeds and invasive plants that are currently present on the site. The mounds at Tifft Nature Preserve are dominated by non-native pasture grasses and other non-native species such as trefoil, vetch and thistle. These species would need to be eliminated for successful establishment of native grassland plants and herbicide application would be the only feasible means to achieve this necessary step. Another site preparation issue somewhat unique at the preserve is control of the deer herd. Unless the size of the deer herd is substantially reduced or all plantings are surrounded by deer-proof fencing, successful establishment of grassland plants is unlikely since delicate young plants would either be eaten or trampled by the deer. Canada Geese can also eat and damage young plants and need to be excluded until the plants are well established. Geese can be excluded by temporarily installing grid wires over the new plantings (see Management Challenges section for more on white-tailed deer and Canada Geese).

- *Planting* – There are a variety of planting techniques and which is best depends on the site conditions, species list, and available equipment. Planting of the seed can occur in fall or spring and may require no equipment for hand broadcasting seed or specialized seed drills pulled by farm tractors for large acreage plantings. Plugs (small plants) can also be planted, but use of plugs is usually only feasible for small plantings due to increased labor and costs. Immediately after planting, until the plants are well established, the site will need to be protected not only from deer, but also from Canada Geese that will eat seeds and young plants. A grid of string or wire with ribbons attached can be strung between fencing or posts surrounding the planted site to exclude goose access.
- *Maintenance* – Whether it is hundreds of acres of tall grass or a butterfly garden on a city lot, these plantings require maintenance. For small garden plots, periodic hand weeding or selective herbicide application is sufficient. Large stands of grassland vegetation require more maintenance and periodic disturbance (e.g. prescribed burning, mowing) to prevent woody vegetation encroachment and to improve the vigor of the vegetation. Herbicide application to control invasive species is common in grassland plantings and a long-term prescribed burning or mowing regime should be addressed prior to planting.

Shorebird Habitat

Shorebirds are a group of birds that include: plovers, yellowlegs, dowitchers, phalaropes, and many sandpipers. At Tifft Nature Preserve, the Greater Yellowlegs, Lesser Yellowlegs, Spotted Sandpiper, Semipalmated Sandpiper and Least Sandpiper are among the most common of a long list of shorebirds that have been observed at the preserve. Shorebirds are not common at Tifft Nature Preserve because most species nest much farther north and few stop on their migration since there is little

quality habitat. As the group's name implies, these birds spend much of their time along shorelines drilling into the soft wet ground for invertebrates. Good shorebird habitat consists of a sandy beach, mudflat, or flooded field with shallow water or fluctuating water levels.

There is one location in the northwest corner of Lake Kirsty that could be modified to improve shorebird habitat (Figure 4). This is the old City Ship Canal, which was filled in decades ago, but little vegetation grows in this area and it is periodically flooded with shallow water as the level of Lake Kirsty fluctuates. Top soil would need to be placed on top of the fill to create a mudflat and graded to a very shallow slope. A berm with a water control structure would also allow water levels to be adjusted and allow periodic flooding. If a mudflat for shorebirds is created it may be challenging to keep them free of invasive plant species, particularly *Phragmites* which is common along the shores of Lake Kirsty and readily invades open wet soils. Shorebird habitat may also be temporarily created in the cattail marsh if water levels are naturally low one year or are intentionally lowered to improve emergent vegetation growth. This would only create temporary habitat and low water levels will increase the ability of *Phragmites* to invade the marsh so intentional drawdowns should be infrequent events.



Figure 4 Potential location for shorebird habitat creation

Vernal Pond Creation

A vernal pond (sometimes called an ephemeral pond) is a temporary shallow pool that holds water from snowmelt or rainfall in the spring, but dries up throughout the summer. They can occur in a variety of habitats including forests, marshes and along the shores of lakes and ponds. Vernal ponds may contain a wide diversity of invertebrates including dragonflies, damselflies, and fairy shrimp and also provide breeding sites for several amphibian species. Some species of salamanders and frogs such as spotted salamanders and wood frogs are considered vernal pond obligates and are dependent on these pools for successful reproduction. The key factor that makes these pools so important as amphibian breeding sites is the lack of fish. Since the ponds are temporary, they do not support permanent fish populations which prey heavily on amphibian eggs and larva. Amphibians using vernal ponds breed early in the spring when the pools are fully flooded, then the eggs and larva develop quickly and metamorphose into terrestrial adults before the ponds dry up in the summer.

At Tifft Nature Preserve, the spring peeper and blue-spotted/Jefferson salamander currently breed in the cattail marsh, but are species known to use vernal ponds and could benefit by creating this type of habitat on the preserve. Another species, the wood frog (see below), which occurs across the state but has not been observed at the preserve, could be introduced with the creation of vernal ponds. Constructing one or more vernal ponds would add to the diversity of habitats on the preserve and they are frequently used for educational programming and citizen science projects (e.g. see the Vernal Pools Project by the Roger Tory Peterson Institute at <http://vernalpools.rtpi.org/>). The woodlands adjacent to the cattail marsh would be suitable locations where vernal ponds could be constructed.

These unique natural features are quickly disappearing across the northeast and throughout the county so the creation of vernal pools to provide habitat for dependent species is becoming more and more common place. There are several “how to” guides and websites that provide detailed instructions for creating vernal ponds (e.g. Biebighauser 2003, De Weese 1998, and http://www.epa.gov/bioindicators/html/vernal_pool_construction.html). These resources provide various designs and exact specifications for construction depending on site characteristics such as existing habitat, soils and hydrology. Pond sizes range from hundreds of square feet to several acres and costs can range from hundreds to a few thousand dollars a pond. Construction of vernal ponds is not complicated, but the underlying fill of coal slag, bricks and other materials may make the job more challenging and expensive.

Species Introductions

Blanding’s Turtle (*Emydoidea blandingii*)

The Blanding’s turtle is a medium sized, long lived, semi-aquatic turtle that overwinters in marshes and wetlands. The turtle’s range spans from the upper Midwest through the Great Lakes to the Northeast and into Canada, but it is a rare species throughout its range. The Blanding’s turtle is listed as a Threatened species in New

York. There are three records of Blanding's turtle at Tifft Nature Preserve in the early 1990's, but no sightings in over ten years. One of the three records is a turtle that was found near Route 5 and released at the preserve by Ken Roblee, a NYS DEC biologist. There is no additional information on the other two records, but these could also have been human released individuals, which is a common occurrence for these attractive and gentle turtles.

The cattail marsh at Tifft Nature Preserve provides overwintering habitat for this species and a possible site for introduction. Buttonbush, a species highly associated with Blanding's turtle habitat, was planted in the marsh following the pond dredging and improves the quality of this habitat. A more challenging component of introducing Blanding's turtles to the preserve would be to provide suitable nesting habitat adjacent or close to the preserve. These turtles prefer to nest in sand or soft ground and have been observed to travel long distances (1/2 mile or more) to find suitable sites. Other factors to consider include assessing food resources on the preserve and non-breeding terrestrial habitat, as well as protecting turtles from hazards such as Route 5, Tifft Street, and the railroad tracks. Introduction of Blanding's turtles at Tifft Nature Preserve would be greatly aided by developing the following partnerships.

- *NYS DEC* – Since the Blanding's turtle is a protected species in New York, permits would be required for the possession, breeding, and introduction of turtles on the preserve. In particular, Ken Roblee would be a valuable partner on this project since he is very familiar with the cattail marsh at Tifft Nature Preserve and is an expert on local reptiles and amphibians.
- *Hudsonia Ltd.* – Hudsonia Ltd. is a non-profit environmental research institute located in eastern New York and has been conducting research on Blanding's turtles since 1983. In 1996, Hudsonia Ltd. began a habitat restoration project to replace wetland and upland habitats that were slated for destruction during an expansion project at Arlington High School in the town of La Grange, Dutchess County, NY. Hudsonia Ltd. has similar environmental education, research, and conservation goals as Tifft Nature Preserve and a partnership with this organization would be invaluable for the successful introduction of Blanding's turtles to the preserve.

Karner Blue Butterfly (*Lycaeides melissa samuelis*)

The Karner blue butterfly is a small butterfly (wingspan is about one inch (2.5 cm)) and is listed as a Federally Endangered species. The species can be found in scattered populations from Minnesota to New Hampshire and occurs in the Hudson River Valley in New York. The butterfly's habitat is open oak savannas and pine barrens on sandy soils with an understory of grasses and flowers. The most important plant species for the Karner blue butterfly is wild lupine (*Lupinus perennis*) which is the obligate food source of the larvae. Other wildflowers are also required to sustain a population of butterflies since the adults feed on the nectar of many plant species. Grassland plantings (see above) would create habitat for this species and a species list

could be tailored to include many wildflowers that are beneficial to butterflies. The long range challenge for creating Karner blue butterfly habitat at Tifft Nature Preserve is the many years it would take to grow a suitable canopy of trees.

Even though the eventual release of butterflies on the preserve is years to decades off, in the summer of 2008, Canisius College professor Dr. Helen Hull-Sanders and her students, planted wild lupine on the mounds for a research project. This project will help assess the potential for growing wild lupine on the mounds, as well as examining physiological aspects of the plant.

Wood Frog (*Rana sylvatica*)

The wood frog is a very cold tolerant amphibian with a range that extends across most of northern North America and includes all of New York. As their name implies, the frog lives in wooded habitats and breeds primarily in vernal ponds and ephemeral wetlands. Wood frogs are one of the first species active in the spring and can even be seen when snow is still present. They breed early and tadpoles develop into adults before the shallow breeding ponds and wetlands dry up in the summer. The woodlands adjacent to the cattail marsh provide habitat for adults and the shallow margins of the west side of the marsh could provide breeding habitat. The successful establishment of a wood frog population at Tifft Nature Preserve would be improved by the construction of vernal ponds discussed above. Introduction of adults, tadpoles or eggs should be from a source as close to the preserve as possible and precautions should be taken to prevent the spread of disease (e.g. Chytridiomycosis caused by the fungus *Batrachochytrium dendrobatidis*, or *Ranavirus*).

Research at Tifft Nature Preserve

Vision

Tifft Nature Preserve is administered by the Buffalo Society of Natural Sciences (BSNS) through the Buffalo Museum of Science. The BSNS has a long history, dating back to 1861, of conducting research in the natural sciences. Early work of the BSNS centered on the disciplines of zoology, ornithology, botany, geology, and others, with collections housed at the museum. In 1982, the BSNS took charge of the city-owned property, then known as Tifft Farm Nature Preserve. The preserve is now viewed as the Society's "living collection" that includes the site's vegetation, wildlife, hydrology, soils, natural processes, and history. The preserve provides an excellent laboratory to conduct research in ecology and environmental science and to continue the BSNS's tradition as a leading figure in scientific research in Buffalo and western New York.

The 264-acre (107-hectare) site was formerly a transshipment center and landfill, but also has the distinction of being one of the largest urban nature preserves in the country. The past land uses and present context of Tifft Nature Preserve provide a unique opportunity for ecological research in areas such as brownfield reclamation, environmental toxicology, and urban wildlife management. This history and isolation from other natural habitats also presents many challenges for current management and preservation of the site's natural resources. Therefore, research that will assist in addressing these challenges is encouraged. These areas include: invasive species, ecological restoration, wetland habitat management, and nuisance wildlife control. However, the research topics listed above should not limit a potential scientist's imagination and research proposals from microbiology to landscape ecology will be considered. With the preserve's 75-acre (30-hectare) remnant cattail marsh (the largest in Erie County), a rich diversity of wildlife (over 260 bird species have been observed), and its prime location on Lake Erie's waterfront, the opportunities of scientific inquiry are endless.

In addition to research, the BSNS provides high quality science education for the public through the Buffalo Museum of Science and Tifft Nature Preserve. As the "living collection," the preserve is an excellent field site for research that will educate the public about natural history, ecology, the environment we live in, and the process of scientific discovery. Our vision is to educate diverse segments of the public about ecological research including: grade school and high school students, undergraduate and graduate students, volunteers and visitors at the preserve, citizen scientists, and interested lifelong learners of all ages and backgrounds. The rationale and the results of all research at the preserve need to be shared in some way with school children, volunteers, or the public. Research that includes any of these groups, ideally through direct involvement, is strongly encouraged.

Guidelines

Ecological research is an integral part of the mission of the BSNS and Tift Nature Preserve, but needs to be conducted in a manner that does not diminish the natural resources of the preserve. Therefore, the following guidelines and restrictions are placed on the types and methods of research allowed on the preserve. These include:

- *Manipulative Studies* – Research that removes, damages, or otherwise dramatically alters the existing native vegetation, reduces habitat for wildlife, increases the potential for the spread of invasive species, or otherwise negatively impacts the preserve will not be allowed. This guideline places more restrictions on areas such as the remnant cattail marsh which has many native wetland species and good wildlife habitat. In contrast, there will be fewer restrictions in an area like the mounds that is covered by non-native vegetation (Figure 5). Other areas of the preserve fall somewhere between these two extremes and approval of a research proposal will depend on current conditions and the nature of the research and methodology.
- *Species Introductions* – Research that proposes to introduce non-native plants, vertebrates, invertebrates, or microorganisms to any terrestrial or aquatic community will not be allowed without a plan to contain the species or eradicate them upon completion of the project. Exceptions include USDA approved biological control agents. Introduced native species, such as for plant community restoration studies or species reintroductions, should be obtained from a source as close as possible (e.g. local genotype seed, see McKay et al. 2002 for practical guidelines for determining what is local in restoration projects) and should be disease free. Native species proposed for introduction should also not be known to negatively impact existing native species or have a history of becoming invasive or otherwise problematic.
- *Voucher Specimens* – To verify the results of research and enhance the collections at the Buffalo Museum of Science, voucher specimens should be collected whenever possible and turned over to the BSNS. Specimens of plants and invertebrates are easily obtained and should be collected. With the exception of reptiles, amphibians, fish and small mammals, vertebrate species should not be collected. No species should be illegally taken for the sake of obtaining a voucher specimen. Photo vouchers can be used for species when obtaining an actual specimen is not appropriate and can improve acceptance of results for rare or difficult to identify species. Specimens should be prepared and preserved in a manner appropriate for the species and the following information should accompany all specimens: identification (including scientific and common names), collector's name, date of collection, location on preserve, and a description of collection technique, habitat, or other useful information. Contact preserve staff for more details on collecting and preparing voucher specimens.

- *Access* – Access to all parts of the preserve with vehicles or other large equipment may not be possible, or only seasonally accessible. Construction of roads and trails, excessive rutting from vehicles traveling on wet ground, or destruction of vegetation to access parts of the preserve or establish research plots will not be allowed. However, an extensive trail system already exists, a small all-terrain utility vehicle may be available for use, and after hours access to the preserve can be arranged to accommodate research needs. Tifft Nature Preserve is also open to the public and large areas of the preserve that are currently open to public access will not be closed for extended periods of time (weeks to months) to conduct research.
- *Aesthetics* – Tifft Nature Preserve is a public place for research, education, and enjoyment of the environment. Therefore, research that negatively affects the aesthetics and the public's enjoyment of the preserve will not be approved. This includes projects that will permanently alter native vegetation, establish long-term research plots or structures in highly visible areas, or otherwise change the character of the preserve. Aesthetics is a highly subjective judgment and proposals will be reviewed on a case by case basis. It is likely that accommodations can be made for nearly all research proposals.
- *Permits* – It is the responsibility of the researcher proposing a study to obtain all necessary state and federal permits. Research proposals without proper documentation of permits will not be approved. Permits are required for conducting research on state and federally listed species, banding birds, and may be needed for catching or trapping fish and game species. Other permit requirements depend on the species and the nature of the research. Pesticide Applicator Certification from the NYS DEC is required to apply herbicides or pesticides on property owned by the City of Buffalo. Colleges and universities should provide documentation that a research proposal was approved by the institution's Animal Care and Use Committee when applicable.
- *Liability* – All research at Tifft Nature Preserve is conducted "at your own risk." The Buffalo Society of Natural Sciences, the Buffalo Museum of Science, Tifft Nature Preserve, and the City of Buffalo are not responsible for any injury or bodily harm to researchers, students, field crew members, or volunteers while they are conducting research on the preserve. Nor are they responsible for any loss or damage to property or equipment that is used while conducting research. The access road gate is locked at night and the preserve is closed from dusk till dawn, but the BSNS is not responsible for missing or damaged equipment left unattended overnight. Proof of insurance is not required as part of a research proposal, but all claims for injury or property damage should be sent to a researcher's personal or institutional policies.

Proposal Process

A brief research proposal will be required for approval before research at Tifft Nature Preserve can commence. There is no annual deadline for research proposals, but they should be submitted well in advance of proposed start date for review by Buffalo Museum of Science staff. In general, 30 – 60 days should be sufficient for most proposals, but more time should be given for complex and logistically challenging research. There is no standard format for proposals, but they should include the information listed below. Research proposals receiving grant funding from agencies, foundations, or other sources will usually meet these requirements with few modifications.

- Research proposal title
- Name of principle investigator and collaborators along with contact information and affiliations
- Detailed, but concise, project description including background information, methodology, and expected results
- Map of preserve with areas of proposed research indicated (contact Tifft Nature Preserve to obtain a map)
- Length of study and access needs
- Special equipment access or logistical needs
- Staff time, equipment, or financial assistance requested
- Plan for sharing results with students, volunteers, or the general public and willingness to have research directly incorporated into educational programming

The BSNS will not charge overhead for research conducted at Tifft Nature Preserve, but financial partnerships that support both research and the preserve are encouraged. Preserve staff are willing to assist in grant writing and obtaining research funding, especially when consulted early in the proposal process.

Upon completion of a research project, the BSNS will be provided with a hard or electronic copy, ideally both, of all research reports, thesis and dissertations, peer-reviewed journal articles, and other publications produced from data collected at the preserve.

Proposals should be submitted to the following location in hard copy or electronic format:

Tifft Nature Preserve
c/o Dave Spiering
1200 Furhmann Blvd.
Buffalo, NY 14203
716-825-6397
dspiering@sciencebuff.org



Figure 5 Major Habitats on the preserve and surrounding lands

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Environmental Education

Vision

The Buffalo Society of Natural Sciences goal is to provide high quality science education through the Buffalo Museum of Science and Tifft Nature Preserve. As the Society's living collection, the preserve is an excellent field site to educate the public about natural history, ecology, the environment we live in, and the process of scientific discovery. Our vision is to provide environmental education to diverse segments of the public including: grade school and high school students, undergraduate and graduate students, volunteers and visitors at the preserve, citizen scientists, and interested lifelong learners of all ages and backgrounds. To fulfill this vision, the goal is to develop Tifft Nature Preserve into an environmental education hub serving the region. The following three approaches will be discussed to achieve this vision and reach a diverse audience of varying ages and backgrounds:

1. Educational Programming
2. Citizen Science
3. Connections with Scientists

Educational Programming

The Buffalo Museum of Science and Tifft Nature Preserve already offer quality science education programs on a wide range of subjects. The following program ideas build on this foundation and are focused on environmental subject matter. Many of the current programs offered at the museum and preserve are targeted at grade school children. This age group will continue to be served, but potential ideas to expand programming to middle and high school students should be pursued.

- *Authentic Learning Communities (ALC)* – The ALC program is an excellent model to incorporate education directly into ecological research and land management. Several current ALC programs (Invasive Species, Urban Ecology, and Biodiversity) are good examples of using the preserve's resources to their maximum educational potential. Continuing or expanding on existing ALC programs should occur, but developing new programs around topics such as Geographic Information Systems (GIS), Dendrochronology (tree ring analysis), or wildlife population monitoring could be explored.
- *Project WILD* – Project WILD is one of the most widely-used conservation and environmental education programs among educators of students in kindergarten through high school. The program links students to their environment through wildlife-based education that fosters responsible actions toward wildlife and related natural resources. Project WILD provides instructional materials that are intended for use in both classroom and informal settings and designed to support state and national academic standards appropriate for grades K-12.

- *Project WET* – Project WET (Water Education for Teachers) is an award-winning, nonprofit water education program. The program facilitates and promotes awareness, appreciation, knowledge, and stewardship of water resources through the dissemination of classroom-ready teaching aids and the establishment of internationally sponsored Project WET programs.
- *NatureMapping Program* – The NatureMapping Program was developed in 1992 in Washington State to train students and the public to become aware of their natural resources and to provide the tools to inventory and monitor their resources. The program has expanded to a dozen states and provides training workshops and materials on the latest emerging technologies (e.g. GIS, GPS, satellite imagery). Successful projects using radio-telemetry with cougars and mule deer included a network of students, teachers, and researchers.

This list is not meant to be exhaustive, but provides a representation of the type of educational programming that is well suited to the preserve's resources and mission. The development of additional new programming ideas or using materials from other existing programs may occur.

Citizen Science

Citizen science refers to research that involves a network of non-scientist volunteers in making and reporting observations and measurements, or otherwise collecting data. These networks assist scientists in conducting research as well as promoting public engagement with research and science in general. Citizen scientists can include students, families, preserve volunteers and visitors, and amateur experts.

- *BioBlitz* – A bioblitz is a 24-hour species inventory conducted by scientists, students, amateur taxa experts, families, and other members of the local community. Bioblitzes have occurred across the country, including a high profile event in Central Park of New York City, and are organized by institutions such as the Cape Cod Museum of Natural History, the Boston Museum of Science and Technology, and the Carnegie Museum of Natural History. Tifft Nature Preserve provides an ideal location and opportunity for such an event. A Tifft Nature Preserve Bioblitz would not only provide an excellent venue for hands-on environmental education, but also an accurate and up-to-date species inventory to aid preserve management.
- *National Phenology Network* – Phenology is the study of periodic plant and animal life cycle events that are influenced by environmental changes, especially seasonal variations. The National Phenology Network exists to facilitate collection and dissemination of phenological data to support global change research. The network gives guidance to help professional and citizen scientists select and observe appropriate species at their location, and encourages them to register and submit their data each year. Following the network's protocols,

simple instructions could be posted in the visitor center for people to follow for collecting data and then reporting their findings before they leave the preserve.

- *Marsh Monitoring Program* – The Marsh Monitoring Program (MMP) began in 1995 and is coordinated by Bird Studies Canada, in partnership with Environment Canada and the United States Environmental Protection Agency. Surveys are conducted by a network of volunteers and the program provides long-term monitoring of marsh-dependent bird and anuran (frog and toad) species in marsh habitats throughout the Great Lakes basin. Data collected by MMP volunteers are used to determine long-term trends in species diversity and occurrence, and to guide conservation, restoration and management programs for marshes and their bird and amphibian inhabitants. Anuran surveys occurred at Tifft Nature Preserve from 1995 to 1998, and Dr. Robert Andrie has conducted the marsh bird surveys from 1995 to 2007. Both anuran and bird surveys should be conducted each year at the preserve during the spring and summer breeding seasons.
- *Cornell Lab of Ornithology Projects* – The Cornell Lab of Ornithology, located only hours from Tifft Nature Preserve, is a leader in developing and promoting bird related citizen science projects. They coordinate several projects that can be conducted year round and in a variety of environments. Projects most suited to the preserve include: Celebrate Urban Birds, The Birdhouse Network, eBird, and the Great Backyard Bird Count which the preserve already performs each winter.

Again, the list above is only meant to provide examples of the type of citizen science projects that already exist and not to limit the possibility of other projects or ideas. Following the example and methods of successful existing programs, Tifft Nature Preserve could develop unique citizen science programs that are tailored to the preserve's resources and management needs such as monitoring white-tailed deer populations.

Connections with Scientists

One of the most enriching and rewarding learning experiences students and the public can have is through direct connection with scientists while conducting authentic research. In addition to the scientists and curators at the museum and the Tifft Nature Preserve ecologist, professors at Buffalo State College, SUNY at Buffalo (UB), and Canisius College, as well as other colleges, universities and institutions, can provide this direct connection with scientific research. Ecological and environmental research is encouraged at the preserve and scientists proposing a study need to incorporate some form of student or public education into their proposal (See Research section of this plan). This connection with scientists can occur through involvement in the educational programming or citizen science projects mentioned above or in novel ways proposed by the scientist depending on the nature of their research.

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Public Use & Enjoyment

Trails & Boardwalks

There is currently a well established system of trails on the preserve that provides public access to most of the preserve (Figure 6). The trails provide diverse experiences for visitors by running through shady woods and sunny open areas, following the shores of ponds and the stream, and bringing them to the edge of the cattail marsh. The boardwalks and viewing blinds then actually take visitors into the marsh ecosystem by passing directly through the marsh's emergent vegetation and providing excellent viewing of waterfowl, marsh birds, and other wildlife.

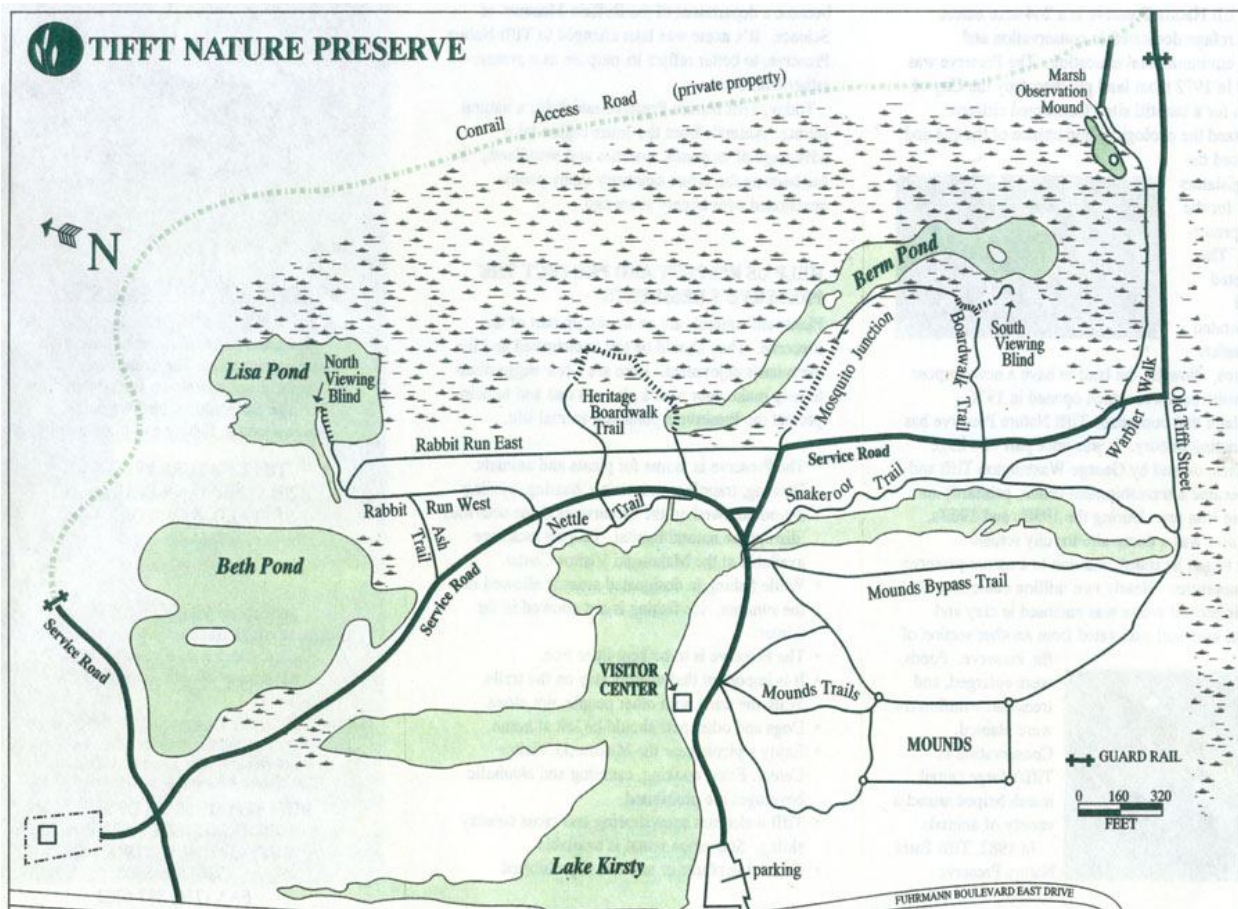


Figure 6 Map of Trails at Tifft Nature Preserve

With good access to the preserve and numerous opportunities for viewing wildlife, there is no need to construct new trails and boardwalks. However, the existing system should be maintained to provide safe and enjoyable access to the public. This requires mowing of grass-covered trails in the summer and periodically covering low spots and filling in holes on dirt trails with gravel, stone, or wood chips. Trails leading up to the boardwalks are necessarily located in wet areas and will require the most frequent and extensive maintenance work. The section of Warbler Walk Trail north of

the Service Road running along the south edge of the cattail marsh and leading to the Marsh Observation Mound in the southeast corner of the preserve is a very wet and muddy trail and is frequently flooded in spring and during high water. This trail does not connect to a boardwalk and the Marsh Observation Mound can be accessed by using Old Tifft Street. Therefore, this section of trail could be closed in the spring and during high water to protect the cattail marsh and the integrity of the trail without limiting access to any major portion of the preserve. Since this section of trail is so close to the marsh, gravel or other fill should not be used for trail maintenance and would likely not be permitted under the NYS DEC Freshwater Wetlands Act.

The wooden boardwalks will also require periodic maintenance and repair. In the fall of 2008 an extensive project to repair and maintain the boardwalks, viewing blinds, and trails was undertaken. This project included: leveling and raising sections of boardwalks, replacing handrails on all boardwalks, installing new walls at all three viewing blinds, and placing crushed stone in sections of some trails. With these renovations complete, the boardwalks should require only limited care and maintenance for the next several years. The raising of sections of Heritage and Mosquito Junction Boardwalks will prevent these areas from being flooded in the spring, and will allow for more flexibility in water level control, including maintaining higher water levels, that may be helpful for control of *Phragmites* in the marsh.

Although no additions to the trail and boardwalk system are recommended, there are other improvements that could be made that would increase wildlife viewing and educational opportunities. An elevated viewing platform constructed off the existing Heritage Boardwalk structure would raise visitors well above the tall emergent vegetation of the marsh and allow them to look down on nesting birds and other wildlife. The Master Plan for the preserve (EcoPlans 1975) included an observation tower in its original recommendations to provide such viewing opportunities of the cattail marsh. The plan called for placing the observation tower in the area where the Berm Pond viewing blind is currently located, but building off of Heritage Boardwalk would provide excellent views of the newly created channels and ponds in the marsh. Another option, and the exact opposite of building an elevated platform, is to construct a deck close to the water. This would provide easier access for students and small children to dip net for invertebrates in the marsh. This “dipping deck” could also be constructed off of Heritage Boardwalk near the outdoor pavilion in an area that is commonly used for aquatic education programs. Since this deck would be close to the water, it would likely need to be removable to prevent damage from ice in the winter and flooding in the spring. Building these structures off an existing boardwalk minimizes the amount of construction needed and disturbance to the wetland.

Interpretive Signage

Signage at the preserve currently consists mostly of preserve maps and information of preserve rules. There is a full color preserve map that includes the trails, major habitats, pictures of notable wildlife, and some history on the preserve near the parking lot and entrance to the trails. There is also a large sign listing the preserve

rules (see below), but also suggests activities such as bird watching and nature photography that are encouraged at the preserve. Signs around Lake Kirsty also inform anglers where fishing is and is not permitted and not to feed the waterfowl. Outside the visitor center there is a large preserve and trail map that can be viewed by visitors even when the center is closed. Signs mounted like street names are located throughout the preserve to name trails and orient visitors. There are a few signs remaining at number stations from an established nature walk in the past, but several stations are missing and many of the signs are damaged. These stations and signs are in the style of classic nature centers by identifying trees, wildflowers, or providing natural history information.

Signage can be a way to teach the public about nature on self-guided walks, but is no replacement for a qualified educator. Signs are passive by nature and do not engage readers in active learning or in the process of science. Excessive signage can also distract visitors from the natural experience they came to enjoy. Full color signs with good graphics and appropriate content are expensive to design and purchase and are often passed by without a glance by visitors or worse yet, vandalized. Therefore, developing a series of interpretive signs for the preserve is a low priority. Financial and staff resources would be better spent on providing guided educational programs for students and visitors. Another alternative to signage is a self-guided brochure or booklet that can tell and interpret the story of the preserve. Depending on the format, this could be a free brochure available outside the visitor center or a full color book that would be available for loan or purchase at the visitor center's gift shop. Any interpretive signs need to be very well designed, properly installed, and their necessity justified. However, temporary signage explaining research studies, restoration projects, or trail closures for maintenance are useful. These types of signs should answer visitors' immediate question of "what's going on" and then direct them to the visitor center if they are interested in learning more.

Preserve Rules

The public is encouraged to walk the trails, view the wildlife, and learn about nature at Tift Nature Preserve, but some rules are necessary to maintain the quality of the preserve's natural resources and a safe and enjoyable experience for all visitors. Therefore, the following rules have been established and should continue to be enforced.

- Stay on the trails
- Do not litter
- Do not disturb the wildlife or other visitors
- Do not feed the wildlife
- Do not pick or eat plants
- Do not collect/release animals
- Do not collect deer antlers
- Do not bring dogs or pets
- Do not bike, swim, boat or jog
- Do not sled or fly kites
- Do not go on the ice
- Do not hunt, trap or build fires
- Do not cook at picnic tables
- Do not bring alcohol
- No ATV's or snowmobiles (All-Terrain Vehicles)

These rules are clearly posted on signs near the parking lot and where visitors enter the preserve's trails. They are also listed on the back of the trail maps that are available inside and outside the visitor center. In general, a polite conversation with a visitor who is violating the preserve's rules is enough to rectify the situation and should be the first step for preserve staff. However, if this does not work, or in the case of extreme violations, the City of Buffalo Police Department or a NYS DEC Conservation Officer may need to be called. If the safety of preserve staff, volunteers, or visitors is jeopardized, the police department (or 911) should be called immediately.

An additional rule not listed above concerns fishing at Tifft Nature Preserve. Fishing is permitted on the west and south shores, and part of the east shore of Lake Kirsty, but nowhere else on the preserve. These areas are clearly indicated on signs at the parking lot and outside the visitor center, as well as on the trail maps. Also, anglers must follow all NYS DEC fishing regulations.

The rule "Do not feed the wildlife" has one exception that requires some elaboration. Black-capped Chickadees can be fed sunflower seeds from November 1st to April 1st. There is a handout available in the visitor center that explains why visitors should not feed the wildlife and describes in detail the policies for feeding chickadees. Feeding the chickadees has a long tradition at the preserve and is a very popular activity for school groups, families and other visitors. Although feeding these small songbirds in a responsible way does not create the problems associated with feeding other wildlife, such as deer or waterfowl, it alters the bird's natural behavior and sends a mixed message to visitors. Not encouraging the feeding of chickadees by no longer selling seed in the visitor center and phasing out of the feeding exception for chickadees by continually shortening the allowable feeding season over a few years would be a way to resolve this inconsistency in preserve policy with the least amount of resistance from visitors who enjoy this activity.

Buildings & Grounds

To maintain a productive work environment for staff and a safe and enjoyable destination for visitors, the buildings and grounds on the preserve require routine care and maintenance. The preserve's facilities and infrastructure include: two buildings, a parking lot and service road with a bridge, fencing and gates, five miles (8 km) of trails, two boardwalks, three viewing blinds, culverts and water pumping system, numerous benches, and signage throughout the preserve. Currently, there is limited part-time support from the museum operations staff for buildings and grounds upkeep at the preserve. The Master Plan (Ecoplans 1975) recommended two full-time positions for facility and grounds maintenance. In addition to buildings and grounds maintenance there can be considerable custodial work needed after busy weekends or large educational programs. There is a need for at least one full-time staff position for building and grounds upkeep and custodial duties.

In addition to routine building and grounds maintenance, a long term plan for the preserve's facilities and infrastructure would be useful. The original portion of the visitor

center is thirty years old and the additions to the building, as well as the maintenance building, are not much newer. The need for a renovated or new staff and visitor facility has been acknowledged, but no formal plans have been developed and a capital improvement plan is beyond the scope of this document.

Trespassing & Security

Tifft Nature Preserve exists within a very urban landscape with many different owners and varied uses of the surrounding lands. Therefore, there is a need to demarcate the legal boundary and prevent unlawful trespass and inappropriate activities from occurring on the preserve. A perimeter fence would establish the boundary and prevent trespassing, but it is not a realistic option for several reasons. From a logistical standpoint, the cost and challenges of constructing a secure fence around 264 acres (107 hectares) through a variety of habitats and ground conditions would be immense. Also, a perimeter fence would limit wildlife movement and further isolate the plants and animals on the preserve. Although fencing the entire perimeter will not work, there are many benefits to fencing placed in strategic locations on the preserve's boundary. Currently there is a chain link fence on the west boundary of the mounds along Fuhrmann Boulevard. This fence works well to catch litter and refuse blown off Route 5 and the lake front and should be maintained. The parking lot on Fuhrmann Boulevard is surrounded by low profile fencing that prevents ATV access to the preserve, particularly the mounds, when the gate on the service road is closed. There is chain link fencing surrounding the maintenance building in the northwest corner of the preserve. This fence should also be kept in place to provide security for tools and equipment stored in the building. With the eventual redesign of Route 5, Fuhrmann Boulevard, and the lakefront the west side of the preserve may take on a new look. Alternatives that are in the best interests of the preserve were pursued during the planning process for this redevelopment project (Karen Wallace, *personal communication*). There is also chain link fencing on the east side of the marsh running along National Grid's property line with Lehigh Valley Railroad. This fence was constructed by the power company and ideally will be maintained by them to prevent trespass, vandalism, and illegal dumping on their property and the preserve. In the southeast corner of the preserve, ATV's, SUV's and other off-road vehicles have accessed the property in the past. There are currently large cement blocks placed in the access road to deter this activity. If this type of trespass continues, a gate or other structure to exclude access may be needed.

The fencing options listed above control access and mark the boundary where they are located, but leave most of the preserve open to unrestricted access. The rest of the property boundary should be clearly posted with signs following guidelines in the New York State Environmental Conservation Law (<http://www.dec.ny.gov/outdoor/8371.html>). These signs should not be general "No Trespassing" signs, but should identify the property as a nature preserve, state that hunting and vehicles are not permitted, and direct people to access the property through the parking area on Fuhrmann Boulevard where a complete list of the preserve rules is posted. Having the boundary posted at regular intervals with well maintained signs will aid in prosecuting individuals for trespassing or other unlawful activities on the preserve.

In an urban environment, maintaining safe and secure conditions for staff and visitors are also major concerns. The Master Plan for the preserve (Ecoplans 1975) recommended establishing the position of “Resident Ranger” who would live on site and could provide 24-hour security. This position was never created, but there have been varying levels of security staff assigned to the preserve through the years. Unfortunately, there have been past instances that required security staff and law enforcement officers. Currently there is no security staff at the preserve. Non-personnel security features include: alarm systems at the visitor center and maintenance building, outdoor lighting at both buildings, and a camera in the parking lot on Fuhrmann Boulevard. The alarm systems, lighting, and camera provide some degree of protection, and also function as a deterrent to prevent crime and should be maintained. Perhaps the best deterrent is increased staffing, volunteer, and visitor presence. The more people working and enjoying the preserve, the safer it becomes. If crime or security becomes a problem, preserve staff can request increased patrolling by the City of Buffalo Police Department or a security guard may need to be hired. All observed, reported, or suspected illegal activities should be reported to the security staff at the museum and the police department.

Ecotourism

Ecotourism is a recent and developing niche in the travel and vacation marketplace. The International Ecotourism Society states that “ecotourism is about connecting conservation, communities, and sustainable travel”. It also encourages the following principles: minimize impact, build environmental awareness and respect, and provide direct financial benefits for conservation (<http://www.ecotourism.org>). Ecotourists engage in a diverse variety of activities including hiking, nature photography and bird watching, among others, and can travel to distant exotic places, vacation in state or national parks, or just spend a day at a local natural area. Tifft Nature Preserve is an excellent ecotourism destination not only for local residents, but also national and international visitors to western New York.

There are several marketing angles that could be pursued to attract visitors to the preserve. On a regional scale, the preserve is conveniently located midway along a major travel route (Route 5) between the charming countryside of Cattaraugus County and the stunning wonder of Niagara Falls. For the urban traveler, the preserve provides a quiet break just minutes away from major Buffalo attractions such as the Albright-Knox Art Gallery, Elmwood Avenue and Allen Street, or the city’s vibrant theater district. Perhaps the biggest asset to attract ecotourists is the diverse bird community and excellent birding opportunities on the preserve. Tifft Nature Preserve is already a featured stop on a birding trail that includes the nearby Woodlawn Beach State Park and Times Beach Nature Preserve and continues north along the Niagara River. The basic infrastructure (trails, boardwalks, viewing blinds, visitor’s center, bird lists, trail maps, etc.) is already in place at the preserve to attract nature oriented travelers. However, two components need development to capitalize on possible ecotourism revenue. First, there needs to be a way to achieve one of the goals of the International Ecotourism Society, “provide direct financial benefits for conservation.” Currently, the

preserve is free and open to the public which allows visitors to enjoy the natural assets of the preserve, but creates no funding source for preserving and maintaining those natural resources. The second component is marketing. The preserve could be better highlighted in visitor guides, updated birding trail guides could be created, birding festivals could occur at the preserve, and a visit to Tifft Nature Preserve could even be included in vacation packages with travel agents. The Marketing Department at the Buffalo Museum of Science could help explore these options.

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Implementation of the Management Plan

Key Resources & Priorities

There are many reasons why Tifft Nature Preserve is special, including the unique story of a transshipping center and industrial dump turned nature preserve, the fact that it is one of the largest urban nature preserve in the country, and the 30 years of environmental educational programming and nature recreation the site has provided to thousands of students and visitors. **But there are two key natural resources that rise to the top and make the preserve a truly important site for biodiversity conservation. These are the cattail marsh and the bird habitat on the preserve.** The cattail marsh is the largest remnant marsh left in Erie County and one of the largest in the entire Lake Erie coastal region. The cattail marsh is the only plant community on the preserve that is dominated by native vegetation and provides breeding habitat for several rare bird species such as the Least Bittern and Pied-billed Grebe. The marsh is not the only area important as bird habitat though. The woodland habitat on the preserve and its position on the shore of Lake Erie along a major flyway make the preserve an important migratory stopover site for birds. The canopy of trees at Tifft Nature Preserve attracts a wide variety of songbirds, especially warblers, on their way to breeding grounds further north in the spring and wintering grounds to the south in the fall. Maintaining the integrity of the cattail marsh and ensuring the continued existence of a forest canopy need to be the top priorities for land management on the preserve.

In addition to the important natural resources, the preserve is positioned to be a regional leader in environmental education and ecological research. Tifft Nature Preserve could play a major role in the revitalization of South Buffalo that may occur through the Brownfield Opportunity Area Program. The preserve could be a center for science education for preschoolers to graduate students and provide a location for a wide range of research topics from brownfield remediation to conservation biology of rare species. Although achieving these education and research goals are years into the future the ground work needs to be laid now on the path to achieving these objectives.

Below is a list of topics discussed in earlier sections of this plan prioritized by their importance to fulfilling the conservation, research and education mission of Tifft Nature Preserve. A five year timeline is presented for implementing the priority actions for management of the preserve's vegetation and wildlife (Tables 2 & 3). All of the ideas presented earlier in the plan are not included in this priority list since completing projects in addition to the priority actions listed below is beyond the resources of Tifft Nature Preserve and the Buffalo Museum of Science at this time. At the end of the five year preserve management timeline presented below, progress should be assessed and priorities reevaluated.

Preserve Management

- 1) *Invasive Species* – Control of invasive species is essential to preserving wildlife habitat and achieving almost every other natural resource goal. Preventing the establishment of *Phragmites* in the cattail marsh is the most critical invasive species management need. Fortunately, the New York Power Authority (NYPA) Habitat Improvement Project (HIP) is focused on invasive species and *Phragmites* in particular. See Table 2 for specific actions.
- 2) *Managing White-tailed Deer* – The large deer herd on the preserve has a dramatic influence on the preserve's vegetation and habitat for other wildlife species. Without reducing the size of the deer population or excluding deer from sections of the preserve, few other habitat improvements are likely to succeed. In addition to the biological aspects of managing the deer population, considerable time and resources need to be committed to educating students and the public on the subject to gain approval for a Deer Management Plan. See Table 3 for specific actions.
- 3) *Improve Tree Regeneration* – Establishing the next generation of canopy trees is necessary for maintaining the habitat quality of the preserve as a migratory stop-over site, as well as the esthetics of the preserve. The success of this objective is heavily dependent on achieving the first two priorities. See Table 2 for specific actions.
- 4) *Nest Boxes* – Removing nest boxes in need of repair and installing new well designed nest boxes in appropriate locations is not only an easily achievable goal, but will almost instantly improve wildlife habitat and the public image of the preserve. A plan for monitoring and maintaining the nest boxes should also be developed. See Table 3 for specific actions.
- 5) *Managing Abundant Wildlife* – Large populations of beaver and Canada Geese on the preserve can have negative impacts for other wildlife as well as visitor experiences. If populations exceed natural or cultural carry capacities, these wildlife species should be controlled using techniques presented above and the negative impacts mitigated. See Table 3 for specific actions.
- 6) *Wetland Plantings* – Planting native vegetation in and around the cattail marsh will not only maintain and improve one of the preserve's most important natural assets, but can be used as a strategy to control and prevent the spread of invasive species and will be conducted in conjunction with invasive species control efforts. See Table 2 for specific actions.

Table 2 Five Year Vegetation Management Timeline – *Invasive Species, Improve Tree Regeneration, Wetland Plantings*

| | 2009 | 2010 | 2011 | 2012 | 2013 |
|-------------------|--|--|--|--|--|
| Invasive Species | Work with NYPA on HIP Action Plan targeting <i>Phragmites</i> in the cattail marsh | Begin Implementing NYPA HIP Plan | Continue Implementation of NYPA HIP Plan as needed | Continue Implementation of NYPA HIP Plan as needed | Continue Implementation of NYPA HIP Plan as needed |
| | Establish Baseline Inventory and Status of Invasive Plants through Vegetation Surveys | Monitor Distribution of Invasive Plants | Monitor Distribution of Invasive Plants and Effectiveness of any Control Efforts | Monitor Distribution of Invasive Plants and Effectiveness of any Control Efforts | Monitor Distribution of Invasive Plants and Effectiveness of any Control Efforts |
| | Develop Plan for Funding and Monitoring of Invasive Plant Control Efforts | Begin Control Efforts for Invasive Plants | Continue Control Efforts for Invasive Plants | Continue Control Efforts for Invasive Plants | Continue Control Efforts for Invasive Plants |
| Tree Regeneration | Pursue Funding for Tree Seedlings, Fencing, and Deer Protection and Develop Tree Planting Plan | Relocate Wetland Spoils to Improve Soils for Tree Seedlings, Construct Deer Exclosures | Plant Tree Seedlings Protected from Deer Browsing to Improve Tree Regeneration | Plant Tree Seedlings Protected from Deer Browsing to Improve Tree Regeneration | Plant Tree Seedlings Protected from Deer Browsing to Improve Tree Regeneration |
| | | | | | |
| Wetland Plantings | Pursue Funding for Plant Seeds and Plugs and associated costs of planting | Plant Wetland Species in Conjunction with NYPA HIP Plan and Invasive Species Control Efforts | Plant Wetland Species in Conjunction with NYPA HIP Plan and Invasive Species Control Efforts | Plant Wetland Species in Conjunction with NYPA HIP Plan and Invasive Species Control Efforts | Plant Wetland Species in Conjunction with NYPA HIP Plan and Invasive Species Control Efforts |

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Table 3 Five Year Wildlife Management Timeline – *Managing White-tailed Deer, Nest Boxes, Manage Abundant Wildlife*

| | 2009 | 2010 | 2011 | 2012 | 2013 |
|----------------------------|--|---|---|---|---|
| Managing White-tailed Deer | Monitor Deer and Estimate Population on the Preserve | Monitor Deer and Estimate Population on the Preserve | Monitor Deer and Estimate Population on the Preserve | Monitor Deer and Estimate Population on the Preserve | Monitor Deer and Estimate Population on the Preserve |
| | Develop Educational Content on Deer Management | Incorporate Content into Educational and Public Programs | Incorporate Content into Educational and Public Programs | Incorporate Content into Educational and Public Programs | Incorporate Content into Educational and Public Programs |
| | Begin Developing Deer Management Plan | Continue Development of Deer Management Plan | Continue Development of Deer Management Plan | Complete and Gain Support of Deer Management Plan | Begin Implementing Deer Management Plan |
| | Pursue Funding for Deer Enclosures | Construct Deer Enclosures and Begin Monitoring Vegetation | Continue Monitoring Vegetation in Deer Enclosures | Continue Monitoring Vegetation in Deer Enclosures | Continue Monitoring Vegetation in Deer Enclosures |
| Nest Boxes | Inventory and Assess the Condition of all Nest Boxes on the Preserve | Repair, Build and Install Nest Boxes | Monitor and Maintain all Nest Boxes | Monitor and Maintain all Nest Boxes | Monitor and Maintain all Nest Boxes |
| | | | | | |
| Manage Abundant Wildlife | Monitor Populations of Beaver on the Preserve | Wrap Trees for Protection from Beavers and Protect Culverts as needed | Wrap Trees for Protection from Beavers and Protect Culverts as needed | Wrap Trees for Protection from Beavers and Protect Culverts as needed | Wrap Trees for Protection from Beavers and Protect Culverts as needed |
| | Monitor Populations of Canada Geese on the Preserve | Oil Canada Goose Eggs in the Nest as needed | Oil Canada Goose Eggs in the Nest as needed | Oil Canada Goose Eggs in the Nest as needed | Oil Canada Goose Eggs in the Nest as needed |

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Research at Tifft Nature Preserve

To build Tifft Nature Preserve into a credible science institution and attract local, regional and even national researchers, strong partnerships with local colleges and universities need to be established and maintained. In the summer of 2008, research projects by Buffalo State College and Canisius College faculty and students occurred at the preserve which is an excellent start to building a research program at the preserve. Partnerships with SUNY at Buffalo (UB) and Medaille College should to be pursued in the future. In addition to colleges and universities, research projects with scientists and individuals at the New York State Department of Environmental Conservation, Buffalo Ornithological Society, Western New York Herpetological Society, and other science or conservation organizations could be initiated at the preserve.

Environmental Education

Tifft Nature Preserve already provides quality science and environmental educational programs to many students every year. To build on the strong education foundation at the preserve, programs could be developed to target a wider age range of students and curriculum in the Authentic Learning Communities (ALC) program could be expanded. An ALC program on Invasive Species is already developed and being used by local school districts and additional programs on topics such as White-tailed deer or Geographic Information Systems (GIS) could be established. In addition to school curriculum, public programs and workshops offered by Buffalo Museum of Science educators or Friends of Tifft Nature Preserve, Inc. volunteers are a great way to educate and attract families, students outside of the classroom, and lifelong learners of all ages.

Public Use & Enjoyment

- 1) *Maintain Boardwalks & Trails* – In the fall of 2008 an extensive project to repair and maintain the boardwalks, viewing blinds, and trails was undertaken at the preserve. Following completion of this project, the trails will require routine upkeep such as mowing, brush clearing and periodic covering with crushed stone in some areas to maintain safe and enjoyable access to all visitors.
- 2) *Pursue Funding for Buildings & Grounds Maintenance* – Upkeep of an aging building and considerable grounds keeping duties will be continually needed at the preserve to ensure visitors have an enjoyable experience and to maintain a good public image. Secure funding for buildings and grounds maintenance is an ongoing need.

Staffing Levels

The Master Plan (Ecoplans 1975) laid out a staffing structure that included 11 full time and 10 part time employees at the preserve to carry out the essential functions of administration, education, research and maintenance. Funding for preserve staff and an annual budget was to come from the following sources: the City of Buffalo, user fees, membership and contributions, and grants. Such a large staff and dated funding structure are not appropriate for the preserve at this time. Currently funding is provided by the Buffalo Museum of Science, Friends of Tifft Nature Preserve, Inc., and grants, and staffing levels are being built up again after losses from the 2005 county budget crisis.

In 2007, an AmeriCorps member was hired by Friends of Tifft Nature Preserve, Inc. to staff the visitor center. With the AmeriCorps position and a museum educator, the two-person staff keeps the visitor center open Wednesday through Sunday. At the start of 2008, a full time ecologist was hired to oversee land management and conduct research on the preserve. The museum also commits 20 hours/week of Operations staff to buildings and grounds maintenance at the preserve. In the fall of 2008, both Friends of Tifft Nature Preserve, Inc. and the Buffalo Museum of Science will hire AmeriCorps members to function as cabin greeters, volunteer coordinators, assist educators, and work with the preserve ecologist on land management projects. The Development department at the museum obtained funding for a Tifft Experience Manager that will be filled soon. This position will be responsible for day to day operations and improving the sustainability of Tifft Nature Preserve.

The staffing structure proposed in the Master Plan is not the appropriate for the preserve today, but it includes the key components of successful nature preserves and similar conservation, education and research institutions. The Organization for Biological Field Stations produced an informative Operations Manual (OBFS 2001) for helping others in planning, funding and operating a field station. Estimated staffing requirements from this manual include three full-time administrators (including an executive director and facilities manager), one or more full-time support staff, a full-time education coordinator with a full-time education assistant and a science staff of varying size. See Table 4 for a listing of staffing levels of nature centers and other similar institutions in New York and elsewhere. While the locations, sizes, and missions of the institutions vary, the positions of director/manager and maintenance staff are common among them all. Successful implementation of this management plan will require administrative leadership and also increased and consistent staffing for maintenance of the preserve's buildings and grounds, as well as for habitat improvement and restoration projects. With increased resources, Tifft Nature Preserve will operate at full capacity and maintain staffing levels similar to other nature centers and institutions shown in Table 4.

Table 4 Staffing levels for various positions at nature centers, field stations, and other similar institutions

| Position Description | Tiift Nature Pres. | OBFS Manual | Beaver Meadow | Reinstien Woods | Iroquois NWR | Albany Pine Bush | Rice Creek Fld. Stn. | Q. Hill Nature Center | Beaver Creek Reserve | Archbold Biological Station | Tyson Research Center |
|------------------------------|--------------------|-------------|---------------|-----------------|--------------|------------------|----------------------|-----------------------|----------------------|-----------------------------|-----------------------|
| Location | NY | N/A | NY | NY | NY | NY | NY | MN | WI | FL | MO |
| Director or Manager | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Other Administrators | 1 | 1 | 1 | 0 | 0 | 3 | 1 | 1 | 2 | 2 | 2 |
| Admin. Support Staff | 2 | 1+ | 1 | 0 | 0 | 2 | 1 | 1 | 4 | 4 | 3 |
| Facilities and Maintenance | 0.5 | 1 | 1 | 1+ | 2 | 2 | 1 | 1 | 2 | 3 | 2 |
| Education and Interpretation | 2 | 2 | 2 | 3+ | 1 | 2 | 3 | 6 | 2 | 0 | 0 |
| Scientists | 1 | varies | 0 | 0 | 2 | 1 | 0 | 0 | 0 | many | 2 |
| Total Staffing Level | 6.5* | 6+ | 6 | 5+ | 6 | 11 | 7 | 10 | 11 | 10+ | 10 |
| Acerage | 264 | N/A | 324 | 298 | 5,000+ | 3,010 | 321 | 290 | 360 | 5,193 | 2,000 |
| Sponsor Organization | BMS | N/A | Audubon | NYS DEC | US FWS | TNC | SUNY Oswego | School District | County Gov't | NonProfit Group | Washington University |

* Staffing level is when all planned positions are filled.

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Appendix

Stakeholder Input During Planning at Tifft Nature Preserve

Gathering stakeholder input is an important component of natural resource planning and was conducted during the development of this management plan. The involvement of stakeholders such as Friends of Tifft Nature Preserve, Inc., organizations affiliated with the Buffalo Museum of Science, and a dedicated group of volunteers are essential to the operation of Tifft Nature Preserve, fulfilling its mission and implementing this management plan. These stakeholders are a constant resource for ideas, assistance and enthusiasm. Their input is summarized below and was incorporated in this plan.

Volunteer Meeting – Monthly meeting of the Tifft Nature Preserve volunteers held on 21 February 2008

Natural Resource Management

- Control of beavers and damage they cause to trees
- Control of *Phragmites* and Japanese knotweed
- Assessment of the deer herd and its impact
- Look into planting more buttonbush
- Reduce the amount of stinging nettle
- Management of Canada geese
- Encourage more wild animals, wildflowers, and diversity

Public Use & Enjoyment

- Increase visitation with public outreach programs
- Get the community more involved with the preserve
- Improve publicity to make the preserve more visible
- Construct an observation tower
- Highlight the preserve as a birding destination by producing birding route maps, host a birding festival, include the preserve in vacation packages
- Recruit more volunteers

Friends of Tifft Nature Preserve, Inc. – The Preservation and Maintenance Committee met to update their project list for the preserve on 13 March 2008

Committee - R. Andrie, H. Darling, J. DeCarolus, C. Welch, W. Bogacki, E. Ratajczak and M. Frawley

Purpose - To maintain suitable habitat diversity and biodiversity at the Tifft Nature Preserve and maintenance of infrastructure to an extent and quality approved by the Friends of Tifft Nature Preserve, Inc.

Preliminary List of Projects

1. Boardwalks & Trails – Needs will be determined and prioritized by the committee in April and a plan for permitting, funding, and construction will be developed before the end of 2008
2. Wetland Dredging Spoils – Spoils will be monitored for the next year for invasive species and a plan for planting or relocation will be developed
3. Management of Water Levels – M. Frawley and D. Spiering will monitor water levels in the marsh to maintain high water levels
4. Overall Preserve Management – D. Spiering is drafting a management plan to address issues such as invasive species, nuisance wildlife (beaver, deer), utility corridor, habitat improvements, etc.
5. General Maintenance and Infrastructure for Public Use – Scout groups could build benches, signs, bird houses, beaver control structure, etc.
6. Revise and Update Wildlife and Plant Lists – Planning a Tifft Nature Preserve Bioblitz in summer of 2009 or 2010
7. Public Overlooks, Observation Tower or Blind – Continue to address feasibility and strategic placement, especially while working on Project #1
8. Security – Increased museum and preserve staffing and activity should reduce security concerns
9. Expand Preserve – Pursue options to incorporate properties to the south and east to be included in the preserve
10. Additional Projects – Please make suggestions to committee

Public Meeting – An open public meeting advertised in Tifft Tales (volunteer newsletter), Friends of Tifft Nature Preserve newsletter, Nature Preserves (newsletter of the Nature Sanctuary Society of Western New York) and Clintonia (magazine of The Niagara Frontier Botanical Society) held on 20 May 2008

Natural Resource Management

- Invasive species management
- Stock fish in Lake Kirsty

Public Use & Enjoyment

- Install seasonal appropriate interpretive signage
- Improve indoor exhibits
- Install a web cam or running slide that can be viewed in the cabin
- Trail north of Beth Pond needs improvement
- Create a trail along the perimeter, particularly on eastern side of preserve
- Make connections with South Buffalo groups such as the Dudley Library
- The level of security at the preserve was questioned
- Get people to come back
- Increase marketing such as newspaper posting or school connections
- Install a suggestion box and post answers
- Sell drinks, snacks and coffee
- Improve website and all online survey and input section
- Continue the snowshoe rental program
- Encourage activities such as nature photography

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