

Little Traverse Bay Band of Odawa Indians Terrestrial Invasive Species Strategic Management Plan



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September 30, 2019

Funding for this project was provided by the Bureau of Indian Affairs Invasive Species Grant Program

Suggested Citation:

May, Liana and Phyllis Higman. 2019. Little Traverse Bay Band of Odawa Indians Terrestrial Invasive Species Strategic Management Plan. MNFI Report No. 2019-26. 96 pp.

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Acknowledgements

We would like to thank the Bureau of Indian Affairs for funding this project and Noah Jansen for pursuing it and reaching out to us. Noah's dedication to a deep understanding of the natural world is evident in the vision he has set forth for systematically addressing invasive species within the Reservation, one of the leading threats to biodiversity world-wide. We are grateful for the many colleagues and friends who have helped us understand Michigan's ecosystems and the threat that invasive species pose to them.

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Introduction

The LTBB and Odawa People

The Little Traverse Bay Band (LTBB) of Odawa people have lived in the northwestern Lower Michigan region for hundreds of years. Historically, the tribe engaged in making maple syrup, growing crops, fishing, hunting, and gathering food and medicine around the northwestern Michigan region, and were known to travel to southern Michigan in winter months. As Europeans began to settle in the Straits area, Escanaba, and south to Petoskey, staple supplies became available and regional migrations declined (LTBB 2005). The LTBB established a permanent settlement in 1742 at Waganakising (L'arbre Coroche), located between Harbor Springs and Cross Village, and the band has remained in this area since.

The 1836 Treaty of Washington ceded land to the United States for settlement, but also secured rights for Native American tribes to retain their homeland, and preserved rights to hunt, fish, and gather plants on lands not required for settlement, referred to as "Treaty Rights." In 1855, the Treaty of Detroit outlined the Tribe's reservation area as 337 square miles along the northwestern portion of Northern Lower Michigan in Emmet and Charlevoix Counties (Fig. 1). With the signing of the Public Law 103-324 in 1994, the Waganakising Odawak were reaffirmed by the U.S. Congress as the Little Traverse Bay Bands of Odawa Indians (LTBB). Currently, the Tribe has over 4,300 members governed by a nine-member Tribal Council.

This plan addresses terrestrial invasive species management within the Reservation as defined in the LTBB Constitution. This is a 337-square mile Treaty-delineated area and any Tribal Trust land outside of that area. Most of the reservation area is not owned by the Tribe or its members since the land was opened to European settlement in the 1870s; the Tribe directly manages about 1,000 acres of land that is registered in the Tribal Trust. The Tribe uses and manages resources on public land that they have a vested interest in to exercise treaty rights.

Regional Natural Resources

The LTBB Reservation lies across a glaciated landscape with sandy and loamy calcareous soils overlying shale and limestone. As the Wisconsin glaciations receded 10,000 years ago, they left behind a landscape characterized by rolling glacial till, outwash plains, lacustrine deposits, kettle and embayment lakes, streams and rivers. The Beaver Archipelago lies 20 miles offshore and consists of 15 islands, two of which are within the LTBB reservation. Nisiwabigong (High) Island is about 3,500 acres and Kiigaan Mnijsing (Garden) Island is about 4,500 acres, both of which are owned by the State of Michigan, except for a small amount of private land on Garden Island.

A natural community is an assemblage of interacting plants, animals, and other organisms that repeatedly occurs across similar environmental conditions across the landscape. The dominant natural communities in this region are mesic northern forest, rich conifer swamp, and hardwood-conifer swamp. There are smaller amounts of dry-mesic northern forest, boreal forest, dune and shoreline communities, and a variety of wetland communities including wet meadows, emergent and submergent marshes, fens, and interdunal wetlands. These communities are home to many plants and animals important to the Tribe, such as black ash and sweetgrass (Appendix 1). This area is also important to rare species in the state of Michigan. There are 477 records of 83 Michigan special concern, threatened or endangered species (Appendix 2). This includes five species known only from the Great Lakes region (endemic): state and federal threatened *Iris lacustris* (dwarf-lake iris), *Solidago houghtonii* (Houghton's goldenrod) and *Cirsium pitcheri* (Pitcher's thistle) and state and federal endangered *Mimulus*

michiganensis (Michigan monkey-flower) and *Somatochlora hineana* (Hine's emerald dragonfly). Other federally listed species that occur within the Reservation, Emmet or Charlevoix counties include federal and state endangered piping plover (*Charadrius melodus*) and Hungerford's crawling water beetle (*Brychius hunderfordi*), federal threatened and state species concern northern long-eared bat (*Myotis septentrionalis*), federal threatened and state special concern eastern massasauga (*Sistrurus catenatus*).



Figure 1. Open dunes north of Waganakising with populations of state threatened Lake Huron tansy, Pitcher's thistle, and Pumpell's brome occurring with invasive spotted knapweed (photo by L. May).

Since the growth in European settlement began in the 1800s, the area has undergone many changes. Forests across the region were cleared for timber in the late 1800s and early 1900s, and this gave way to agriculture and livestock operations in the early and mid-1900s. Wetland loss is concentrated across the northern portion of Emmet County and corresponds with the expansion of aspen and birch forest. Development and urban growth has been concentrated around Petoskey and Harbor Springs, and along the Lake Michigan and inland lakes' shorelines. High-quality natural communities occur across the region, including large wetland complexes (Maple River, Wycamp Lake), Great Lakes shoreline communities (Wilderness State Park), and dry-mesic and mesic northern forests. High and Garden Islands are the least anthropogenically disturbed and together harbor seventeen occurrences of twelve natural community types; fifteen of which are ranked AB or higher in Michigan's Natural Heritage database.

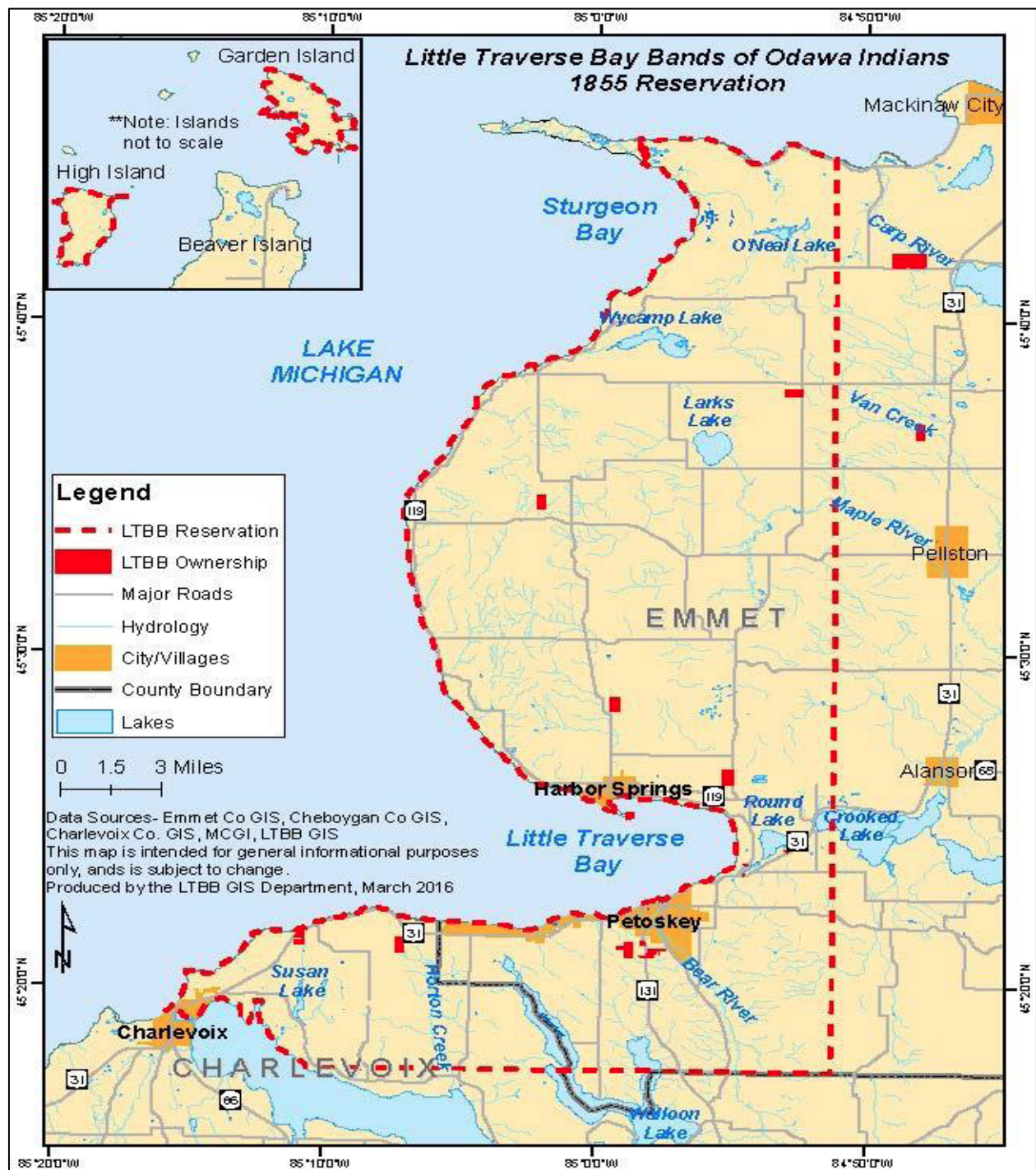


Figure 2. Little Traverse Bay Band of Odawa Indians 1855 Reservation Boundary.

The State of Michigan owns a significant amount of land across the Reservation area in Emmet County. This land is managed by the Michigan Department of Natural Resources as State Forest Land, State Wildlife and Game Areas, and State Parks and Recreation Areas. These public lands provide important areas to exercise treaty rights, and the tribe may have a vested interest in managing resources, including terrestrial invasive species, on state-owned land. The State also has a great deal of experience managing TIS on their land and can be looked to for collaboration.

Terrestrial Invasive Species

Terrestrial invasive species (TIS) are non-native species that occur predominantly on uplands and “whose introduction does or is likely to cause economic or environmental harm or harm to human health” (Executive Order 13112, Feb 3, 1999). While this plan focuses on TIS, it is important to understand that some of these can invade wetlands under certain conditions and are not restricted to upland areas. TIS outcompete native plants and animals, or in some cases, cause disease and death. They reduce the biological diversity, resilience, and functionality in native ecosystems and alter landscapes to reduce amounts of suitable habitat for native plants and animals. In turn, this reduces the ecosystem services and cultural resources that are provided by natural systems. The Michigan Terrestrial Invasive Species State Management Plan (2016) states that TIS cause economic damage to infrastructure and equipment, decrease the aesthetic quality and value of real estate, impact forests including loss of thermal cooling and increase rainwater runoff, decrease yields in crops, increase use of herbicides, and decrease tourism and opportunities for wildlife viewing. Because of the many ecological and cultural impacts of TIS, the LTBB Natural Resource Department made the management of these species a priority in the Natural Resource Department’s Strategic Plan (2016). This TIS Strategic Management Plan seeks to outline TIS prevention, early detection and management strategies.

Vision Statement

In recognition of the damaging effects that TIS have on the environment, economies, human health, and cultural traditions, we aim to minimize negative impacts from TIS to the LTBB community and the natural communities within the 1855 Reservation Area for the next seven generations by:

- Identifying and prioritizing TIS that threaten culturally important resources, threatened and endangered species, and natural communities in the reservation area
- Preventing the arrival and spread of TIS in the reservation area
- Eradicating populations as possible
- Containing the spread of established TIS populations
- Managing and restoring high value sites where success is likely to be achieved

Guiding Principles

Invasive species are abundant, can invade every natural community type and spread across jurisdictional boundaries. With expanding global trade and regional recreation, the arrival of new, unpredictable invasion is certain, making the task of addressing and managing invasive species especially challenging. In the face of this challenge, prevention and management of invasive species impacts can be accomplished most effectively by embracing the following guiding principles when determining which activities are carried out where, and how.

- ❖ *Collaboration and community engagement*
- ❖ *Prevention management*
- ❖ *Risk assessment and prioritization of both species and sites*
- ❖ *Integrated pest management*
- ❖ *Monitoring and adaptive management*

These principles are described in the following sections and together they serve to guide activities that are undertaken to address TIS in the region.

Collaboration and Community Engagement

Invasive species cross jurisdictional and property boundaries, disperse through a variety of mechanisms and can re-invade sites after control measures have been taken. Confronting this challenge necessitates collaboration with all stakeholders involved and requires the establishment of effective planning and communication channels. The LTBB owns only a small area of the land within the reservation boundaries, making it imperative to work with other landowners to address TIS across the region. Creating partnerships with involved landowners, land managers, and stakeholders is central to successful management. Much of the regional collaboration can be organized through the Charlevoix, Antrim, Kalkaska, Emmet Cooperative Invasive Species Management Area (CAKE CISMA). The Midwest Invasive Species Information Network (MISIN) is an excellent resource for location data on invasive species; they maintain a continually updated web-based database on invasive species locations that the LTBB may draw information from and upload observations to. In addition, the Michigan Invasive Species Coalition (MISC 2018) is the guiding body for CISMAs and has many resources to offer.

Along with collaboration between organizations and stakeholders, it is important to be proactive in engaging the community and encouraging participation in invasive species management because it is often individuals' choices that can result in the spread or curtailment of a TIS population. There are gaps in understanding the impacts of invasive species, and divergent values within communities for how, where and which invasive species should be managed. It is important to understand community values, perceptions, and preferences and work together to find common ground to move forward with collaborative efforts. It is also critical to document and learn from activities that are undertaken and adapt them as needed. It is a waste of resources to use methods that do not achieve management goals.

Educational and informational campaigns are effective at bringing everyone to a common understanding of the issues and potential solutions that empower citizens to take initiative on their private land, to help in work bees, or to make good decisions when landscaping. Messages should be well researched and accurate, and the timing and goals of messages should be aligned with partner organizations across the region to create a synergistic effect. It is important to establish a two-way line of communication, taking in and responding to potential questions and concerns the community may have.

The following lists identify many key partners in the region that are or could be involved in collaborative invasive species efforts. It is important, however, to take the pulse regularly to determine if additional partners could be helpful; partners will come and go, and new skills sets may be required as control efforts and techniques progress over time.

Conservation and Educational Non-Governmental Organizations

- CAKE CISMA
- Little Traverse Conservancy
- The Grand Traverse Regional Land Conservancy
- Walloon Lake Trust and Conservancy
- Tip of the Mitt Watershed Council
- Michigan Natural Features Inventory
- Midwest Invasive Species Information Network
- Michigan Invasive Species Coalition
- The Stewardship Network
- The Nature Conservancy

Private Landowner Groups

- Emmet County Lakeshore Association
- Beaver Island Association
- Pickerel-Crooked Lakes Association
- Walloon Lake Association
- Larks Lake Association

Local Government

- Emmet and Charlevoix County Conservation Districts
- Emmet and Charlevoix County Road Commissions
- Emmet County Parks and Recreation Departments
- Townships and Municipalities

State and Federal Resource Agencies

- Wilderness and Petoskey State Park
- Michigan Department of Natural Resources
- Michigan Department of Environment, Great Lakes and Energy
- Michigan Department of Agriculture and Rural Development
- Natural Resource Conservation Service
- United States Fish and Wildlife Service
- United States Forest Service



Figure 3. Collaborative planning teams at work indoors and outdoors (photos by P. Higman).

Prevention Management

The most effective method of managing invasive species is to prevent their arrival and establishment (Leung et al 2002). Prevention involves first assessing potential species that pose a future threat, then identifying pathways of introduction. Land managers should be proactive in tracking movements of new invasive species through the state and country, training on the identification of early detection species, and assessing and reducing local invasion pathways. Prevention management should have an emphasis on public education and outreach to raise awareness of invasive species and the importance of individual actions in preventing their arrival and spread.

A dispersal pathway is a means by which a species is transported from one area to another. Dispersal pathways are dependent on the reproductive biology and dispersal mechanisms of the organism; they vary by species but can also be grouped into major categories. Natural pathways include wind, hitching on animals, and water currents. Man-made pathways are both intentional and unintentional, and overcome natural dispersal barriers or increase dispersal rates and distances. Many invasive species have become established through intentional pathways such as conservation plantings (e.g. autumn olive), the horticulture industry (e.g. Japanese barberry), supplementing livestock pastures (e.g. reed-canary grass), and forestry (Scotch pine). Unintentional pathways include a wide variety of activities, such as trade and shipping, movement of construction materials, utility and logging equipment, movement of natural resources such as firewood, hay, and soil, and as hitchhikers on campers, hunters, and natural resource managers. Key man-made invasion pathways for TIS species in northwestern Michigan are listed in Table 1.

Table 1. Primary human dispersal pathways for TIS and management considerations.

Invasion Pathway	Ways to reduce TIS dispersal
Firewood and timber harvest and sales	<ul style="list-style-type: none"> ▪ Don't move firewood or timber out of quarantine zones ▪ Do not move firewood from the mainland to the Beaver Island Archipelago unless it is certified to be pest-free (such as heat-treated firewood) ▪ Do not bring timber or firewood in from out-of-state unless certified ▪ Minimize number of logging trails ▪ Clean equipment, tire treads, before and after activities (see Ontario Clean Equipment Protocol: http://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/Clean-Equipment-Protocol_June2016_D3_WEB-1.pdf)
Construction, development, and restoration activities	<ul style="list-style-type: none"> ▪ Clean machinery, especially tire treads or tracks, before and after (see Ontario Clean Equipment Protocol above) ▪ Avoid using soil from off-site or use weed-free soil ▪ Encourage adoption of native plants ordinances for new construction ▪ Work from non-infested sites to most infested sites when mowing, grading, clearing ▪ Avoid bringing machinery into areas free of earthworms
Campers, trail users, hunters, other outdoor activities	<ul style="list-style-type: none"> ▪ Use boot-brushes at trailheads to remove seeds and dirt from treads ▪ Post educational material (ports, rest areas, souvenir shops, visitors centers, trailheads) ▪ Minimize redundancy in access roads, parking areas, and trails ▪ Encourage trail users to stay on designated trails ▪ Remove dirt, bugs, and plants from gear and footwear before returning home ▪ Dispose of extra earthworm bait in the trash not on land or water ▪ Use local firewood, do not bring it from home ▪ Burn all firewood during your trip ▪ Clean ORVs especially tire treads

Tourism related activities	<ul style="list-style-type: none"> ▪ Wash vehicle before traveling to a new area ▪ Clean luggage and outdoor gear ▪ Check pets for hitchhiking seeds ▪ Educate tourists on TIS dispersal pathways
Horticultural trade	<ul style="list-style-type: none"> ▪ Encourage retailers and wholesalers to stop selling known TIS ▪ Educate the public on alternatives to TIS ▪ Encourage the use of plants grown in the region ▪ Avoid non-native plants that set seed ▪ Use certified or weed-free material (soil, mulch, gravel, rock)
Research and monitoring activities	<ul style="list-style-type: none"> ▪ Clean boots, waders, instruments, backpacks, and other gear ▪ Avoid travelling through infested areas ▪ If you must go to weed-infested areas, do this after visiting high-quality areas
Agricultural activities	<ul style="list-style-type: none"> ▪ Use certified or weed-free hay and straw ▪ Use weed free materials (soil, gravel, rock) ▪ Burn or utilize wood waste (pallets, crates, packing materials) ▪ Clean machinery when moving between fields

Risk Assessment and Prioritization of both Species and Sites

Risk assessment is the process of identifying the likelihood of a species' introduction, establishment, and spread, the severity of its impact on the environment, human health and the economy, and its response to control methods (Lodge et al 2016). It provides a science-based approach to understanding the risks posed by a species to our local ecosystems through its biology and functional role in its native range, history of invasiveness elsewhere, impacts of past control efforts, and dispersal pathways. Risk assessment also considers potential contributing or interacting factors such as climate change, pollution, and land use activities. Risk assessments can also apply to ecosystems in terms of assessing their vulnerability to invasion, however such assessments are less common.

Some species that have been identified as posing high risk to the environment, economy, or human health have been regulated by the State of Michigan under the Natural Resources and Environmental Protection Act of 1994 and their import, sale, and possession is restricted or prohibited (Appendix 3). Other high-risk species that are not yet regulated have been recognized as priority species by the state and are included in the State's Watch List (Appendix 4). Still other species have demonstrated significant impacts to ecosystems, the economy or human health, but are not formally recognized or regulated in Michigan. Appendix 5 provides a list of all relevant laws relating to invasive species.

This plan uses existing risk assessment data from multiple sources and personal field experience to identify priority species and categorize them as prevention, early detection, containment or asset-based control species. These categories reflect phases of an invasion shown in Figure 4 below. The goal is to be as cost-effective as possible by steering action towards the left end of the curve to prevent priority species that are not here from arriving and responding to those that are uncommon while they are still uncommon. For larger infestations at the right end of the curve, the objective is to contain species for which control is not feasible and treat priority species at important sites where control is feasible and likely. Time and money should not be wasted on treatments where success is unlikely, unless there is a longer-term solution.

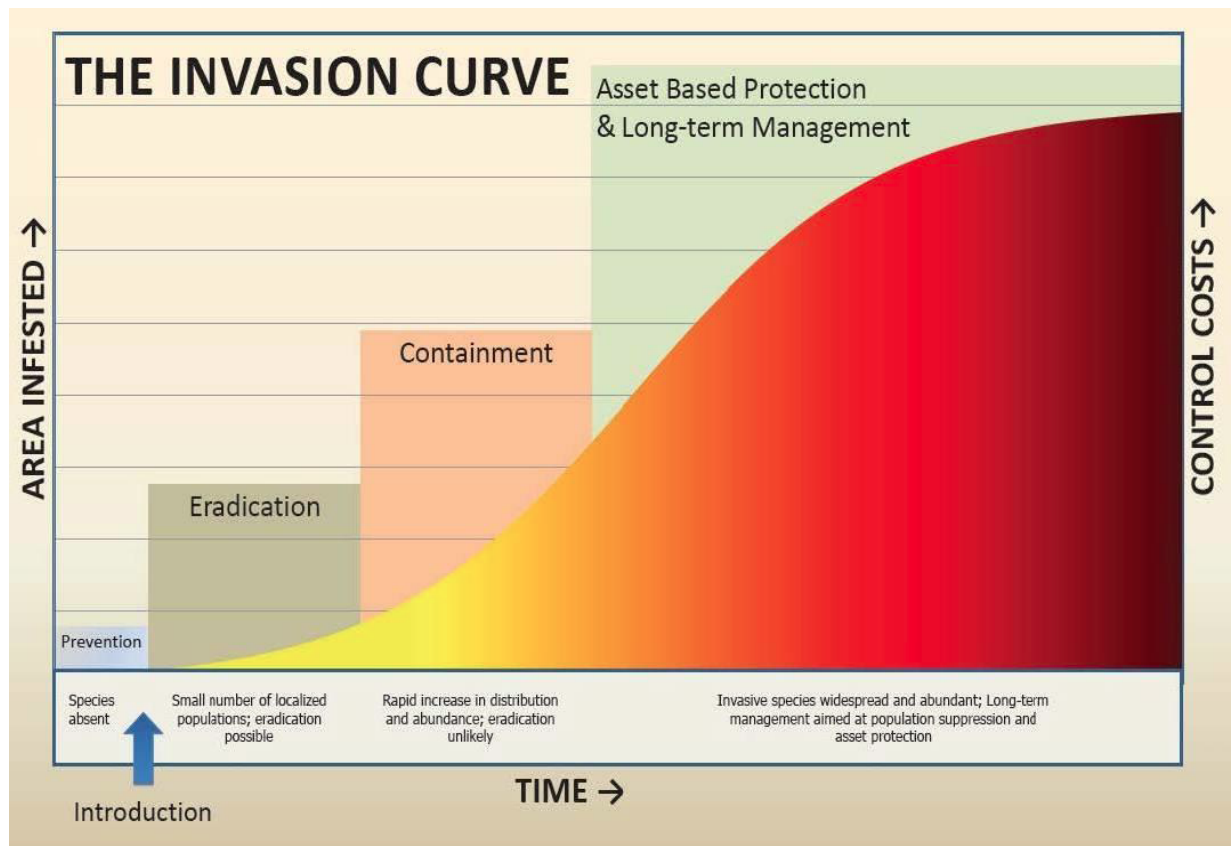


Figure 4. Eradication of terrestrial invasive species is rare but is most likely when population numbers are low and the area infested is small, using the early detection and response (EDR) strategy for species that are in the eradication portion of the curve.

Resources are always a limiting factor when addressing invasive species, and it is important to establish priority species as well as important sites and assess how priority species are distributed and dispersing in relationship to important sites. Many plans focus on a species-based approach at the expense of identifying important places that comprise the ecological infrastructure of the region. It is important to take the time to identify and map ecologically and otherwise important places and deliberately plan to keep invasive species out of the most intact areas. It is also important to take the time to understand and improve distribution data for invasive species as well as the risks they pose, before prioritizing and acting. Knowing the threat, distribution and abundance of invasive species is central to the determination of early detection, containment, and asset-based control species. Overlaying these data with the distribution of important sites makes decision-making easier and more powerful. Depending on traits of the target species, the size and density of the population, the location of the population, potential ecological, cultural or socio-economic losses, and available resources, target populations can be assessed on a case by case basis to prioritize treatment projects.

Invasive species distribution data are far from complete and this plan recommends the development of a regular detection-monitoring survey strategy to look for priority species based on known and likely hotspots, entry points and dispersal vectors such as roads. It also recommends considering dedicated surveys of the highest priority species and training staff and partners to map and report priority species during the course of their work. Using a simple system such as the MISIN mapping application (Appendix 7), which requires only the species, the location and drop-down categories of density and abundance, has been extremely effective in getting highly informative invasive species occurrences on a map. Making a habit of mapping invasive species when you see them, rather than after the fact will improve

distribution maps much more quickly and enable the implementation of more targeted and cost-effective actions.

Aggressive, quickly spreading TIS in high-quality natural areas or other highly valued areas with a high likelihood for successful eradication or control should be prioritized. It is especially important to prioritize early detection species, but containment species that are newly invading high-quality areas can also be prioritized (asset-based control). Seed-source populations should be targeted for species that are readily animal dispersed, because these populations will continually introduce new propagules to satellite areas. Generally, it is most effective to treat smaller satellite populations first to keep them from expanding, and then work inwards towards the core infestation. Species that are well established across the landscape are the most difficult and costly to manage, and treatment programs have a lower success rate. Management of these infestations should focus on high priority areas where successful control is likely.

Table 2 presents four key questions that should always be considered before prioritizing and taking action to address any invasion. The CAKE CISMA has also developed a prioritization tool that can be used to rank different TIS populations (Appendix 8).

Table 2. Guidance on prioritizing TIS populations.

What is the value of the site that the species is invading?	<ul style="list-style-type: none"> ▪ Are there important cultural resources at this site? ▪ Are there high-quality natural communities at this site? ▪ Are there threatened or endangered species at this site? ▪ Will the TIS impact recreation, economic, or agriculture at or near the site? ▪ Could treatment at the site be used as an education opportunity (e.g. training volunteers, posting signs at boat launches or along trails)? ▪ Is this site owned by the LTBB? ▪ Do tribal members have access to hunt, fish, or gather at this site? ▪ Are there vulnerable sites nearby in which the TIS may readily spread? ▪ Are there activities at the site that may support or distract from successful management?
What kind of threat does the TIS pose?	<ul style="list-style-type: none"> ▪ Is this an EDRR or asset-based control species? ▪ What are the impacts to the ecosystem? ▪ What is the reproductive biology of this species? ▪ What are the primary pathways of dispersal? ▪ How abundant is this species at the site and in the region? ▪ How fast does this species reproduce or spread?
What is the distribution and extent of the TIS?	<ul style="list-style-type: none"> ▪ Where can treatment be most effective and likely to succeed (satellites vs. source populations)? ▪ How does this species spread? ▪ Are there nearby populations that will re-infest the treatment site? ▪ Are there pathways that need to be blocked?
What resources are available to treat this species?	<ul style="list-style-type: none"> ▪ Are there enough resources to successfully complete the management goals? ▪ Is collaboration with other organizations possible (e.g. follow-up monitoring, repeated treatments, restoration)? ▪ Is there special funding available to treat this species?

Priority Species

As new species or new populations establish, they become increasingly more costly and laborious, or impossible to eradicate. Many well-established invasive species in northern Michigan have become

permanent fixtures within our landscape. For this reason, it is critical to prioritize species that pose the highest risks to the most important places. Terrestrial invasive species were categorized into four management groups: Prevention, Early Detection and Response, Containment, and Asset-based Control. Additionally, each species was assigned a threat potential ranking, with 1 being of least concern, and 5 being of highest concern (Table 3). An additional category of undetermined threat is used for species in which there is not enough information available to determine the threat level. The assigned category is based upon best current knowledge; however, these will evolve over time as new information comes to light. Priorities for action will reflect these risk categories as well as on-the-ground conditions. These lists represent a snapshot in time and are intended to guide decision-making; they should not be considered absolute as species distributions and ecological conditions will change over time. The categorization of species should be reviewed regularly.

Table 3. Traits characterizing each priority level for TIS on the LTBB Reservation.

Prevention	EDR	Containment	Asset-based Control
Threat level 2-5 (moderately low to high)	Threat level 3-5 (moderate to high)	Threat level 2-5 (moderately low to high)	Threat level 1-5 (low to high)
Not present in the LTBB Reservation	Not present in the LTBB Reservation or extremely limited	Already established on the LTBB Reservation	Established in many areas on the LTBB Reservation, or a lower threat species that may or may-not be widely established
Eradication extremely difficult – no effective control or control methods have unacceptably high costs to non-target species	Eradication possible if treated early	Eradication extremely difficult – species already well established in some areas on the LTBB Reservation	Eradication likely impossible – species is already well established in many sites on the LTBB Reservation, but control may be warranted to achieve site-specific objectives

Over 250 species were reviewed and evaluated for this plan. Species present in Emmet and Charlevoix Counties were determined using the MISIN database and correspondence with regional land managers. TIS that are not yet present in the Reservation, but may pose a future threat, were determined using state and national publications, watch lists, distribution maps and species physiological niche data. Once species distribution and abundances were determined, each species was evaluated for threat level that it poses for natural communities present within the Reservation, given the species' ecology and biology. Species that were determined not to pose a significant threat were culled from the target list. Remaining species are classified in Tables 4-8. Data was drawn from the following sources:

- CAKE CISMA, The Little Traverse Conservancy
- LTBB Natural Resources Department, Northwestern Michigan Invasive Species Network (ISN)
- Midwest Invasive Species Information Network (MISIN)
- Michigan's Terrestrial Invasive Species State Management Plan
- Michigan Natural Features Inventory
- Michigan Watch List, State of Wisconsin's Chapter NR 40 Invasive Species Rule
- Midwest Invasive Plant Network (MIPN)
- CABI Invasive Species Compendium
- Bugwood.org
- NatureServe

Prevention Species

This group of species (Table 4) is best managed by working to prevent their arrival within the reservation area. Species are assigned this category if they pose a significant threat and have not yet arrived in the state, or in some cases, the reservation area, or if they can only be managed by prevention (e.g., some tree diseases). Preventive measures include educating people about how to identify them, how they can be spread, how to report them using the MISIN and working cooperatively to reduce potential dispersal pathways such as internet sales, the pet trade and recreation activities.

Table 4. Species best managed by taking preventative measures.

Lifeform	Scientific Name	Common Name	Legal Status	Threat Level
Disease	<i>Ceratocystis fagacearum</i>	oak wilt		5
	<i>Pityophthorus juglandis</i> & <i>Geosmithia morbida</i>	thousand cankers disease	Watch List	5
Insect	<i>Adelges piceae</i>	balsam woolly adelgid	Watch List	5
	<i>Adelges tsugae</i>	hemlock woolly adelgid	Watch List	5
			Watch List	
	<i>Anoplophora glabripennis</i>	Asian longhorned beetle	Prohibited	5
	<i>Dendroctonus ponderosae</i>	mountain pine beetle	Watch List	5
Mammal	<i>Sus scrofa</i>	feral swine	Prohibited	3
Mollusk	<i>Achatina fulica</i>	giant African snail	Prohibited	5
Plant	<i>Achyranthes japonica</i>	Japanese chaff flower		3
	<i>Alnus glutinosa</i>	black alder		4
	<i>Brachypodium sylvaticum</i>	slender false-brome		5
	<i>Cardamine impatiens</i>	narrow-leaved bittercress		4
	<i>Carex kobomugi</i>	Asiatic sand sedge	Watch List	4
	<i>Centaurea spp. (diffusa, jacea, nigra, repens)</i>	knapweeds		4
	<i>Dioscorea polystachya</i>	Chinese yam	Watch List	4
	<i>Glyceria maxima</i>	reed mannagrass		4
	<i>Humulus japonicus</i>	Japanese hops		4
	<i>Lespedeza cuneata</i>	Chinese lespedeza		4
	<i>Mahonia aquifolium</i>	Oregon grape		3
	<i>Microstegium vimineum</i>	Japanese stiltgrass	Watch List	5
	<i>Miscanthus sinensis</i>	Chinese silvergrass		3
	<i>Paulownia tomentosa</i>	princess tree		3
	<i>Persicaria perfoliata</i>	mile-a-minute weed	Watch List	5
	<i>Petasites hybridus</i>	butterbur		5
	<i>Phellodendron amurense</i>	Amur corktree		5
	<i>Typha laxmannii</i>	graceful cattail		5
	<i>Valeriana officinalis</i>	common valerian		3



Figure 5. Asian longhorned beetle (left, photo by D. Duerr), mountain pine beetle (middle, photo by PaDIL), and hemlock woolly adelgid (right, photo by T. Coleman) are managed by restricting the flow of firewood and timber into the area from quarantine areas.

Early Detection and Response Species (EDR)

Species in this category (Table 5) are newly invading species that pose a significant threat if they become established but may be controlled by early detection and timely and effective responses. This includes species on the Michigan Watch List that are present in the state and newly identified TIS within northwestern Michigan. Early detection and response (EDR) is critical for managing emerging invasive species and includes educating partners and the public about newly identified invasive species and their known distribution, implementing strategic detection-monitoring, assessing newly documented populations, and implementing well-researched and timely response plans. Response plans should consider the risk assessment for the TIS, viable integrated pest management techniques, and risks and costs associated with treatments. Species listed in the EDR category should be prioritized wherever possible, regardless of site value, across the region, to keep them from establishing and spreading.

Table 5. Species managed through early detection and response (EDR).

Lifeform	Scientific Name	Common Name	Legal Status	Threat Level
Plant	<i>Alliaria petiolata</i>	garlic mustard		5
	<i>Ampelopsis brevipedunculata</i>	porcelainberry		3
	<i>Berberis thunbergii</i>	Japanese barberry		5
	<i>Berberis vulgare</i>	common barberry		4
	<i>Celastrus orbiculatus</i>	Oriental bittersweet		5
	<i>Fallopia japonica</i>	Japanese knotweed	Prohibited	5
	<i>Fallopia sachalinense</i>	giant knotweed		5
	<i>Fallopia x bohemicum</i>	Bohemian knotweed		5
	<i>Ficaria verna</i>	lesser celandine		3
	<i>Heracleum mantegazzianum</i>	giant hogweed	Prohibited	5
	<i>Leymus arenarius</i>	lyme-grass		4
	<i>Lonicera japonica</i>	Japanese honeysuckle		5
	<i>Lonicera maackii</i>	Amur honeysuckle		4
	<i>Pueraria montana var. lobata</i>	kudzu	Watch List	5
	<i>Rhodotypos scandens</i>	black jetbead		4
	<i>Rosa multiflora</i>	multiflora rose		4
	<i>Rubus phoenicolasius</i>	Japanese wineberry		3
	<i>Tussilago farfara</i>	coltsfoot		4



Figure 6. Lesser celandine is an EDR species that invades the forest understory and stream edges (photos by L. Mehrhoff, left and J. Randall, right from Bugwood.org).

Containment Species

Containment species (Table 6) are those that are widespread and well-established in northwestern Michigan and are unable to be eradicated at the landscape level. Management should focus on containing populations by reducing dispersal vectors and controlling populations as opportunities arise.

Table 6. Species best managed through containing to existing land area.

Lifeform	Scientific Name	Common Name	Legal Status	Threat Level
Plant	<i>Cynanchum louiseae</i>	black swallow-wort		5
	<i>Cynanchum rossicum</i>	pale swallow-wort		5
	<i>Pyrus calleryana</i>	Callery pear		3



Figure 7. Black swallow-wort infestation in the understory of a forest in southern Michigan; populations in Petoskey should be contained to existing land area .

Asset-based Control Species

Asset-based control species (Table 7) are species that are widespread and well-established in Michigan and not possible to eradicate at the landscape level but could be controlled at specific sites. Situations that may warrant treatment of otherwise widespread species include high-quality natural communities

and areas where the TIS will have a substantial impact on threatened or endangered species, or cultural resources.

Table 7. Asset-based control species are those that are widespread but may be treated to meet site-specific objectives.

Lifeform	Scientific Name	Common Name	Legal Status	Threat Level
Disease	<i>Cryptococcus fagisuga</i> , <i>Nectria</i>	beech bark disease		5
Insect	<i>Agrilus planipennis</i>	emerald ash borer	Prohibited	5
	<i>Halyomorpha halys</i>	brown marmorated stink bug		3
Plant	<i>Acer platanoides</i>	Norway maple	Restricted	5
	<i>Aegopodium podagraria</i>	bishop's goutweed		2
	<i>Ailanthus altissima</i>	tree of heaven		4
	<i>Centaurea stoebe</i>	spotted knapweed		4
	<i>Cirsium arvense</i>	Canada thistle		4
	<i>Elaeagnus angustifolia</i>	Russian olive		4
	<i>Elaeagnus umbellata</i>	autumn olive		4
	<i>Euonymus alatus</i>	burning bush		2
	<i>Euphorbia esula</i>	leafy spurge		4
	<i>Galium odoratum</i>	sweet woodruff		2
	<i>Gypsophila paniculata</i>	baby's breath		5
	<i>Hesperis matronalis</i>	dame's rocket		4
	<i>Ligustrum obtusifolium</i>	privet		4
	<i>Ligustrum vulgare</i>	privet		4
	<i>Lonicera morrowii</i>	Morrow's honeysuckle		4
	<i>Lonicera tatarica</i>	Tatarian honeysuckle		4
	<i>Lonicera x bella</i>	Bell's honeysuckle		4
	<i>Mentha x piperita</i>	peppermint		2
	<i>Myosotis scorpioides</i>	water forget-me-not		2
	<i>Nasturtium microphyllum</i>	watercress		2
	<i>Pastinaca sativa</i>	wild parsnip		4
	<i>Pinus nigra</i>	Austrian pine		1
	<i>Pinus sylvestris</i>	Scots pine		3
	<i>Rhamnus cathartica</i>	common buckthorn		5
	<i>Robinia pseudoacacia</i>	black locust		4
	<i>Silene vulgaris</i>	bladder campion		3
	<i>Viburnum opulus</i>	European highbush-cranberry		3
	<i>Vinca minor</i>	common periwinkle		3
	<i>Solanum dulcamara</i>	bittersweet nightshade		2

Species with an Undetermined Threat Level

The risks of many potential invasive species are not fully understood because systematic risk analyses have not been conducted for all species. This may be due to a lack of published information about the ecology and biology of a species in its native or introduced range, how it will interact with the ecosystems in Northwestern Lower Michigan, or because of a lack of funding, assigned responsibility or time to accomplish this task. The species listed here have been identified by various sources as

problematic and should be periodically reviewed as new information becomes available, so that they can be classified into one of the above four categories or deemed not to pose a significant threat in northwestern Michigan. If populations are present in the reservation area, it will be useful to monitor the rate of spread and ecological impacts. Many currently known invasive species had a significant lag time before their invasiveness became obvious. In addition, some species that are not currently invasive may become so if conditions, such as temperature or precipitation levels, change.

Table 8. Species with an undetermined threat level.

Lifeform	Scientific Name	Common Name	Legal Status
Mollusk	<i>Candidula intersecta</i>	wrinkled dune snail	Prohibited
	<i>Helix aspersa</i>	brown garden snail	Prohibited
	<i>Hygromia cinctella</i>	girdled snail	Prohibited
	<i>Monacha cartusiana</i>	Carthusian snail	Prohibited
	<i>Xerolenta obvia</i>	heath snail	Prohibited

Priority Sites

Priority sites are places that have important values for the LTTB and partners. These include areas of high conservation-value such as high-quality natural communities, natural communities that are declining in the state or globally, areas with threatened or endangered species, areas with high biological diversity, and large contiguous tracts of land. Priority sites also include natural communities with important cultural resources or those that are important for practicing treaty rights. They also include sites that pose safety concerns or that act as significant vectors of dispersal for TIS. Some priority sites are identified in Tables 9 and 10, however, evaluating the importance of sites will be an on-going process as new information is learned. Annual review of priority sites is recommended.

Sites with important cultural resources

Sites with culturally important species, resources important to exercising treaty rights, and historic or otherwise important sites should be prioritized, particularly where these communities are on Tribe owned or managed land. This may also include state-owned land that the Tribe has a vested interest in. A list of culturally important plants and the natural communities they occur in is included in Appendix 1. Wetland communities are included, as TIS may persist in wetlands or invade in dry years. Table 9 lists culturally significant plants and the natural communities they occur in, as well as some known locations within the reservation boundary. Natural communities are ranked by how vulnerable they are, both globally (G-rank) and in the state (S-rank). Descriptions of global and state ranking criteria is provided in Appendix 6.

Table 9. Potential locations of culturally significant plants within the LTBB Reservation on public and trust land.

Natural Community	G/S Rank	Important Native Plants	Locations
Limestone Cobble Shore	G2G3/S3	sweetgrass, sweet gale, scouring rush, bearberry	Great Lakes shoreline
Great Lake Marsh	G2/S3	sweetgrass, sweet gale, scouring rush	Wilderness State Park, Nine-mile Point, Garden Island

Open Dunes Sand Gravel Beach Great Lakes Barrens	G3/S3 G3/S3 G3/S2	bearberry, cherry, milkweed, hairy puccoon, bracken, pipsissewa, wild bergamot, wormwood, strawberries, aspen, sumac, wintergreen	Wilderness State Park, Petoskey State Park, Garden and High Islands, Nine-mile Point parcel, Cross Village shoreline parcel
Bog Northern Fen Coastal Fen	G3G5/S4 G3/S3 G1G2/S2	sphagnum, black ash, bog rosemary, cranberry, tamarack, Labrador tea, mountain holly, Michigan holly, common reed, blueberry, sweetgrass, sweet gal	Wilderness State Park, Garden Island
Emergent Marsh Northern Wet Meadow	GU/S4 G4/S4	wild rice, red-osier dogwood, alder, sensitive fern, Joe-pye-weed, swamp milkweed, sweet-flag, water lily, cat-tail, boneset	Wycamp, O'Neal, Round, and Larks Lake shorelines, Maple River and Brush Creek Wetlands, Garden Island
Rich Conifer Swamp Poor Conifer Swamp Hardwood-Conifer Swamp Northern Hardwood Swamp	G4/S3 G4/S4 G4/S3 G4/S3	goldthread, snowberry, cedar, balsam fir, yellow birch, elms, black ash, marsh marigold, jewelweed, cardinal flower, scouring rush	Taimi Hoag, Maple River and Brush Creek wetlands, Wilderness State Park
Boreal Forest	GU/S3	goldthread, snowberry, cedar, balsam fir, yellow birch	High Island, Garden Island, Wilderness State Park
Mesic Northern Forest	G4/S3	basswood, beech, hazelnut, aspen, cohosh, lady fern, jack-in-the-pulpit, wild grape, yellow lady slipper, trillium, white pine, ironwood, Indian cucumber root, maidenhair fern, sugar maple, red maple, partridge berry, trout lily, white birch, white ash, leeks	High Island, Garden Island, Osborne Rd parcel, widespread across region
Dry Northern Forest Dry-mesic Northern Forest	G3/S3 G4/S3	blueberry, oaks, gay-wings, huckleberry, bracken, club-mosses, sweet fern, aspen, sumac, strawberries, witch-hazel, wintergreen	Wilderness State Park, High Island

Sites with high conservation value natural communities

Natural communities may have one or more traits that make them management priorities. Some natural communities are declining at the state and/or global level, making their conservation a priority. Other natural communities may be stable within the state but have particularly high biological diversity or floristic quality, or they may be important because of structural or functional traits, such as an uninterrupted complex of several communities, high-quality neotropical migrant habitat, or important ecological functions. The element occurrence (EO) rank is one method of evaluating the quality of a

natural community; it is based on the ecological integrity of the community and its probability of persistence (i.e. A=excellent integrity, D=poor estimated viability). Table 10 displays specific sites known to have high ranking element occurrence (EO) ranks from past MNFI surveys on Garden and High Islands (Cohen 2016). Also included is the State rank which reflect the rarity within Michigan (i.e. S1=critically imperiled, S5=common). Sites with EO ranks of A, AB, or B and State ranks of S1 and S2 should be prioritized for detection-monitoring. Priority species to survey for at each site are listed, along with information about known invasive populations. Some sites have invasive species that are not considered a priority in this plan, or are wetland species, but are included for completeness. Wetland sites are included in the table because some terrestrial species can also invade wetlands.

Systematic surveys have not been conducted throughout the region, and there are potentially other high-quality sites in Emmet and Charlevoix counties that have not yet been recognized. There are few published natural feature, floristic quality assessments, or other surveys on the mainland of Emmet and Charlevoix counties, highlighting an apparent lack of information on the condition of many areas. It would be highly beneficial to work with conservancies and other large landholders in the region to identify known high-quality natural communities and to determine other priority areas for natural feature surveys. This would help inform where TIS control efforts are particularly important. MNFI will work with LTBB and the CISMA regarding data access and restrictions, so that priorities can be identified without compromising proprietary information.

Table 10. Natural communities within the Reservation boundaries that have an EO Rank of B or higher, and priority invasive species for survey and control (*already present on site).

Site Name	Natural Community	EO Rank	G/S Rank	Priority Invaders
Garden Island Boreal Forest	Boreal Forest	A	GU/S3	garlic mustard, glossy buckthorn, Dame's rocket, common buckthorn, multiflora rose, autumn olive, honeysuckles, Norway maple
Jensen Harbor, Garden Island	Coastal Fen	A	G1G2/S2	glossy buckthorn, purple loosestrife, narrow-leaved cattail, hybrid cat-tail, reed canary grass, phragmites
Sweat Lodge Swale, Garden Island	Coastal Fen	B	G1G2/S2	glossy buckthorn, purple loosestrife, narrow-leaved cattail, hybrid cat-tail, reed canary grass, phragmites
Northcutt and Monatou Bays, Garden Island	Coastal Fen	AB	G1G2/S2	glossy buckthorn, purple loosestrife, narrow-leaved cattail, hybrid cat-tail, reed canary grass, phragmites
Monatou Bay, Garden Island	Limestone Cobble Shore	A	G2G3/S3	spotted knapweed, common St. John's-wort, Canada bluegrass, glossy buckthorn
Taganing Marsh and Shore, Garden Island	Great Lakes Marsh Limestone Cobble Shore	A	G2/S3	common St. John's-wort, glossy buckthorn, Canada bluegrass*, spotted knapweed*, phragmites, narrow-leaved cattail, hybrid cattail, frogbit, hydrilla, purple loosestrife, watercress, reed canary-grass, European marsh thistle
		B	G2G3/S3	

Indian Harbor, Garden Island	Great Lakes Marsh	AB	G2/S3	phragmites, narrow-leaved cattail, hybrid cattail, reed canary-grass, purple loosestrife, frogbit, hydrilla, watercress, European marsh thistle, glossy buckthorn
	Coastal Fen	B	G1G2/S2	
Garden Island Harbor	Northern Fen	AB	G3/S3	glossy buckthorn, multiflora rose, autumn olive, purple loosestrife, narrow-leaved & hybrid cattail, reed canary-grass, phragmites
High Island Shoreline	Limestone Cobble Shore	AB	G2G3/S3	narrow-leaved cattail*, phragmites*, white sweet-clover*, Canada bluegrass*, spotted knapweed*, common St. John's-wort, glossy buckthorn
	Sand and Gravel Beach	A	G3/S3	
High Island Dunes	Open Dunes	A	G3/S3	spotted knapweed, baby's breath, common St. John's-wort, bull thistle, white sweet-clover, black swallow-wort, pale swallow-wort, black locust, common buckthorn, autumn olive, honeysuckles, multiflora rose, bladder campion
Nezewabegon Barrens, High Island	Great Lakes Barrens	AB	G3/S2	narrow-leaved cattail*, phragmites*, white sweet-clover*, spotted knapweed, baby's breath, bladder campion, common St. John's-wort
Nezewabegon Forest, High Island	Mesic Northern Forest	AB	G4/S3	garlic mustard, Dame's rocket, honeysuckles, Japanese barberry, common buckthorn, multiflora rose, Norway maple
High Island Boreal Forest	Boreal Forest	AB	GU/S3	garlic mustard, glossy buckthorn, Dame's rocket, common buckthorn, multiflora rose, autumn olive, honeysuckles, Norway maple, bittersweet nightshade*

Sites with Threatened, Endangered or Special Concern Species

Invasive species pose serious threats to threatened and endangered species (T/E/S) populations, second only to habitat loss. It is estimated that 42% of TES in the United States are directly threatened by invasive species population (Pimentel et al. 2004). Risks include direct competition for space and resources, habitat conversion, and changes in ecological functions. In line with the Inland Fisheries and Wildlife Program in the NRD Strategic Plan *Goal Two: Identify, Research, and Protect LTBB Threatened and Endangered Species*, sites with TES species should be prioritized. State special concern species should also be prioritized because they have been identified as declining in Michigan and are particularly vulnerable to invasive species competition. Many T/E/S occurrences are found within high quality natural communities, but some are not. These sites should be considered for TIS monitoring when prioritizing control efforts (Goal 2). A table of Special Concern, Threatened, and Endangered species within Emmet and Charlevoix Counties is included in Appendix 2.

Threatened and endangered species, and the sites in which they are found, may have special protections depending on the species and the regulatory body. Federally T/E/S are protected by the

Endangered Species Act of 1973 (available <https://www.fws.gov/endangered/laws-policies/esa.html>) and State T/E/S species are protected by the Endangered Species Act (Part 365 of PA451, 1994 Michigan Natural Resources and Environmental Protection Act, available <http://www.legislature.mi.gov/documents/mcl/pdf/mcl-451-1994-iii-1-endangered-species-365.pdf>). Special Concern amphibians and reptiles have further protections by the Michigan DNR Director's Order No. FO-224-13 (available https://www.michigan.gov/documents/dnr/FO-224-02_182417_7.pdf). Before creating and implementing a treatment plan for a site with T/E/S, review the applicable laws and regulations for that species and apply for all applicable permits. Carefully review and take into consideration the T/E/S biology and life history and evaluate how the TIS treatment plan will directly or indirectly impact the T/E/S; treatment techniques may need to be adjusted depending on the situation.



Figure 8. Invasive water forget-me-not competing with the only seed-producing population of the federally endangered Michigan monkey-flower; near the Maple River (photo by L. May, June 2018).

Integrated Pest Management

Integrated pest management (IPM) is the integration of multiple prevention and treatment measures to manage an invasive species population to keeping it below a damaging level. Treatment measures include mechanical removal, chemical controls, prescribed fire, biological controls and cultural controls. Specific combinations of treatments are used, depending on the target species, and are almost always more effective than the treatments applied separately, and in most cases necessary to achieve the desired effect. The use of IPM is essential for effective, efficient control of most TIS, and requires an understanding the biology of the invasive species, the way it is interacting with the environment, and how it is impacted by various control techniques. Species-specific IPM strategies can be found on several online sites such as Invasive.org (<https://www.invasive.org>), CABI Invasive Species Compendium (<https://www.cabi.org/isc>), MISIN (<https://www.misin.msu.edu>), MNFI (<http://mnfi.anr.msu.edu/invasive-species/invasives.cfm>), and the University of Wisconsin's Invasive

Species Control database (<https://mipncontroldatabase.wisc.edu>). However, IPM is also site-specific—there is no one size-fits-all option. Thus, determining the combination, timing, and sequences of control methods also requires an understanding of current site conditions. Control methods will continue to evolve as the natural resource community learns from treatments implemented and monitored over time. Every treatment should be considered an experiment to learn from and requires careful documentation and monitoring.

Mechanical Controls

Mechanical controls include hand-pulling, tilling, cutting, mulching, removing egg masses, destroying nests, flooding, or other physical forms of treatment. Physical removal can be an effective form of control for small TIS populations but is labor intensive and often not practical by the time infestations are discovered. The effectiveness of mechanical controls for plants depends on their ability to regenerate from root or stem fragments and root crowns, as well as their reproduction biology, dispersal strategies, phenology, and ecological niche. Mechanical treatments are often an option for insects and pathogens, though at times it may be appropriate to remove diseased host species. If employing mechanical controls, review species characteristics and follow all specifications closely, including the timing, method and frequency. Invasive species can be easily spread by mechanical methods if they are not prescribed correctly, exacerbating infestations. For example, hand pulling a species too close to the time of seed production is likely to result in spreading the infestation. Similarly, cutting live stems of Japanese knotweed is not advised, as new plants can develop from rhizome and stem fragments.

Prescribed Fire

In fire-adapted natural communities, prescribed fire can be used to remove above ground vegetative materials, release nutrients and stimulate the native seed bank. Although widely known to have beneficial effects on vegetation communities, only certain communities are adapted to fire regimes. Fire is rarely effective when used alone for invasive species control and can even stimulate some invasive species, increasing their competitiveness. It is typically used as part of an integrated pest management plan and requires a thorough understanding of the sequence and timing to achieve the desired effect. Prescribed fire is intended to mimic natural disturbance regimes, but because many fire-adapted systems in Michigan have been fragmented, it is important to include refugia for fire-sensitive species since natural refugia are often missing. Some insects and herpetofauna are very sensitive to fire and the effects are relatively understudied. The current decline in reptiles and amphibians in Michigan has caused concern about potential cumulative effects of prescribed fire management. For specific guidelines on amphibian and reptile conservation in prescribed fire management areas visit the Midwest Partners in Amphibian and Reptile Conservation's fire management website (<http://mwparc.org/products/fire/plain/>). Information on the effects of fire on vegetation communities can be found on the USDA Fire Effect Information System (FEIS) website (<https://www.feis-crs.org/feis/>). The FEIS website also publishes information the impact of fire and its viability as a management tool for many native and invasive species. Prescribed burning should only be conducted by experienced managers following a professional burn plan that accounts for weather and other contingencies. Permits must be attained through the Tribe for fires on Trust land or through the local fire department or the MDNR for land off of the Reservation.

Chemical Control

Chemical control is the use of pesticides or herbicides to kill or inhibit reproduction in organisms. Pesticides should only be used when needed, and almost always in combination with other methods.

For example, herbicide is often applied to invasive shrubs in the fall, following by prescribed burning the following year when the seed bank expresses itself. The chemical used, and timing of the application, depends on the biology of the target species; improper prescriptions will not produce successful results and can result in harm to native species and soil or water contamination. Pesticides should be applied by licensed applicators following the pesticide label and in a way that minimizes their possible harm to people, non-target organisms, and waterways. Chemical control is one of the most common treatment methods employed for many plant TIS; however, managers should be ever-vigilant and stay abreast of the literature as new findings about their impacts, including resistance, become known.

Biological Controls

Biological controls are natural biological organisms, processes and materials that can control invasive species. Biological control strategies often use natural enemies from a species' home range that eat or parasitize the target species. For example, *Galerucella pusilla* is a beetle that is a natural enemy of purple loosestrife and is currently considered a cost-effective method of control that is viable in some situations. Another example of biological control is grazing goats on dense colonies of invasive plant species such as garlic mustard or thistles. More recent research efforts such as gene silencing and disruption of plant endophytes have also been initiated. Effective biological controls only exist for a small number of TIS, though research is ongoing. Regulations regarding the release of organisms new to an environment are necessarily stringent, since once a new organism is out of the box it is virtually impossible to put it back in.

Cultural Controls and Restoration

Cultural control and restoration is the manipulation of community structure and composition to increase competition with invasive species or reduce the ecological niche that the invasive species need to spread and reproduce. This includes removing seed germination sites for invasive plant species by revegetating disturbed areas with native species or removing secondary host species for pathogens. The cultural control of not pruning or cutting oaks trees between during the growing season is the best method of preventing oak wilt.

Restoration of native communities is an important and often overlooked component of invasive species management. TIS are opportunists that can quickly populate disturbed landscapes, including the very sites where disturbances were created by implementing invasive species control measures. Re-invading or new invasive species can compete aggressively with native species for these disturbance-niches. Restoring an area with a diversity of native plants, disease resistant trees, or a native insectivore community greatly increases the resilience of the community to future invasions. For example, studies show invasive plant species do not significantly outperform co-occurring native species in many traits such as growth rate, fecundity, and competitive ability (Daehler 2003). Instead, they have a greater phenotypic plasticity that allows them to adapt to disturbances better than native species, and they are typically more efficient in utilizing high light and nutrients to construct tissues (Daehler 2003). Thus, it is often the abiotic environment that is facilitating the niche and the invasive species is the "passenger," rather than the invasive species "driving" their niche creation (MacDougall and Turkington 2005). Again, both the control method used, and site-specific conditions are important to understand, including any residual soil activity by herbicides and a determination of whether there is an existing viable seed bank. Money can be wasted on planting native species that are vulnerable to residual herbicide effects or where the native seed bank is able to express itself well already.

When restoring plant communities, it is important to consider that native seed and stock sold by producers are often not local or Michigan genotypes, and in some cases, native trees and shrubs are from clone stock or cultivars. Local genotypes perform better in local environmental conditions because the genotypes have been selected for thousands of years in that locale (McKay et al 2005, Vander Mijnsbrugge et al 1997). There is no clear determination of “how local is local” (McKay et al 2005), however it is recommended to use seed from the restoration site unless there is reason to believe low population numbers have led to low diversity and inbreeding (e.g. isolated small populations of species). A common practice is to collect native seeds or cuttings from the restoration site and have them grown out at a nursery or farm. If that is not possible, native plant material may be obtained from several nurseries in Michigan; make sure to discuss with the producer where the seed comes from and try to obtain genotypes from Northwestern Lower Michigan. The Michigan Native Plant Producers Association (<http://www.mnppa.org/members.html>), the Wildflower Association of Michigan (<http://www.wildflowersmich.org>), or the local Conservation District have good information on available native species. It is also useful to know that many non-native plants do not support the abundance of native insect specialists that native species do (Tallamy 2009). This has implications for wildlife, since Invertebrates form the base of many food chains. Also, some non-native plants support insects only for one part of their life cycle and not the rest of it (Tallamy 2010).

Disposal

Meticulous attention to proper disposal of invasive species that are removed during control efforts is critical, so that it does not further spread the species. Flower heads, seeds, root fragments, egg masses, or diseased materials must be killed or left in a state in which they will not be able to reproduce. Flowering heads of some plant species may continue to mature and produce viable fruit even if the plant has been pulled or cut, and tree diseases are spread by moving contaminated wood. The Michigan DNR recommends incineration or bagging plants in black plastic bags and disposing of the bags in the local landfill. Insects and pathogens have specific disposal methods. See Appendix 9 for disposal practices.

Monitoring and Adaptive Management

Treatment-monitoring is critical to evaluating the treatment success and calculating the cost-effectiveness of the project. *Detection-monitoring* is used to detect new populations or new TIS and can be accomplished by targeted surveys at likely entry points or high value sites. *Monitoring of trends* in population sizes and distributions over time can be used to gauge invasiveness and ecosystem impacts, as well as assess restoration success (USFWS 2018). This plan focuses on and includes specific activities for treatment- and detection-monitoring. However, it could be expanded in the future to incorporate other monitoring activities. This plan also recommends that the monitoring data be shared within the MISIN network, so others can conduct analyses to help improve their control efforts.

Specific treatment-monitoring methods should be determined by the site management goals; but, at a minimum should include standardized photo monitoring and qualitative estimates of the abundance of target species and integrity of the natural community. However, some quantitative sampling, such as simple point-line intercept transects, can be accomplished relatively easily for routine treatment-monitoring. Other factors to consider include the amount of seed in the seed bank, length of seed viability, germination rates, fecundity, growth rates, susceptibility to control methods, potential re-invasion from neighboring sites, and amount of suitable habitat. Statistically rigorous, plot-based data should be collected when testing new or controversial methods and should include untreated reference sites. Sites should be assessed pre- and post-treatment for as many years as possible, ideally until propagules such as seeds, root or stem-fragments, stump sprouts, or egg masses, are no longer present.

Goals and Activities

The following lays out specific activities associated with TIS management objectives. They are listed in a suggested chronological order under each goal for implementation however the sequencing of activities may change based on funding opportunities or specific priorities determined by LTBB.

GOAL 1. Prevent the introduction and spread of TIS species

Prevention is the most effective and least costly way to manage for invasive species. Preventing the establishment of new TIS populations involves understanding an organism's reproductive biology and reducing dispersal pathways. The latter often relies on appealing to the public, businesses, and local governments to modify behavior, policy, or regulations. Education and information is often the key to change, thus engaging with the community is important.

Activity 1-1. Establish and approve lists of prevention, EDR, containment, and asset-based control species and review annually

Preliminary lists are provided in this plan but will evolve over time as new information comes to light. A core team in the Natural Resources Department should be assigned the responsibility of approving these lists, using current information provided from resources noted in this plan and with input from the regional CISMAs and other partners. These should be reviewed and updated annually based on new distribution and research on TIS that arises over time. These lists can be further prioritized as needed.

Timeline: December 2019 and ongoing

Cost: Staff time

Venue: NRD office

Activity 1-2. Design a TIS flyer or brochure relevant to northwestern Lower Michigan and distribute widely

Determine which species from Activity 1 are most important for partners and the public to become aware of and design a flyer featuring these species and how to report them. The CAKE Cisma has a flier available on their website

(http://www.stewardshipnetwork.org/sites/default/files/cakeinvasive_flyer2_0.pdf, Appendix 10) that outlines their priority terrestrial and aquatic invasive species; this may serve the purposes of the Tribe or could be modified as needed. Distribute flyer or brochure at places frequented by the public such as local businesses, points of entry into natural areas and lakes as possible, and recreation and tourism offices. Other printed products are available on the Michigan Invasive Species Coalition Web Forum (<https://forum.michiganinvasives.org>) which was developed in part for sharing information and printed products that can be adapted to different areas of the state to minimize duplication of effort. Review and update annually or when needed.

Timeline: December 2019

Cost: \$415.00 for 1,000 full color, two-sided trifold brochures or \$215 for 1,000 full color single-sided pages, staff time to distribute

Venue: local businesses, tourism offices, natural areas where possible

Activity 1-3. Develop and adopt TIS decontamination protocols for the Natural Resource Department

Develop best management practices to decontaminate boots, waders, clothes, and other outdoor gear after field work. Routinely wash field vehicles with a focus on the undercarriage and tire treads. When working in the field, try to avoid walking through TIS populations. If invasive species populations must be visited, go to un-infested areas first, working towards the most infested areas, so that seeds or propagules are not tracked into clean areas. Have boot cleaning brushes and picks on hand.

Timeline: March 2020

Cost: Minimal staff time, decontamination equipment (boot brush \$20 each, power washer \$200-500 depending on brand)

Venue: NRD office

Activity 1-4. Conduct a Natural Resource Department staff training on invasive species, priority species identification, EDR and decontamination protocols

Train all field staff in the Natural Resources Department on the principles of invasion biology, a framework for action, how to identify priority TIS, and the basic concepts in prevention and management. MISIN has online identification training modules that cover many priority species. Supplement online and video training with printed booklets that can be used to review or brought into the field. A simple one-page identification flier with a subset of the highest priority TES and watch list species is available from the CAKE CISMA (see Activity 2 above). TIS spiral-bound booklets or PDF files are also available through MNFI (<https://mnfi.anr.msu.edu/publications/books>). Training should include a field component and can be combined with aquatic invasive species training or conducted separately.

Timeline: Completed June 2019; Review and repeat biennially

Cost: Staff time, TIS booklets (\$16 printed and bound from MNFI or free PDF)

Venue: NRD office and vicinity for field component of training

Activity 1-5. Purchase time for a PSA on local radio and television stations and broadcast "stop-the-spread" messaging.

Purchase time on local radio and television stations to broadcast a message that we all are working together to reduce the spread of invasive species. This can be paired with messaging on aquatic invasive species. The PlayCleanGo Campaign provides a positive framework for communicating this message to visitors and recreational land users:

- **REMOVE** plants, animals, and mud from boots, gear, pets, and/or your vehicle before leaving.
- **CLEAN** your gear before entering and leaving the recreation site.
- **STAY** on designated roads and trails.
- **USE CERTIFIED** or local firewood and hay.

In 2018 the Clean Boating Campaign purchased packages with local television stations for about \$3700 per package; messaging on TIS may be combined with the Clean Boating Campaign or kept separate.

Timeline: April 2020

Cost: \$4000 (estimate)

Venue: Petoskey area radio and television stations (103.9 WCMU, 105.9 WKHQ, TV 9&10, Fox 32, TV7&4, etc.)

Activity 1-6. Publish relevant TIS articles in the Tribal newsletter and other newspapers

Prepare articles for publication in the tribal newsletter throughout the growing season (April-September) to engage the community in invasive species prevention and management. This can include success stories and volunteer opportunities. Topics should be seasonally relevant and released progressively throughout the year as TIS emerge or during important management times. For example, publish an article on garlic mustard identification and management in May or June, and in October publish an article about the impacts of Oriental bittersweet. In the late winter, publish an article about planning a native garden. This can also include articles on aquatic invasive species. Other topics include:

- How to clean boots and outdoor gear to keep invasive species out of hunting and gathering land
- The impact a species is having on a local ecosystem and how the community can manage it
- Successful management projects
- Volunteer and community activities such as work bees and workshops
- Basic species identification and treatment information
- How planting native species in your yard can benefit ecosystems

Advertisements may also be run in the newspapers for about \$1700 for an ad package covering most of the summer season. The Clean Boating Campaign ran ads in the Harbor Light and The Petoskey News Review during the summer of 2018. Possibly expand the messaging of the ads in 2019 to include TIS. Evaluate the effectiveness of the advertising in 2018.

Timeline: April 2020 and ongoing, seasonal with species emergence or important management times

Cost: Staff time to write articles; ~\$1700 per newspaper for an ad package.

Venue: Odawa Trails, Petoskey News Review, Harbor Light News

Activity 1-7. Host a public workshop to teach community members how to use Citizen Scientist invasive species reporting apps

Citizen science engages interested members of the public in conservation activities, often through technology such as smartphone apps. Host a workshop to teach people to become citizen scientists to help land managers control invasive species. Teach people how to use the MISIN smartphone app and/or the online database to upload invasive species locations that can be accessed by land managers. The MISIN is housed and operated out of the Michigan State University (MSU) in East Lansing and provides immediate technical assistance by phone call. They also look for feedback from users to identify issues with the phone app and ideas for expanding the app to address identified uses that are not currently addressed. AIS occurrences are also tracked by the MISIN and shared with the USGS NAS database, also housed at MSU.

The Little Traverse Conservancy (LTC) is interested in engaging citizen scientists and host public education workshops teaching species identification and data collection with smartphone apps. Discuss the possibility of LTC hosting or collaborating on this workshop. This could be repeated annually.

Timeline: June-August 2020, repeated annually

Cost: Staff time

Venue: Natural areas, parks, and specific locations where priority TIS are known to occur and can readily be observed by participants.

Activity 1-8. Host public workshops on species identification and treatment

Engage the public and let them know how they can help with invasive species by hosting a public workshop on invasive species identification, treatment options they could implement, and options for hiring contractors. Focus on EDR species, and species that are often in people's backyards, such as honeysuckle and autumn olive. Pair with a work bee, ideally in an area where there are several different TIS, so people can become familiar with the species and treatment methods in the field. Work bees for selected species have been quite successful for CISMAs statewide—it is important to ensure that these occur for species and locations where progress can be observed. A discussion of the seedbank and other propagules should be included, and decontamination procedures should be demonstrated and used.

Timeline: June-August 2020

Cost: Staff time to develop and run workshops

Venue: Public-accessible natural area such as Little Traverse Conservancy land or prioritized treatment sites where treatment can be implemented

Activity 1-9. Encourage municipalities, the Tribe, and other groups to adopt a native plant ordinance

Many invasive species populations stem from ornamental plants that are used in landscaping. While these plants can be desirable in their planted locations, they spread to neighboring properties or natural areas where they cause problems and increase management costs for local governments, land managers, and farmers. To address this, encourage the tribal government, municipalities, homeowner associations, and developers to plant native species in landscaping. The Northwest Michigan Invasive Species Network (ISN) has developed a planting guide, *Recommended Planting Guidelines for Municipalities*, that could be adopted for use on tribal land and local municipalities (https://www.leelanau.cc/downloads/isn_planting_guide_for_municipalities_final.pdf, Appendix 11). They also assist with developing invasive species and planting guide ordinances and they consider both TIS and AIS.

Timeline: March 2020

Cost: Staff time to develop this idea with the CAKE Cisma, adopt/adapt an existing ordinance, and promote within the tribe. Hopefully the CAKE Cisma can work with the townships and villages.

Venue: Emmet County townships and villages

Activity 1-10. Encourage landscapers and nurseries to avoid selling and planting TIS

Work with the Northwest Michigan ISN to extend the Go Beyond Beauty (<http://www.habitatmatters.org/go-beyond-beauty.html>) program into Emmet and Charlevoix Counties. Go Beyond Beauty incentivizes local greenhouses, nurseries, and landscapers not to sell or plant invasive species, and to source plants that are grown in the region to avoid introducing invasive hitchhikers such as hemlock woolly adelgid. They incentivize businesses to sign up through positive advertising. This includes both terrestrial and aquatic invasive species used in landscaping. Currently, ISN is applying for grant funding to extend this program statewide. If funded, ISN will be taking applicants outside of their service area and CAKE and other participants will be a key part of the success of that program.

Timeline: January 2020 reach out to ISN to check on grant status, sign up businesses on an ongoing basis

Cost: Staff time to reach out to local businesses; Go Beyond Beauty may provide funds for advertising participating businesses

Venue: Emmet County nurseries, landscapers, and greenhouses

Activity 1-11. Create an NRD web page with landowner resources for invasive species management

This could highlight LTTB's vision, priorities and activities with links to other informational websites. It would be useful to include information on landowner assistance programs (e.g. NRCS EQIP funding for agricultural and forest land) and key concepts in preventing invasive species. Every effort should be made to utilize appropriate existing materials. This can be paired with the equivalent activity in the AIS Plan.

Timeline: February 2020

Cost: Staff time

Venue: Online

Activity 1-12. Incorporate TIS education into youth programs

Invasive species lessons may be incorporated in youth education programs such as the Ishkaakimkwe Kinoomaagewinan (IK) Teachings of the Earth curriculum design for schools and teachers (<http://www.ltbodawa-nsn.gov/EDU/K-12.html>). This program provides curricular support to educators in four school districts in the Char-Em Intermediate School District, engaging students in Odawa perspectives and culture. STEAM (science, technology, engineering, arts, and mathematics) programming would also be a good venue for invasive species education.

Discuss how invasive species interact with natural communities and ecosystems and various ways they can be a part of the solution. Lessons can be simple and involve field identification. Discuss both TIS and AIS.

Timeline: June 2020

Cost: Time to work with educator programs to develop an invasive species lesson

Venue: Classrooms

Activity 1-13. Install boot brush stations and educational kiosks at trailheads on land owned by the Tribe

A major dispersal pathway for many TIS is in contaminated soil in the treads of boots and shoes. Boot brush stations offer a chance for people to clean their boots before entering a trail and again on the way out. This also provides a point for public education and engagement through an attached kiosk. Educational kiosks should communicate how TIS are impacting our environment, how to identify them, and how to avoid spreading them.

As the community grows in their knowledge and understanding of invasive species, nicely designed collection bins appropriate for hand-pulled species such as garlic mustard, dame's rocket, or spotted knapweed could be placed at trailheads as well; the kiosks would identify when hand-pulling is appropriate and for which species. These may only be appropriate for areas where the target species is easily identifiable and where the bins are easily accessed and maintained.

Timeline: As funding becomes available, with a goal of May 2021

Cost: ~\$350 per boot brush station including educational kiosk (price varies depending on quantity and does not include installation); \$1,000 collection bins. Seek grant funding for this activity.

Venue: At all trailheads on tribal land

GOAL 2. Survey and assess existing TIS populations

Making good decisions about invasive species management requires a solid understanding of where and how abundant they are. Many control efforts jump the gun to treat infestations that are not optimal priorities because the distribution and abundance of the invader has not been determined. Examples include treating in the middle of a source infestation which is likely to be reinvaded quickly, or treating a species that is not spreading rapidly, instead of a high impact species that is spreading quickly. It is important to understand the extent of TIS populations and risks they pose to plan optimal and successful treatment programs.

Activity 2-1. Adopt a standardized protocol for surveying and storing invasive species data that is aligned with partner organizations

A standardized protocol for surveying and storing invasive species data that is aligned with partner organizations is necessary for easy data compilation and sharing. The MISIN methodology is a statewide standard for data collection and allows easy upload of data to MISIN's web-based mapping application and enables sharing between partner organizations. The MISIN GPS Mapping Protocols are included in Appendix 7. The Michigan Invasive Species Grant Program (MISGP) requires entry of data into MISIN to consolidate data from many observers, thereby improving distribution maps throughout the Great Lakes. The MISIN protocol is designed for rapid point collection with an emphasis on early detection. LTBB may determine that additional invasive species data be gathered for other purposes. It would be useful to work closely with the MISIN and other CISMAs to avoid duplication of effort and enhance data compatibility between partners. See Goal 4 for a discussion of treatment and monitoring data.

Timeline: January 2020

Cost: 2 hours of staff time

Venue: NRD office

Activity 2-2. Review early alerts of priority TIS in the MISIN database annually

The MISIN allows users to request early-alert notifications whenever selected species are reported in selected counties. LTBB has already selected all prevention and EDR species for Emmet and Charlevoix counties and they will receive an alert whenever one of these species is newly reported in the MISIN. These reports can be investigated as described in Goal 3, Activity 2. Be sure to update subscriptions when lists of target species are revised. Review these lists of target species annually to make sure you are being updated on the appropriate species.

Timeline: January 2020, annually

Cost: 2 hours of staff time

Venue: NRD office

Activity 2-3. Compile distribution data for TIS priority species

Compile data on TIS priority species locations in the region annually from all known sources, including MNFI, MISIN, EDDMapS, I-Map, CISMAs, partner organizations, and staff. AIS data can also be gathered from the USGS Nonindigenous Aquatic Species (NAS) database. There are data exchanges between these databases, but due to differing data fields, these are not always up-to-date. Convene an annual

meeting with partners to share distribution data and discuss emerging species, trends in distribution patterns (i.e. moving north along highways, moving along the coastline), extent of infestations and impacts on natural areas, etc. Almost everyone knows of some invasive species occurrences that they haven't mapped for one reason or another and coming together annually or even more frequently can generate important data. Use this opportunity to continually reassess species threat rankings and management needs as well.

Timeline: January 2020, annually

Cost: Staff time to organize meeting and review annual survey data

Venue: NRD office or partner organization office

Activity 2-4. Create a GIS data layer of high value sites and key dispersal vectors for Trust and public land

Resources available for treatment of invasive species inevitably fall short of demand; therefore, it is worth the time to identify the most important places for management and identifiable vectors and entry points in GIS spatial database layers. These data layers can then be overlain with invasive species distributions to help identify where control efforts are most important and likely to have an impact. Identify high value areas including culturally, ecologically, recreationally, economically, or otherwise important places. Overlay these with a data layer of key dispersal vectors such as roads, trails, areas with active timber harvest, campgrounds, parking areas, meeting places, etc. Key wetland and aquatic habitats can be incorporated to identify priority AIS management areas, and AIS vectors such as boat ramps. The Oakland County CISMA Strategic Invasive Species Plan has an example of how data layers can be overlaid and analyzed for strategic decision-making (GIS Database and Desktop Analysis Tool; Appendix 12) (OC CISMA 2017).

Timeline: January 2020

Cost: Staff time to create or compile data layers, dependent on availability of existing data

Venue: NRD office

Activity 2-5. Adopt a prioritization tool

A prioritization tool is a standardized method used to rank and prioritize invasive species populations. The process typically involves gathering information on the location, density, and abundance of an invasive species population, its likelihood of being controlled, and resources potentially impacted, and feeding that data into a questionnaire that outputs an index or rank. The index can then be used to compare TIS populations and make management decisions. There are many different prioritization tools available online and that have been developed by Michigan organizations; the CAKE CISMA has already created a prioritization tool that can be used by the Tribe; it is included in Appendix 8. The data layers developed in Activity 4 above can be integrated into this process and the tool can be used for prioritizing AIS as well.

Timeline: January 2020

Cost: Staff time

Venue: NRD office

Activity 2-6. Establish a TIS early detection-monitoring system

Early detection and response to new species or new populations is often reactive to random observations. It may prove useful to systematically target key entry points and vectors for priority TIS

and conduct regular surveys to be more proactive with potential new infestations. The results of Activities 3 and 4 above can be used to prioritize detection-monitoring areas, including hot spots, trailheads, horse staging areas, etc. An effort could be made to build a citizen monitoring network to make this an annual event like the MDNR frog and toad survey. Regular reminders to integrate priority TIS observations into ongoing field work during best survey windows for each TIS would also be useful.

Timeline: February 2020

Cost: Staff time

Venue: NRD office

Activity 2-7. Establish a long-term systematic survey strategy aligned with partner organizations

Managers conducting TIS have historically worked independently on lands they own or manage, such as land conservancies or state parks. They may have a good idea of the invasive species populations within their boundaries but may not have the capacity to survey outside of them. Sharing the location, abundance and density data between partner organizations helps represent the distribution of invasive species at a regional level. This allows managers to put local populations in context of their overall distribution which can improve how populations are managed. Use the compiled distribution data gathered in Activity 3 above, to locate TIS populations on or near LTTB-managed land, where populations may be crossing jurisdictional boundaries, or are not being monitored or treated by any organization. Use these data and data from Activities 4-5 above, to develop a long-term survey strategy which identifies priorities for the Tribe and partner organizations. The long-term survey strategy should address the following arenas (Activities 8-10), but other priorities may be identified by LTBB and partners.

Timeline: June 2021-ongoing

Cost: Staff time / Contractor fees

Venue: NRD office

➤ Surveys for priority species on LTBB Tribal Trust land

Survey all Tribal Trust land (approximately 1,000 acres). Commercial property and other developed parcels may just need a quick check along the property line and in weedy areas for priority species, while larger tracts of land will need the entire parcel surveyed. Table 11 contains a list of parcels that can be prioritized for monitoring because they have nearby populations of priority species. Use every opportunity to record invasive species during other fieldwork such as the Inland Fish and Wildlife Program, the Environmental Services Program fieldwork, or during Conservation Officer patrols. Provide staff an identification guide “cheat-sheet” for ERD species such as the one produced by the CAKE CISMA (Appendix 10) or developed for staff training in Goal 1.

Seek funding to survey remaining lands using the prioritization tool from Activity 5, to systematically cover highest priority to lowest priority over areas time. Or, identify high-threat species, such as black swallow-wort, for dedicated survey. Funding can support in-house staff or be used to hire surveyors. Different species often require different survey times throughout the growing season, but most species can be identified June-August. If a potential TIS is observed but needs to be revisited to confirm identification, mark this population and return at the proper time of year.

Table 11. Tribal trust land with nearby priority invasive species populations in need of monitoring.

LOCATION	PARCEL NAME	INVASIVE SPECIES
Petoskey	910 Petoskey St Parcel	Monitor for black swallow-wort
Petoskey	915 Emmet St Parcel	Monitor for black swallow-wort
Petoskey	Monroe St Parcel	Monitor for black swallow-wort
Petoskey	911 Spring St Parcel	Monitor for black swallow-wort
Petoskey	Odawa Hotel Parcel	Monitor for Japanese knotweed
Petoskey	Odawa Casino Parcels	Monitor for Japanese knotweed
Petoskey	Victories Parcels	Monitor for Japanese knotweed
Charlevoix	Taimi Hoag Parcel	Monitor for Japanese barberry
Harbor Springs	Osborne Rd	Monitor for giant knotweed, Japanese barberry

Timeline: Begin in June 2020 and ongoing until complete.

Cost: Staff time to survey 30-150 acres per day, depending on type of parcel

Venue: Tribal Trust land

➤ *Surveys of the interior of High and Garden Island and ongoing surveys of their coastal zones*

The coastlines of High and Garden Islands were surveyed in 2012 by a partnership between the Beaver Island Association, the LTBB, the MDNR, the Nature Conservancy, and MNFI. These surveys, and subsequent treatments, focused on non-native phragmites which occurs primarily along the shoreline. The island interiors have not yet been comprehensively surveyed for TIS, although invasive species were noted during floristic and natural community surveys conducted by MNFI in 2012 and 2015 (Higman et al 2012a, Higman et al 2012b, Higman et al 2016, Cohen 2016). These surveys occurred while en route to survey sites and with rare species and target natural community sites, thus focus was directed to these areas; TIS findings include spotted knapweed on shores of both islands and wild parsnip in the interior of High Island.

The total island area in need of TIS surveys is roughly 8,000 acres, which includes both wetlands and uplands. Data and shapefiles from these surveys, and potentially surveys conducted by others, can be used to help identify priority invasive species populations. Focus surveys on trails and clearings, camping areas, cultural resources, high quality natural communities and areas known to have rare species, based upon survey findings and level of survey effort already undertaken (Table 9, 10, Appendix 2). The coastal zones of these island should be re-surveyed at periodic intervals to identify and treat re-colonizing species and new infestations. Collaborate with the Beaver Island Association and CAKE CISMA to apply for grant funding for TIS surveys.

Timeline: Summer 2021 and ongoing until complete

Cost: variable, TBD. Partner with the Beaver Island Association and the CAKE CISMA to prioritize survey areas and seek funding to hire a contractor to conduct surveys.

Venue: High and Garden Islands

➤ *Surveys of high priority areas elsewhere in the region*

Work with CAKE and partners to identify and survey other high value areas identified within the reservation boundary, including high conservation-value natural communities, and sites with important cultural resources or special concern, threatened and endangered species. Other priority sites may be identified through the creation of the GIS data layers in Activity 4 above and by the personal experiences of Tribal members and partners in the area. See Table 10 for suggested sites.

Timeline: Ongoing

Cost: Variable depending on areas identified and ability of partner organizations to help survey

Venue: Reservation area

GOAL 3. Treat target populations of TIS species

Using the prioritization tool for guidance, and survey findings, target populations can be selected for treatment annually based on urgency and available funding and expertise. Treatments should be conducted in tandem with pre- and post-monitoring, which is discussed under Goal 4. The State of Michigan has developed an early detection response framework for aquatic invasive species that could be adapted to TIS (Appendix 13). This framework is intended to ensure that all early detections that are reported are: a) systematically assessed before acting, b) decision-making process for determining whether to treat or not and why, are documented, c) communication about the detection is coordinated with all relevant partners, d) messaging to various audiences is deliberate, accurate and carefully managed, d) treatment goals are specified and e) monitoring to measure whether treatment goals are being met is implemented and documented. This enables others to learn from these efforts and avoid pitfalls, and ultimately improves response efforts over time.

Activity 3-1. Compile best control practices for prevention and EDR species.

Managers are often faced with new species before best control practices are known or considered. To be proactive, it would be highly beneficial to start assembling known research, control techniques and their pros and cons, as well as contacting known experts for priority species where they are already known to occur. Work with the MISC and CAKE Cisma to determine what efforts are currently underway for these species and develop a plan of action for new detections of these species in the region. Identify gaps that LTBB or others could fill and consider seeking funding to do this. It is important to note that there is a lot of information on the web that may not reflect current knowledge. This underscores the need for querying experts who have experience working with the species under consideration whenever possible.

Timeline: February 2020-ongoing

Cost: Staff time

Venue: NRD office

Activity 3-2. Assemble team to assess priority EDR species on Tribal Trust land

Hire or assign a rapid response team of 2-3 people who can mobilize to assess priority (EDR) TIS populations on Tribal trust land and work with the CAKE Cisma and MISC to determine the best course of action. Certify team member(s) with a pesticide applicator license and make resources available to learn IPM strategies for the species. This effort could be modeled after the State of Michigan Early Detection Program for AIS, currently led by MDEQ, in which reports are received through the MISIN

early alert system, natural resources professionals and the public. Each report is assessed on-site using a standardized protocol to determine the best course of action as well as a communication plan for relevant parties and the public, so that messaging is clear and accurate. Each response is tracked carefully, and an after-action report is produced documenting all decision-making and lessons learned. In this way, knowledge gained is available to all stakeholders so that mistakes are avoided, and duplication of research effort is minimized.

In April 2018, the MISIN database was reviewed for invasive species located on or near tribal trust land (Table 12). Since systematic surveys have not been conducted throughout these areas, there are likely more occurrences of priority EDR TIS than are shown here, however, in the short-term, assessments of the occurrences below could be conducted. Implementation of a detection-monitoring and survey strategy (Goal 2, Activity 6) and training for staff and partners (Goal 1, Activity 4) will improve EDR efforts over time.

Table 12. Known EDR TIS populations on or near LTBB Trust properties currently in the MISIN.

LOCATION	PARCEL NAME	INVASIVE SPECIES
Mackinaw City	Pond Street Parcels	Japanese knotweed and leafy spurge
Petoskey	White House Parcel	Japanese knotweed
Petoskey	Wall Parcel	Japanese knotweed

Timeline: June 2020-ongoing

Cost: Dependent on the extent of TIS populations

Venue: Tribal trust land

Activity 3-3. Treat EDR TIS on the Reservation – set realistic target number of sites annually

Using the prioritization tool determined in Goal 2, Activity 5, and assessments in Goal 3 Activity 2, and treat highest priority TIS species occurring within the reservation boundary. Work with partner organizations to coordinate treatment and provide support. Consult best control practice guides and other CISMAs before determining and implementing treatments and use the IPM approach outlined in the guiding principles of this plan. Ensure that the resources needed for success are available before implementing treatments. Work collaboratively with all landowners to ensure there is understanding and support for the treatment methods, and that the necessary resources are available to be successful long term.

Timeline: June 2020 - Ongoing

Cost: Dependent on extent of TIS populations

Venue: Across the reservation

Activity 3-4. Treat all TIS on high-value sites in the Reservation – set realistic target number of sites annually

Using the prioritization tool determined in Goal 2, Activity 5, thoroughly assess and treat TIS are found on high-value sites, sites with important cultural resources, and sites with special concern, threatened and endangered species that are within the reservation boundary. See Tables 9 and 10 for suggested sites and natural communities. Treat highest priority populations first based on the prioritization tool ranking. Work collaboratively with all landowners to ensure there is understanding and support for the

treatment methods, and that the necessary resources are available to be successful long term. Examples include the following, however, the assessment of TIS in Goal 2, should largely drive where and what efforts should be prioritized.

Timeline: June 2020 and ongoing

Cost: Dependent on extent of TIS populations

Venue: Reservation

Activity 3-5. Document treatment data in-house and upload into the MISIN treatment tracking database

Every treatment should be carefully documented in-house and entered into the MISIN treatment tracking database. Sharing of suggested improvements to the tracking system with the MISIN, based on needs identified over time, is highly encouraged. Feedback is needed to make this system the best that it can be for meeting the needs of LTBB and the state; unanticipated needs or useful improvements often crystallize through experience over time and need to be communicated. Work through the MISC forum and with CISMA partners to help strengthen the adaptive management process for control of invasive species within the context of overall site goals in the state.

Timeline: As data is collected

Cost: Staff time to enter data

Venue: NRD office

GOAL 4. Evaluate treatments and adapt strategies as needed

The importance of adaptive management is well recognized, yet, in practice, it is rarely used to its maximum potential. In addition, invasive species are often singled out as management targets, separate from overall site management goals. While this plan focuses on TIS management, it is important that managers begin to think about invasive species within the context of overall site management goals. The desired future condition for each treatment site should be determined first, so that control of invasive species helps move the site towards those conditions. Separating evaluation out as a separate goal is intended to reinforce the importance of this. Monitoring is an essential component of adaptive management and it should be a routine part of all management efforts.

Activity 4-1: Establish system for documenting treatment details.

Since monitoring data is critical for improving invasive species management, a systematic approach for documenting and enabling the consolidation of these data with those of partners is desirable. The MISIN has developed a system for uploading pre- and post-treatment data that that will be made available to relevant partners and will make reporting to funders much easier. The goal is to align the tracking system with reporting requirements for the Michigan Invasive Species Grant Program and hopefully other funders as well, so that it is not necessary to input treatment data multiple times. It is still evolving at the time of writing this report and CISMA input is welcomed. The protocols were adapted from the MDNR Parks Stewardship Program which has been using them effectively for many years. The MISIN treatment tracker guides the input of relevant treatment specifics such as type of treatment, timing, weather and a general assessment of treatment success. More detailed pre and post-monitoring protocols are discussed under Activity 4.3.

Timeline: February 2020

Cost: Staff time to develop a monitoring documentation system

Venue: NRD office

Activity 4-2. Determine management goals for the treatment area.

All treatment sites should be assessed to determine the desired future condition and specific management goals that will move the site towards that condition. This assessment should be included in the documentation for Activity 4-3 and reflected in the monitoring methods that are implemented.

Timeline: Ongoing with all treatments

Cost: Staff time

Venue: Every treatment site

Activity 4-3. Determine best monitoring methods based on the species, site specific management goals and conditions, and available resources and expertise

Monitoring methods should be determined based on site-specific management goals and should include an assessment of impact of treatment on the invader and response of the natural community where the treatment occurred. Only then will you learn whether goals are being achieved. Specific protocols should include some measure of the infestation and the natural community itself is in, before and after treatment. Sampling strategies that can accomplish this include photographic monitoring, point-line intercept, or other standard community sampling methods, such as plots to measure percent cover of plants. At a minimum, photo monitoring should be implemented. This is typically a quick and efficient method to obtain a general assessment of treatment success but does not provide detailed information such as species composition, for example, that is warranted in many cases. Based on specific site management goals other things could be measured as well, such as presence of particular animals, or availability of nutrients. It is helpful to incorporate photo-monitoring into a more complex monitoring strategy, as it is useful as an outreach tool to quickly show before and after images of a treated site. A photo-monitoring protocol developed and used by the MDNR Parks Stewardship Program is provided in Appendix 14. Additionally, a comprehensive summary of vegetation sampling methods with target measurements, field datasheets and diagrams for making sampling tools is available from the BLM at https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044175.pdf. Depending on the biology of the target species, multiple follow-up visits may be necessary. For sites lacking a natural seed bank, restoration plantings may be necessary to keep new invasive species from establishing.

Due to limited resources, monitoring is often the first thing to be cut from projects despite its critical importance for informing future management. It is better to implement fewer high-quality treatments successfully and learn from them through monitoring, than do 10 so-so or poorly conducted treatments that you cannot conclude anything from. It is worse yet to not check on the success of a treatment at all, when many dollars have been invested. This is all too common during the typically fast paced, resource limited field season and is the basis for the plan's strong emphasis on strategic prioritization of the most important actions first.

Timeline: Ongoing for all treatments

Cost: Staff time

Venue: NRD office

Activity 4-4: Implement pre- and post-treatment monitoring

To measure progress, baseline data must be established for comparison. Pre-monitoring should be conducted prior to treatment, and post-treatment monitoring should occur at a time interval appropriate for the method employed, prior to any subsequent treatments and using the same protocol used for pre-treatment monitoring. The monitoring results are used to fine-tune follow-up treatments or change methods that are not achieving desired results. Ideally post-treatment monitoring should be conducted for at least several years and preferably more. Many TIS have seeds or other propagules that remain viable for many years, so monitoring of these species must account for how long they have been established at a site; e.g., for plants, how many years of seed banking has occurred and how long are the seeds viable?

Timeline: Ongoing for all treatments

Cost: Staff time or contracted, dependent on the amount of land area, site specific conditions, and monitoring methods used.

Venue: Primarily tribal lands, but wherever treatments are conducted

Activity 4-5: Document pre- and post-treatment monitoring data

The MISIN treatment tracking system currently enables only the input of treatment details and general comments about effectiveness (Activity 4.1); it does not capture detailed pre and post monitoring data. Thus, documenting and assessing these data in-house is essential for fully evaluating treatment success and adapting management activities as needed. Systematic practices for integrating monitoring data into adaptive management strategies are not widely available, yet this is fundamental to improving management. Since it is an evolving arena, input and feedback is needed from practitioners who implement management to help shape MISIN capabilities and hone its utility for improving management. Stay tuned and provide input as the MSIN evolves over time to help establish the best pathway for cataloging and sharing the results of invasive species management with relevant partners.

Timeline: Ongoing for all treatments

Cost: Staff time or could also be included as a deliverable in contract work

Venue: Wherever treatments are conducted

Activity 4-6. Evaluate this TIS Management Plan and adapt and update as needed

Like treatment evaluation, this TIS management plan should be evaluated every five years to continually improve it. Evaluation should consider new research that becomes available, lessons learned from monitoring, and changes in species distributions, threats and priorities over time. Successes and failures should be acknowledged and understood so that success rate goes up. It is important to ensure that partners are working together as synergistically as possible to improve research data, treatment and monitoring methods. Responsibilities should be equitable and clear, so that partner efforts compliment, not duplicate one another and innovations at local, regional and statewide scales are facilitated. Goals and activities, species lists and priorities, management strategies, lines of communication and approaches should be adjusted as needed. While this evaluation is recommended every 5 years, any problems or obstacles that are identified should be acknowledged and addressed as soon as possible, rather than waiting until the next 5-year evaluation, when they are likely to be further entrenched.

Timeline: Every five years

Cost: Staff time

Venue: NRD office



Figure 9. Partners evaluating the results of invasive phragmites treatment in Grand Traverse Bay
(photo by P. Higman).

Schedule of Activities

Table 13. Schedule of activities

Goal 1	Prevent the introduction and spread of TIS species	Cost	Date Planned
1.1	Establish and approve lists of prevention, EDR, containment, and asset-based control species and review annually	Staff time	December 2019
1.2	Design a TIS flyer or brochure relevant to northwestern Lower Michigan and distribute widely	\$215 for 1000 single sided, \$415 for double	December 2019
1.3	Develop and adopt TIS decontamination protocols	Staff time, decon equip	March 2020
1.4	Conduct a Natural Resource Department staff training on invasive species, priority species identification, EDR and decontamination protocols	Staff time, TIS booklets (\$14 ea.)	Completed July 2019; Biennially review and repeat
1.5	Purchase time for a PSA on local radio and television stations	~\$4000 for ad	March 2020
1.6	Publish articles in newsletters and newspapers on TIS	Staff time, ~ \$1700 for ads	April 2020- ongoing
1.7	Host a public workshop to teach community members how to use Citizen Scientist apps	Staff time	June-August 2020
1.8	Host a public workshop on TIS prevention, ID, and treatment	Staff time	June-August 2020
1.9	Encourage municipalities to adopt a native plant ordinance	Staff time	March 2020
1.10	Encourage landscapers and nurseries to avoid planting and selling TIS	Staff time	Ongoing
1.11	Create an NRD web page with landowner resources	Staff time	February 2020
1.12	Incorporate TIS education into youth programs	Staff time	June 2020
1.13	Install boot brush stations, educational kiosks	~\$350	May 2021
Goal 2	Survey and assess existing TIS populations	Cost	Date Planned
2.1	Adopt a standardized protocol for surveying and storing TIS data	Staff time	January 2020
2.2	Review early alerts of priority TIS in the MISIN annually	Staff time	January 2020 – Ongoing
2.3	Compile distribution data for TIS priority species	Staff time	January 2020
2.4	Create GIS layer of high value places and key vectors	Staff time	January 2020
2.5	Adopt or create a prioritization tool	Staff time	January 2020

2.6	Establish a TIS detection-monitoring system	Staff time	February 2019
2.7	Establish a long-term, systematic survey strategy	Staff time / Contactor fees	June 2021-ongoing
Goal 3	Treat target populations of TIS – set annual goals	Cost	Date Planned
3.1	Compile treatment protocols	Staff time	February 2020-ongoing
3.2	Assemble team and treat EDR species on Tribal Trust land	Staff time dependent of extent of work	June 2020-ongoing
3.3	Treat priority species on high-value sites	Staff time dependent of extent of work	June 2020-ongoing
3.4	Treat asset-based species on high-value sites	Staff time dependent of extent of work	June 2020-ongoing
3.5	Document and enter treatment data into the MISIN	Staff time dependent of extent of work	Ongoing
Goal 4	Evaluate treatments and adapt strategies	Cost	Date Planned
4.1	Establish system for documenting pre- and post-monitoring data	Staff time	February 2020
4.2	Determine management goals for the treatment area	Staff time	ongoing
4.3	Determine best monitoring methods based on site specific management goals and available resources and expertise	Staff time	ongoing
4.4	Implement pre- and post-monitoring	Staff time dependent of extent of work	ongoing
4.5	Document and enter monitoring data into the MISIN	Staff time dependent of extent of work	ongoing
4.6	Evaluate this TIS Management Plan and adapt and update as needed	Staff time	ongoing

Potential Funding Sources

The LTBB does not have long term funding in place for invasive species management so securing grant and cost-share funding is a vital part of sustaining this work. Below are several agency and programs that fund invasive species work. Work with partner organizations to leverage funding. Additionally, The MISC is currently compiling a list of funding sources that will be made available to users on the Forum when complete (when completed, available at: <https://forum.michiganinvasives.org/>).

Bureau of Indian Affairs

Noxious Weed Eradication Program

The primary function of the Noxious Weed Eradication program is to provide resource protection on trust lands. Contact the BIA Branch of Agriculture and Rangeland Development.

https://www.federalgrantswire.com/agriculture-on-indian-lands.html#.XZJx_UZKg2w

Endangered Species Program

This program funds projects that work to improve habitat for and protect federally listed threatened and endangered species and culturally significant species as identified in official tribal documents. It may be relevant where a TIS is directly impacting the habitat of a federally listed species or competing for resources.

<https://www.bia.gov/bia/ots/division-natural-resources/branch-fish-wildlife-recreation>

Michigan Agency
Bureau of Indian Affairs
Department of the Interior
2845 Ashmun Street
Sault Ste. Marie, MI 49783

Great Lakes Restoration Initiative

The Great Lakes Restoration Initiative (GLRI) is a multi-agency collaboration works to accelerate efforts to protect and restore the Great Lakes. One of the long term goals is to prevent new invasive species and to control existing invasive species. The 2015-2019 plan highlighted invasive species project funding, and the 2020-2024 plan is under development. Past funding has included multiple TIS control projects. Funding is awarded through the EPA to partner agencies including the BIA, USFWS, USDA, and other agencies. The Tribe may be more competitive in grant opportunities sought through the BIA. Grant opportunities are announced through the agency providing them.

More information: <https://www.glri.us/funding#grant-opps>

National Fish and Wildlife Foundation – Sustain Our Great Lakes

Sustain our Great Lakes Program is a public-private partnership designed to address threats to the Great Lakes and improve ecological health of the basin. The program provides grants for on-the-ground work centered on aquatic and wetland systems. They provide funding for “the retreatment or management to control invasive species that have received initial treatment or to expand existing invasive control efforts through the management of invasive species on new/previously untreated acres adjacent or strategically connected to existing control efforts.” Although their focus is on aquatic systems, often upland areas adjacent to wetlands systems are important to effective

restoration, for example, river banks with TIS. This funding may be suitable for additional resources for ongoing restoration efforts such as the Bear River Valley Recreation Area swallowwort control.

More information: <https://nfwf.org/greatlakes/Pages/home.aspx>

U.S. Department of Agriculture – IPM Center Grants

The North Central IPM Center provides grants for a variety of integrated pest management (IPM) related research, working groups, and projects addressing critical issues, including IPM on Tribal land. Funding is intended to provide on-time seed funding to help initiate work requiring immediate attention until other long-term funding becomes available.

More information: <https://www.ncipmc.org/projects/working-group-projects/>

Natural Resources Conservation Service – Cost-share Programs

The NRCS provides cost-share funding through EQIP and CSP for treatment of invasive species on private agricultural and forest lands. They also offer cost-share funding and technical assistance for tribe-owned land, and on public (federal, state, and locally-owned) land where the tribe is involved in a project, has a vested interest in (for example along public waterways where important to exercising fishing rights), and is within their reservation boundaries.

Contact: Bill Borgeld

NRCS State Tribal Liaison (Petoskey)

William.Borgeld@mi.usda.gov

U.S. Fish and Wildlife Service – Midwest Partners for Fish and Wildlife

The Partners for Fish and Wildlife program works with private landowners to improve fish and wildlife habitat on their lands by providing technical assistance and cost-sharing. Eligible participants include individuals, tribes, organizations, municipalities, and corporations. Focus is on restoring wetlands, grasslands, forests and stream corridors, and projects that involve restoring areas for Federal trust species (migratory birds, threatened and endangered species, and migratory fish), reduce fragmentation, or occur on conservation priority area are favored. This program may be useful for larger management areas of high conservation-value natural communities or species where TIS pose a significant threat, such as island communities.

More information: <https://www.fws.gov/midwest/partners/index.html>

Michigan Invasive Species Grant Program

The Departments of Natural Resources, Environment, Great Lakes and Energy and Agriculture and Rural Development work together to address strategic issues of prevention, detection, eradication, and control for both terrestrial and aquatic invasive species in Michigan. Project must support the programs overall goals of preventing new invasive species introductions, strengthen statewide early detection and response, limit the dispersal of recently confirmed invasive species, and manage and control widespread and long-established invasive species. Up to \$3.6 million in grant funds is available annually. The minimum grant amount is \$25,000 with maximum grant amounts between \$40,000 and \$400,000 depending on the type of project.

More information: https://www.michigan.gov/invasives/0,5664,7-324-71276_92000---,00.html

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Appendix 1. Cultural Species of Significance to the Odawa People

Source: Pilette, 2009

Upland Plants

American beech (*Fagus grandifolia*)
Basswood/Linden (*Tilia americana*)
Beaked hazelnut (*Corylus cornuta*)
Bearberry (*Arctostaphylos uva-ursi*)
Bigtooth aspen (*Populus grandidentata*)
Blue cohosh (*Caulophyllum thalictroides*)
Bracken fern (*Pteridium aquilinum*)
Cherry spp. (*Prunus* spp.)
Common lowbush-blueberry (*Vaccinium angustifolium*)
Common milkweed (*Asclepias syriaca*)
Common trillium (*Trillium grandiflorum*)
Eastern hemlock (*Tsuga canadensis*)
Eastern white pine (*Pinus strobus*)
Fringed polygala (*Polygala paucifolia*)
Hairy pucoon (*Lithospermum carolinense*)
Hawthorns (*Crataegus* spp.)
Highbush-cranberry (*Viburnum opulus* var. *americanum*)
Hop-hornbeam/Ironwood (*Ostrya virginiana*)
Huckleberry/Crackleberry (*Gaylussacia baccata*)
Indian cucumber root (*Medeola virginiana*)
Maidenhair fern (*Adiantum pedatum*)
Northern red oak (*Quercus rubra*)
Partridge berry (*Mitchella repens*)
Pearly everlasting (*Anaphalis margaritacea*)
Pipsissewa/Prince's pine (*Chimaphila umbellata*)
Princess pine/Ground-pine (*Lycopodium obscurum*)
Red maple (*Acer rubrum*)
Seneca snakeroot (*Polygala seneca*)
Striped maple/Moosewood (*Acer pensylvanicum*)
Sugar maple (*Acer saccharum*)
Staghorn sumac (*Rhus typhina*)
Sweet fern (*Comptonia peregrina*)
Trembling aspen (*Populus tremuloides*)
Trout lily/Adder's tongue (*Erythronium americanum*)
White ash (*Fraxinus americana*)
White birch (*Betula papyrifera*)
Wild bergamot (*Monarda fistulosa*)
Wild leeks/Ramps (*Allium tricoccum*)
Wild strawberry (*Fragaria virginiana*)
Witchhazel (*Hamamelis virginiana*)
Wintergreen (*Gaultheria procumbens*)
Wormwood/Field sagewort (*Artemisia campestris*)

Wetland Plants

American elm (*Ulmus americana*)
Balsam fir (*Abies balsamea*)
Black ash (*Fraxinus nigra*)
Black spruce (*Picea mariana*)
Bog-/Swamp- rosemary (*Andromeda glaucophylla*)
Boneset (*Eupatorium perfoliatum*)
Cardinal flower (*Lobelia cardinalis*)
Common cat-tail (*Typha latifolia*)
Common (field) horsetail/Scouring rush (*Equisetum arvense*)
Common reed (*Phragmites australis*)
Cranberry (*Vaccinium macrocarpon*)
Creeping snowberry (*Gaultheria hispidula*)
Eastern tamarack (*Larix laricina*)
Goldthread (*Coptis trifolia*)
Jack-in-the-pulpit (*Arisaema triphyllum*)
Labrador tea (*Ledum groenlandicum*)
Lady fern (*Athyrium filix-femina*)
Marsh marigold (*Caltha palustris*)
Mountain-holly (*Nemopanthus mucronatus*)
Northern white-cedar (*Thuja occidentalis*)
Northern wild rice (*Zizania palustris*)
Pink or Stemless lady's slipper, Moccasin flower (*Cypripedium acaule*)
Red-osier dogwood (*Cornus stolonifera*)
Riverbank-grape (*Vitis riparia*)
Scouring rush (*Equisetum hymale*)
Sensitive fern (*Onoclea sensibilis*)
Slippery elm (*Ulmus rubra*)
Speckled alder (*Alnus rugosa*)
Sphagnum moss (*Sphagnum* spp.)
Spotted joe-pye weed (*Eupatorium maculatum*)
Spotted touch-me-not/Jewelweed (*Impatiens capensis*)
Swamp milkweed (*Asclepias incarnata*)
Sweetflag (*Acorus americanus*)
Sweet gale (*Myrica gale*)
Sweetgrass (*Hierochloa odorata*)
White-water lily (*Nymphaea odorata*)
Winterberry/Michigan holly (*Ilex verticillata*)
Yellow birch (*Betula allegheniensis*)
Yellow lady-slipper (*Cypripedium calceolus*)

Appendix 2. Special Concern, Threatened and Endangered Species within the Emmet and Charlevoix Counties

Source: MNFI Element Data, Sept. 25, 2019 (<https://mnfi.anr.msu.edu/resources/county-element-data>)

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank	County	Last Observed	Total
<i>Accipiter gentilis</i>	Northern goshawk		SC	G5	S3	Charlevoix	2018	2
<i>Adlumia fungosa</i>	Climbing fumitory		SC	G4	S3	Charlevoix	1966	1
<i>Alasmidonta viridis</i>	Slippershell		T	G4G5	S2S3	Emmet	2011	1
<i>Amerorchis rotundifolia</i>	Small round-leaved orchis		E	G5	S1	Emmet	1981	2
<i>Ammodramus savannarum</i>	Grasshopper sparrow		SC	G5	S4	Charlevoix	2007	1
						Emmet	2007	2
<i>Appalachina sayanus</i>	Spike-lip crater		SC	G5T5	S1	Charlevoix	1938	3
<i>Barbarea orthoceras</i>	Northern Winter Cress		SC	G5	SNR	Emmet	1923	1
<i>Beckmannia syzigachne</i>	Slough grass		T	G5	S2	Emmet	1932	1
<i>Bombus terricola</i>	Yellow banded bumble bee		SC	G3G5	SNR	Charlevoix	1935	5
						Emmet	1990	8
<i>Botaurus lentiginosus</i>	American bittern		SC	G5	S3	Charlevoix	1999	1
<i>Bromus pumpellianus</i>	Pumpelly's brome grass		T	G5T4	S2	Charlevoix	1999	6
						Emmet	2018	8
<i>Brychius hungerfordi</i>	Hungerford's crawling water beetle	LE	E	G1	S1	Charlevoix	2011	1
						Emmet	2017	4
<i>Buteo lineatus</i>	Red-shouldered hawk		T	G5	S4	Charlevoix	2009	14
						Emmet	2015	21
<i>Callitriche heterophylla</i>	Large water starwort		T	G5	S1	Emmet	1955	1
<i>Calypso bulbosa</i>	Calypso or fairy-slipper		T	G5	S2	Charlevoix	1989	6
						Emmet	1985	5
<i>Charadrius melodus</i>	Piping plover	LE	E	G3	S2	Charlevoix	2015	8
						Emmet	2012	10
<i>Chlidonias niger</i>	Black tern		SC	G4G5	S2	Emmet	2005	1
<i>Cincinnati cincinnatiensis</i>	Campeloma spire snail		SC	G5	S3	Charlevoix	2015	6
<i>Cirsium pitcheri</i>	Pitcher's thistle	LT	T	G2G3	S3	Charlevoix	2018	26
						Emmet	2013	18

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank	County	Last Observed	Total
<i>Coregonus artedii</i>	Lake herring or Cisco		T	G5	S3	Charlevoix	1995	2
						Emmet	1985	1
<i>Coregonus zenithicus</i>	Shortjaw cisco		T	G3	S2	Emmet	1998	1
<i>Cottus ricei</i>	Spoonhead sculpin		SC	G5	S1S2	Charlevoix	1994	2
						Emmet	1995	1
<i>Cypripedium arietinum</i>	Ram's head lady's-slipper		SC	G3	S3	Charlevoix	2000	6
						Emmet	2018	8
<i>Dalibarda repens</i>	False violet		T	G5	S1S2	Charlevoix	1904	1
						Emmet	1904	1
<i>Drosera anglica</i>	English sundew		SC	G5	S3	Charlevoix	2011	5
						Emmet	1899	2
<i>Emydoidea blandingii</i>	Blanding's turtle		SC	G4	S2S3	Charlevoix	2015	1
						Emmet	2000	2
<i>Erora laeta</i>	Early hairstreak		SC	GU	SH	Emmet	2018	2
<i>Euxoa aurulenta</i>	Dune cutworm		SC	G5	S2S3	Charlevoix	1935	1
<i>Falco columbarius</i>	Merlin		T	G5	S3	Charlevoix	2007	1
<i>Fontigens nickliniana</i>	Watercress snail		SC	G5	S2S3	Emmet		1
<i>Fossaria galbana</i>	Boreal fossaria		SC	G5Q	SNR	Emmet		1
<i>Gallinula galeata</i>	Common gallinule		T	G5	S3	Charlevoix	1999	1
<i>Gavia immer</i>	Common loon		T	G5	S3	Charlevoix	2017	9
						Emmet	2015	9
<i>Graphephorum melicoides</i>	Purple false oats		SC	G4	SNR	Emmet	1970	3
<i>Gymnocarpium robertianum</i>	Limestone oak fern		T	G5	S2	Charlevoix	2001	1
						Emmet	2002	1
<i>Haliaeetus leucocephalus</i>	Bald eagle		SC	G5	S4	Charlevoix	2017	23
						Emmet	2017	18
<i>Hydroprogne caspia</i>	Caspian tern		T	G5	S2	Charlevoix	2011	3
<i>Iris lacustris</i>	Dwarf lake iris	LT	T	G3	S3	Charlevoix	2012	5
						Emmet	2018	5
<i>Lanius ludovicianus migrans</i>	Migrant loggerhead shrike		E	G4T3Q	S1	Emmet	1981	1
<i>Lasmigona compressa</i>	Creek heelsplitter		SC	G5	S3	Emmet	1945	3
<i>Ligumia nasuta</i>	Eastern pondmussel		E	G4	S2	Emmet	2018	2
<i>Littorella uniflora</i>	American shore-grass		SC	G5	S2S3	Charlevoix	1998	1

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank	County	Last Observed	Total
<i>Microtus pinetorum</i>	Woodland vole		SC	G5	S3S4	Charlevoix	1923	1
						Emmet	1967	3
<i>Mimulus michiganensis</i>	Michigan monkey flower	LE	E	G5T1	S1	Charlevoix	2012	4
						Emmet	2017	4
<i>Myotis lucifugus</i>	Little brown bat		SC	G3	S1	Charlevoix	1987	5
						Emmet	1993	4
<i>Myotis septentrionalis</i>	Northern long-eared bat	LT	SC	G1G2	S1	Charlevoix	1923	1
<i>Necturus maculosus</i>	Mudpuppy		SC	G5	S3S4	Charlevoix	2018	1
						Emmet	2018	1
<i>Nycticorax nycticorax</i>	Black-crowned night-heron		SC	G5	S3	Charlevoix	2007	3
<i>Opheodrys vernalis</i>	Smooth green snake		SC	G5	S3	Charlevoix	2018	1
<i>Orobanche fasciculata</i>	Broomrape		T	G4G5	S2	Charlevoix	2011	4
<i>Pandion haliaetus</i>	Osprey		SC	G5	S4	Charlevoix	2017	3
						Emmet	2017	8
<i>Papaipema aweme</i>	Aweme borer		SC	G1	S1	Charlevoix	1925	1
<i>Physella magnalacustris</i>	Great Lakes physa		SC	G5Q	SNR	Charlevoix	2015	2
						Emmet	1988	1
<i>Pinguicula vulgaris</i>	Butterwort		SC	G5	S3	Charlevoix	2015	4
						Emmet	2018	4
<i>Pisidium idahoense</i>	Giant northern pea clam		SC	G5	SNR	Charlevoix		3
						Emmet		1
<i>Planogyra asteriscus</i>	Eastern flat-whorl		SC	G4	S2S3	Charlevoix	1929	1
<i>Potamogeton hillii</i>	Hill's pondweed		T	G3	S2	Charlevoix	1984	1
						Emmet	1982	2
<i>Potamogeton pulcher</i>	Spotted pondweed		E	G5	S1	Emmet	1980	1
<i>Pterospora andromedea</i>	Pine-drops		T	G5	S2	Emmet	1999	6
<i>Pupilla muscorum</i>	Widespread column		SC	G5	S2	Charlevoix	1949	1
<i>Pyganodon lacustris</i>	Lake floater		SC	GU	SNR	Charlevoix	2015	2
<i>Pygarctia spraguei</i>	Sprague's pygarctia		SC	G5	S2S3	Emmet	1932	1
<i>Pyrgus centaureae wyandot</i>	Grizzled skipper		SC	G5T1T2	S1S2	Emmet	1932	1

<i>Scientific Name</i>	<i>Common Name</i>	<i>Federal Status</i>	<i>State Status</i>	<i>Global Rank</i>	<i>State Rank</i>	<i>County</i>	<i>Last Observed</i>	<i>Total</i>
<i>Rallus elegans</i>	King rail		E	G4	S2	Emmet	1949	1
<i>Ranunculus cymbalaria</i>	Seaside crowfoot		T	G5	SX	Charlevoix	1957	1
<i>Schoenoplectus torreyi</i>	Torrey's bulrush		SC	G5?	S2S3	Charlevoix	1964	1
						Emmet	2018	2
<i>Sistrurus catenatus</i>	Eastern massasauga	LT	SC	G3	S3	Emmet	1955	1
<i>Solidago houghtonii</i>	Houghton's goldenrod	LT	T	G3	S3	Charlevoix	2015	5
						Emmet	2016	8
<i>Somatochlora hineana</i>	Hine's emerald dragonfly	LE	E	G2G3	S1	Charlevoix	2013	1
<i>Stachys pilosa</i>	Hairy hedge-nettle		SC	G5	SNR	Emmet	1924	3
<i>Stagnicola contracta</i>	Deepwater pondsnail		E	G1	SH	Charlevoix	1940	2
<i>Stagnicola petoskeyensis</i>	Petoskey pondsnail		E	GH	SH	Emmet	1908	1
<i>Stagnicola woodruffi</i>	Coldwater pondsnail		SC	G2G3Q	SNR	Charlevoix	2009	5
<i>Stellaria longipes</i>	Stitchwort		SC	G5	S2	Charlevoix	1986	1
<i>Stenelmis douglasensis</i>	Douglas stenelmis riffle beetle		SC	G1G3	S1S2	Emmet	1952	2
<i>Sterna hirundo</i>	Common tern		T	G5	S2	Charlevoix	2011	7
						Emmet	1997	6
<i>Tanacetum huronense</i>	Lake Huron tansy		T	G5T4T5	S3	Charlevoix	2017	24
						Emmet	2018	13
<i>Tephrosia palustris</i>	Marsh fleabane		X	G5	SX	Emmet	1934	1
<i>Trimerotropis huroniana</i>	Lake Huron locust		T	G2G3	S2S3	Charlevoix	2015	16
						Emmet	2011	9
<i>Vertigo elatior</i>	Tapered vertigo		SC	G5	S3	Charlevoix	2015	1
						Emmet		1
<i>Vertigo nylanderii</i>	Deep-throat vertigo		E	G3G4	S1?	Emmet		1
<i>Vertigo paradoxa</i>	Mystery vertigo		SC	G4G5Q	S3S4	Emmet		1
<i>Woodsia obtusa</i>	Blunt-lobed woodsia		T	G5	S1S2	Emmet	1923	1

Appendix 3. Michigan State Prohibited, Restricted and Noxious Weeds

Michigan laws regulate the possession and sale of certain plant species which are considered undesirable from agricultural as well as environmental viewpoints. These unwanted species are listed below according to the applicable laws and regulations.	
A. Prohibited Plant Species (Natural Resources and Environmental Protection Act (Act 451 of 1994, as amended))	
Prohibited species identified under this Act cannot be sold or grown in the state. Any of the following plants, fragments, seeds or a hybrid or genetically engineered variant thereof are specifically prohibited.	
Fanwort	<i>Cabomba caroliniana</i>
Cylindro	<i>Cylindrospermopsis raciborskii</i>
Brazilian elodea	<i>Egeria densa</i>
Japanese knotweed	<i>Fallopia japonica</i>
Giant hogweed	<i>Heracleum mantegazzianum</i>
Hydrilla	<i>Hydrilla verticillata</i>
European frogbit	<i>Hydrocharis morsus-ranae</i>
African oxygen weed	<i>Lagarosiphon major</i>
Parrot's feather	<i>Myriophyllum aquaticum</i>
Starry stonewort	<i>Nitellopsis obtusa</i>
Yellow floating heart	<i>Yellow Floating Heart</i>
Giant salvinia	<i>Salvinia molesta, auriculata, biloba, or herzogii</i>
Water chestnut	<i>Trapa natans</i>
B. Restricted Plant Species (Natural Resources and Environmental Protection Act (Act 451 of 1994, as amended))	
Restricted species under this Act are those that may occur within the state and are generally considered as nuisances or economically detrimental.	
Any of the following plants, fragments, seeds or a hybrid or genetically engineered variant thereof are restricted.	
Flowering rush	<i>Butomus umbellatus</i>
Purple loosestrife	<i>Lythrum salicaria</i>
Eurasian watermilfoil	<i>Myriophyllum spicatum</i>
Phragmites/Common Weed	<i>Phragmites australis</i>
Curly leaf pondweed	<i>Potamogeton crispus</i>

C. Noxious Weeds (Michigan Seed Law (Act 329 of 1965) and Regulations 715 (Under Act 329) Seed Law Implementation)	
1. Prohibited noxious weeds - Seeds of these species are prohibited as contaminants in seed offered for sale.	
Quackgrass	<i>Agropyron repens</i>
Perennial peppergrass Whitetop/hoary cress	<i>Cardaria draba</i>
Plumelss thistle	<i>Carduus acanthoides</i>
Musk thistle	<i>Carduus nutans</i>
Spotted knapweed	<i>Centaurea maculosa</i>
Russian knapweed	<i>Centaurea picris</i>
Canada thistle	<i>Cirsium arvense</i>
Bull thistle	<i>Cirsium vulgare</i>
Field bindweed	<i>Convolvulus arvensis</i>
Hedge bindweed	<i>Convolvulus sepium</i>
Dodder	<i>Cuscuta spp</i>
Yellow nutsedge, chufa	<i>Cyperus esculentus, both seed and tubers</i>
Leafy spurge	<i>Euphorbia esula</i>
Morning glory	<i>Ipomea species</i>
Serrated tussock	<i>Nasella trachoma</i>
Horsenettle	<i>Solanum carolinense</i>
Perennial sowthistle	<i>Sonchus arvensis</i>
Johnson grass	<i>Sorghum halapense</i> , including <i>Sorghum alnum</i> and seed which cannot be distinguished from Johnson grass
Puncturevine	<i>Tribulus terrestris</i>
2. Restricted noxious weed seeds - Generally the limit is one seed per 2000 of agricultural seed offered for sale.	
Velvetleaf	<i>Abutilon theophrasti -</i>
Wild onion	<i>Allium canadense</i>
Wild garlic	<i>Allium vineale</i>
Wild oat	<i>Avena fatua</i>
Yellow rocket	<i>Barbarea vulgaris</i>
hoary alyssum	<i>Berteroa incana</i>
Indian mustard	<i>Brassica juncea</i>
Black mustard	<i>Brassica nigra</i>
Jimsonweed	<i>Datura stramonium</i>
Wild carrot	<i>Daucus carota</i>
Buckhorn plantain	<i>Plantago lanceolata</i>
Wild radish	<i>Raphanus raphanistrum</i>
Curled dock	<i>Rumex crispus</i>

Giant foxtail	<i>Setaria faberii</i>
Charlock	<i>Sinapis arvensis</i>
Solanum species: including all of the following species and any other species with indistinguishable seed: Nightshade complex	
Bitter nightshade	<i>Solanum dulcamara</i>
Silverleaf nightshade	<i>Solanum eleagnifolium</i>
Black nightshade	<i>Solanum nigrum</i>
Eastern black nightshade	<i>Solanum ptycanthum</i>
Hairy nightshade	<i>Solanum sarrachoides</i>
Fanweed	<i>Thlaspi arvense</i> - <i>Deregulated as of December 2015</i>
Cocklebur	<i>Xanthium strumarium</i>

Appendix 4. Michigan's Invasive Species Watch List

Updated March 18, 2019; Source: https://www.michigan.gov/invasives/0,5664,7-324-68002_74188---,00.html

The following information is presented as a guide for reporting occurrences of select invasive species of concern in Michigan.

Invasive Species “Watch List”

The invasive species included on the watch list are priority species that have been identified as posing an immediate and significant threat to Michigan's natural resources. These species have either never been confirmed in Michigan or have very limited distribution, or are localized. Early detection and timely reporting of occurrences of these species is crucial for increasing the likelihood of stopping an invasion and limiting negative ecological and economic impacts. Species are listed below by category. The invasive species below should be reported immediately and directly to staff. Please use the contacts below each category to report a possible detection of a watch list species.

Insects and Tree Diseases (Tree diseases list the scientific name for the pathogen or fungus associated with the disease)

- Asian longhorned beetle (*Anoplophora glabripennis*)
- Balsam wooly adelgid (*Adelges piceae*)
- Hemlock wooly adelgid (*Adelges tsugae*)
- Thousand cankers disease (*Geosmithia morbida*)
- Spotted lanternfly (*Lycorma delicatula*)

Report the species above to Mike Bryan – MDARD Plant Industry Section, bryanm@michigan.gov, 517-284-5648

Mammals

- Nutria (*Myocastor coypus*)
-

Report the species above to Greg Norwood – DNR Wildlife Division, norwoodg@michigan.gov, 517-342-4514

Terrestrial Plants

- Asiatic sand sedge (*Carex kobomugi* Ohwi)
- Chinese yam (*Dioscorea oppositifolia* L.)
- Himalayan balsam (*Impatiens glandulifera*)
- Japanese stiltgrass (*Microstegium vimineum* (Trin.) A. Camus)
- Kudzu (*Pueraria montana* var. *lobata*)
- Mile-a-minute weed (*Persicaria perfoliata*)
- Japanese chaff flower (*Achyranthes japonica*)

Report the species above to Greg Norwood – DNR Wildlife Division, norwoodg@michigan.gov, 517-342-4514

Aquatic Plants

- Parrot feather (*Myriophyllum aquaticum*)
- Yellow Floating Heart (*Nymphoides peltata*)
- European frog-bit (*Hydrocharis morsus-ranae*)
- European Water-clover (*Marsilea quadrifolia*) – This species is currently allowable for sale and possession. Please contact the DEQ if these plants are observed outside of cultivation.
- Brazilian elodea (*Egeria densa*) • Hydrilla (*Hydrilla verticillata*)
- Water chestnut (*Trapa natans*)
- Water hyacinth (*Eichhornia crassipes*) – This species is currently allowable for sale and possession. Please contact the DEQ if these plants are observed outside of cultivation.
- Water lettuce (*Pistia stratiotes*) – This species is currently allowable for sale and possession. Please contact the DEQ if these plants are observed outside of cultivation.
- Water soldier (*Stratiotes aloides*)

Report the species above to Aquatic Nuisance Control Program – DEQ Water Resources Division, DEQ-WRD-ANC@michigan.gov, 517-284-5593

Fish and other Aquatic Animals

- Invasive carps
 - Silver carp (*Hypophthalmichthys molitrix*)
 - Bighead carp (*Hypophthalmichthys nobilis*)
 - Grass carp (*Ctenopharyngodon idella*)
 - Black carp (*Mylopharyngodon piceus*)
- Northern snakehead (*Channa argus*)
- Red swamp crayfish (*Procambarus clarkii*)
- New Zealand mud snail (*Potamopyrgus antipodarum*)

Report the species above to Seth Herbst – DNR Fisheries Division, herbstS1@michigan.gov, 517-284-5841 or for invasive carp report electronically at www.michigan.gov/asiancarp

Appendix 5. Local, state, and federal laws and regulations involving invasive species

Laws and regulations at the state and federal level are designed to stop the introduction and spread of invasive species. These laws are often complicated. Following a few best practices can keep you on the right side of the law.

Best Practices

Don't move firewood – this is the best practice for stopping the spread of forest pests and diseases.

- It is illegal to move hardwood firewood from the Lower Peninsula to the Upper Peninsula of Michigan. There are also more specific rules about moving firewood within and between quarantine areas. Know the current firewood laws.
- You can no longer bring firewood into some National Parks, Forests and Lakeshores in Michigan. Know the rules before you visit.

Clean, Drain and Dry Boats, Trailers and Gear to prevent moving aquatic invasive species and fish diseases.

- It is illegal to place a boat, boating equipment, or boat trailer in the water in Michigan if the boat, equipment or trailer has an aquatic plant attached. Find out more about this law and penalties.
- Boaters are required to drain all bilges and live wells when leaving a water body. Review the Fish Disease Control Order

Don't Dump Bait – dispose of bait on land or in the trash to stop the spread of invasive species and fish disease.

- Michigan's Fish Disease Control Order prohibits moving many fish and baitfish species from one water body to another. View the law and fish species list.

Don't buy, sell, keep or move invasive species. Many invasive species are prohibited or restricted by state or federal laws.

- It is illegal to import or move species listed as "injurious to wildlife" except with a federal permit. View the law (The Lacey Act) and view the list of species injurious to wildlife.
- Noxious weeds cannot be brought into the United States or moved from state to state. Read the Plant Protection Act and view the Noxious Weed List.
- Michigan laws limit the import, sale and possession of prohibited and restricted species including plants, animals, fish, mollusks and crayfish. Read the law (Act 451 Section 324.41301), the 2014 amendment, the 2015 amendment and the current list of prohibited and restricted species.
- Federal law prohibits the interstate transportation, delivery, receipt or sales of alligator grass, water chestnut plants or water hyacinth plants or their seeds. Review the law (18 U.S. Code §46).
- Michigan laws regulate the possession and sale of certain plant species which are considered undesirable from agricultural as well as environmental viewpoints. See a list of prohibited, restricted and noxious weeds.

Ships

- Michigan law requires the MDEQ to determine whether ballast water management practices are being complied with by all vessels operating on the Great Lakes and the St. Lawrence waterway. In accordance with this law, vessels must report compliance with best management practices. Review the law (Act 451 Section 324.3103a) and learn about the ballast water reporting program.

- Michigan law requires all ocean-going vessels engaging in port operations in Michigan to obtain a permit from the MDEQ. Read the law (Act 451 Section 324.3112) and learn about ballast water control permits.

DON'T MAKE A MOVE until you check for the Gypsy Moth. Anyone moving out of state must comply with this federal quarantine regulation.

- People who live in the gypsy moth quarantine area — which includes the state of Michigan— must use PPQ Form 377 to inspect their outdoor household goods for gypsy moth before they move to a non-infested area.
- The Federal gypsy moth regulations (Title 7 Code of Federal Regulations 301.45-4) require this action to prevent the human-assisted movement of this damaging pest of woody plants.
- A copy of the form must accompany the household goods during the move. This checklist may be completed by the person moving or by a qualified certified applicator.
- Once completed and signed, the checklist is an official certificate that will satisfy Federal requirements for interstate moves.

Michigan Laws

[Michigan's Natural Resources and Environmental Protection Act - NREPA](#) (451 of 1994, as amended) "AN ACT to protect the environment and natural resources of the state; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; to regulate the use of certain lands, waters, and other natural resources of the state; to protect the people's right to hunt and fish; to prescribe the powers and duties of certain state and local agencies and officials; to provide for certain charges, fees, assessments, and donations; to provide certain appropriations; to prescribe penalties and provide remedies; and to repeal acts and parts of acts."

[Part 413 of NREPA](#) (Natural Resources and Environmental Protection Act 451 of 1994, Section 324.41301) defines prohibited and restricted species in Michigan and limits the possession, import or sale of such species.

[The Natural Resources Commission Prohibited and Restricted Aquatic Invasive Species Order Amendment 1 of 2014](#) adds to the list of prohibited and restricted species in Michigan outlined in Part 413 of NREPA.

[Commission of Agriculture and Rural Development Invasive Species Order No. 1 of 2015](#) adds Water Soldier to the list of prohibited species in Michigan.

Part 33 of NREPA, Aquatic Nuisance Control (Natural Resources and Environmental Protection Act 451 of 1994, Section 33) defines permitted actions and procedures for the treatment of aquatic nuisance species.

Federal Laws

The Lacey Act: Under the Lacey Act (18 U.S.C. 42, as amended), the Secretary of the Interior is authorized to regulate the importation and transport of species, including offspring and eggs, determined to be injurious to the health and welfare of humans, the interests of agriculture, horticulture or forestry, and the welfare and survival of wildlife resources of the U.S. These injurious species may not be imported into or transported between states, districts or territories of the U.S.

without a permit issued by the U. S. Fish and Wildlife Service. The 2008 Farm Bill (the Food, Conservation, and Energy Act of 2008), amended the Lacey Act by expanding its protection to a broader range of plants and plant products. The Lacey Act now also makes it unlawful to import certain plants and plant products without an import declaration.

Species Injurious to Wildlife: A current list of species considered injurious to wildlife under the Lacey Act.

The Plant Protection Act of 2000, (7 U.S.C. 7701 et seq.) which includes the Noxious Weed Control and Eradication Act of 2004, regulates the movement of plants, plant products, biological control organisms, and noxious weeds and authorizes the Secretary of Agriculture to “publish, by regulation, a list of noxious weeds that are prohibited or restricted from entering the United States or that are subject to restrictions on interstate movement within the United States.” Plant Protection Act and Noxious Weed Control and Eradication Act of 2004

The Federal Noxious Weed List expresses the noxious weeds that are prohibited or restricted from entering or being transported throughout the United States.

The Clean Boating Act of 2008 (Jul 29, 2008) directs EPA to develop management practices for recreational vessels to mitigate adverse effects from recreational boat discharges, such as bilgewater, graywater and deck runoff, that may contain substances harmful to water quality or spread invasive species.

The National Invasive Species Act of 1996 (Public Law 104-332), a reauthorization and amendment of the **Non-Indigenous Aquatic Nuisance Prevention and Control Act** of 1990 (Public Law 101-646), is intended to prevent invasive species from entering inland waters through ballast water.

18 U.S. Code § 46 - **Transportation of water hyacinths** - prohibits interstate transportation, delivery, receipt or sales of alligator grass (*Alternanthera philoxeroides*), or water chestnut plants (*Trapa natans*) or water hyacinth plants (*Eichhornia crassipes*) or the seeds of such grass or plants.

Ballast water- In addition to state laws there are a variety of federal and international laws regarding ballast water that are not listed here. [Contact the DEQ](#) for additional information.

Appendix 6. Global and State Ranks

Source: Faber-Langendoen et al 2012

Global Ranks

G1 = critically imperiled: at very high risk of extinction due to extreme rarity (often 5 or fewer occurrences), very steep declines, or other factors.

G2 = imperiled: at high risk of extinction due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors.

G3 = vulnerable: at moderate risk of extinction due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors.

G4 = apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5 = secure: common; widespread.

GU = currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

GX = eliminated: eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

G? = incomplete data.

State Ranks

S1 = critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2 = imperiled in the state because of rarity due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

S3 = vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

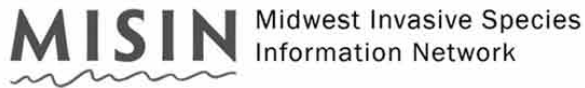
S4 = uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 = common and widespread in the state.

SX = community is presumed to be extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

S? = incomplete data.

Appendix 7. MISIN Survey Protocol



For more information:
info@misin.msu.edu

Invasive Plant Mapping Protocols

Objective

The objective for creating these mapping protocols is to develop a unified database of invasive species occurrences within the Midwest region of the United States. These protocols were created in partnership with the Michigan Invasive Species Coalition (MISC). These guidelines will assist all partners within the region in documenting the occurrence and spread of invasive species. The data collected will allow for the development and implementation of effective control strategies in the region.

Documentation: All information about invasive species occurrences must be documented using the categories on the official data form. All locations must be recorded using GPS. New occurrences should be marked with flagging ONLY if necessary to help relocate the invasive species for treatment. Volunteers must obtain permission before using flagging. The use of flagging or other references should be noted on the data form under the comments section.

All equipment, materials and instructions will be provided by project partners as needed.

GPS Protocols: For all observations, record a point location in the center of each population. If the area is heavily infested and distinct populations can be easily seen one to the next, mark no more than ONE point per 100ft. An average of 25 points should be taken per waypoint. All GPS points must be labeled with a unique ID number using the numbering convention explained below.

Unique ID: For each GPS position collected, record a unique twelve digit number in the GPS unit for each point as follows: "BBJJGM0014IU" where BB is the two letter code for the natural area, JJ is the mapper's initials, GM is the invasive species code, 001 is the three digit sequence number, 4 is the area, I is the sparse density, and U is for untreated. Within each location, the three digit sequence number of the ID for each person should not be repeated. If the GPS unit you are using does not allow for a twelve digit number, only record the first nine digits. These nine digits are considered the waypoint number and can be matched to the data sheet later.

Data Collection – Standard Operating Procedure

1. Identify which volunteers have received invasive species identification training and/or mapping training. (<http://www.misin.msu.edu/training/>)
2. Ensure each mapping team contains at least one member with experience in both mapping and identification methods.
3. Provide basic refresher training to all volunteers regarding the invasive species which the group expects to encounter and the mapping protocol for recording GPS waypoints.
4. Before sending teams out to map independently, direct volunteers to locate targeted invasive species in the immediate area, to ensure teams are equipped to identify target species and have the opportunity to ask questions.
5. Provide each team with a GPS unit, a data collection form, and have them fill out the following details on the form:
 - a. Date
 - b. GPS Unit #
 - c. Observer(s)
 - d. Site/Location
6. Divide overall site into reasonable chunks for each team. Whenever team members encounter one of the targeted invasive species in their assigned area, log a waypoint as per the directions below, making sure the calculated precision of the GPS unit is within 10 meters.

Logging a GPS Waypoint

GPS waypoints may be logged in one of two ways; either log the location on the GPS unit as a point and label using the format described below and on the lower left hand corner of the data collection sheet, or record the latitude and longitude on the data collection sheet manually.

- The GPS Waypoint Code includes:
 - Location Code: “BB”- volunteers should create a two digit code representing the natural area the observation was recorded. E.g. “IW” for inland wetland.
 - Observer Initials: First initial of first name and first initial of last name. E.g. “JJ”
 - Species: Enter the two digit code for the invasive plant species found at the location. Each person will be given a code sheet with all of the invasive plant common names, scientific names, and the two digit abbreviation codes. E.g. phragmites = PH
 - Waypoint ID Number: This is a three digit sequence number. The first entry should be “001”, the second “002”, the third “003”, etc. A sequence number of the ID for each person should never repeat in the site being surveyed.

- **Record Area**—Select one of the following:
 - 0 = None / NA
 - 1 = Individual/few/several
 - 2 = < 1,000 square feet (half tennis court)
 - 3 = 1,000 square feet to 0.5 acre
 - 4 = 0.5 acre to 1 acre (football field w/o end zones)
 - 5 = > 1 acre
- **Record Density**—Select one of the following options:
 - 0 = None / NA
 - 1 = Sparse (scattered individual stems or very small stands)
 - 2 = Patchy (a mix of sparse and dense areas)
 - 3 = Dense (greater than 40% of the area)
 - 4 = Monoculture (nearly 100% of area)
- **Record Treatment Status**—Enter “U” for untreated; or “N” for nonconsecutive years treated; or enter the number of years of consecutive treatment; or “D” for don’t know.
- **Record GPS Coordinates**—If not entering the waypoint code directly into the GPS unit, write the GPS coordinates for each plant species found at each location. All coordinates must be recorded in decimal degrees. For example: 44.75723, -85.65276 (N44.75723 W85.65276).
- **Record Comments**—Use this space to record anything of interest about the observation; i.e. note the use of flagging, general quality of natural community, last year treated (if known) or other pertinent information about the location, species infestation or mapping.

Date: _____ GPS Unit #: _____ Observer: _____ Site: _____

Waypoint Code: XXYYZZ001	Area	Density	Treatment Status
XX = Location Code	0 = None	1 = Sparse (scattered individual stems or very small stands)	U = Untreated
YY = Observer's Initials	1 = Individual/few/several	2 = Patchy (a mix of sparse and dense areas)	# = Consecutive years treated
ZZ = Species*	2 = < 1,000 sq. ft. (half tennis court)	3 = Dense (greater than 40% of the area)	N = Nonconsecutive years treated
001 = Waypoint ID Number	3 = 1,000 sq. ft. to 0.5 acre	4 = Monoculture (nearly 100% of area)	D = Don't know
(consecutive, ascending, and non-repeating, i.e. 001, 002, 003, etc.)	4 = 0.5 acre to 1 acre (football field w/o end zones)		
*see attached sheet	5 = > 1 acre		

Last Updated: June 05, 2013

GPS Abbreviation Codes			GPS Abbreviation Codes		
Invasive Species Network -- Target Species			Invasive Species Network -- Species of Concern		
Common Name	Abbrev. Code	Scientific Name	Common Name	Abbrev. Code	Scientific Name
Amur honeysuckle	AH	<i>Lonicera maackii</i>	African oxygen weed	OW	<i>Lagarosiphon major</i>
Autumn olive	AO	<i>Elaeagnus umbellata</i>	Amur cork-tree	AC	<i>Phellodendron amurense</i>
Baby's breath	BB	<i>Gypsophila paniculata</i>	Austrian pine	AP	<i>Pinus nigra</i>
Bell's honeysuckle	BH	<i>Lonicera xbella</i>	Bigleaf periwinkle	BP	<i>Vinca major</i>
Bishops goutweed	BG	<i>Aegopodium podagraria</i>	Birdfoot trefoil	LC	<i>Lotus corniculata</i>
Bull thistle	BT	<i>Cirsium vulgare</i>	Bittersweet nightshade	BN	<i>Solanum dulcamara</i>
Canada thistle	CT	<i>Cirsium arvense</i>	Black alder	BA	<i>Alnus glutinosa</i>
Common buckthorn	CB	<i>Rhamnus cathartica</i>	Black jetbead	BJ	<i>Rhodotypos scandens</i>
Dame's rocket	DR	<i>Hesperis matronalis</i>	Black locust	BL	<i>Robinia pseudoacacia</i>
European fly honeysuckle	LX	<i>Lonicera xylosteum</i>	Black swallow-wort	VN	<i>Vincetoxicum nigrum</i>
European swamp thistle	ST	<i>Cirsium palustre</i>	Bladder campion	BC	<i>Silene latifolia</i>
Garlic mustard	GM	<i>Alliaria petiolata</i>	Bouncingbet	SO	<i>Saponaria officinalis</i>
Giant knotweed	GK	<i>Polygonum sachalinense</i>	Brazilian water-weed	BW	<i>Egeria densa</i>
Glossy buckthorn	GB	<i>Rhamnus frangula</i>	Bristly locust	RH	<i>Robinia hispida</i>
Japanese barberry	JB	<i>Berberis thunbergii</i>	Brittle water-nymph	LN	<i>Najas minor</i>
Japanese honeysuckle	LJ	<i>Lonicera japonica</i>	Butterbur	PE	<i>Petasites hybridus</i>
Japanese knotweed	JK	<i>Polygonum cuspidatum</i>	Callery pear	CP	<i>Pyrus calleryana</i>
Leafy spurge	LS	<i>Euphorbia esula</i>	Coltsfoot	CF	<i>Tussilago farfara</i>
Lymegrass	LG	<i>Leymus arenarius</i>	Common chickweed	CC	<i>Stellaria media</i>
Morrow's honeysuckle	MH	<i>Lonicera morrowii</i>	Common mullein	MN	<i>Verbascum thapsus</i>
Multiflora rose	MR	<i>Rosa multiflora</i>	Common periwinkle	PW	<i>Vinca minor</i>
Narrowleaf cattail	NC	<i>Typha angustifolia</i>	Common St. Johnswort	SJ	<i>Hypericum perforatum</i>
Oriental bittersweet	OB	<i>Celastrus orbiculatus</i>	Common tansy	TV	<i>Tanacetum vulgare</i>
Phragmites (non-native)	PH	<i>Phragmites australis</i>	Cotton thistle	OA	<i>Onopordon acanthium</i>
Purple loosestrife	PL	<i>Lythrum salicaria</i>	Cow vetch	VV	<i>Vicia cracca</i>
Reed canarygrass	RC	<i>Phalaris arundinacea</i>	Curly pondweed	PC	<i>Potamogeton crispus</i>
Russian olive	RO	<i>Elaeagnus angustifolia</i>	Crown vetch	CV	<i>Coronilla varia</i>
Tatarian honeysuckle	TH	<i>Lonicera tatarica</i>	Cypress spurge	CS	<i>Euphorbia cyparissias</i>
Wild parsnip	WP	<i>Pastinaca sativa</i>	Dotted duck-weed	DD	<i>Landoltia punctata</i>
			European cranberry bush	HC	<i>Viburnum opulus</i>
			European frog-bit	FB	<i>Hydrocharis morsus-ranae</i>
			European lily of the valley	LV	<i>Convallaria majalis</i>
			European water clover	WC	<i>Marsilea quadrifolia</i>
			Field hedge parsley	TA	<i>Torilis arvensis</i>
			Flowering rush	FR	<i>Butomus umbellatus</i>

Invasive Species Network -- Species of Concern		
Common Name	Abbrev. Code	Scientific Name
Fuller's teasel	DF	<i>Dipsacus fullonum</i>
Giant hogweed	GH	<i>Heracleum mantegazzianum</i>
Giant salvinia	GS	<i>Salvinia molesta</i>
Hydrilla	HD	<i>Hydrilla verticillata</i>
Houndstongue	HT	<i>Cynoglossum officinale</i>
Japanese hedge parsley	JH	<i>Torilis japonica</i>
Japanese hops	HJ	<i>Humulus japonicus</i>
Japanese stilt grass	JS	<i>Microstegium vimineum</i>
Jimsonweed	JW	<i>Datura stramonium</i>
Kudzu	KZ	<i>Pueraria montana</i>
Lombardy poplar	LP	<i>Populus nigra</i> var. <i>italica</i>
Mile-a-Minute weed	MM	<i>Polygonum perfoliatum</i>
Money plant	MP	<i>Lunaria annua</i>
Moneywort	MW	<i>Lysimachia nummularia</i>
Nodding thistle	NT	<i>Carduus nutans</i>
Norway maple	NM	<i>Acer platanoides</i>
Orange day lily	OD	<i>Heemerocallis fulva</i>
Ornamental jewelweed	IG	<i>Impatiens glandulifera</i>

Note: When Reporting Native Phragmites (*Phragmites australis* subsp. *Americanus*) Use Abbreviation Code: **NP**

Appendix 8. CAKE CISMA Prioritization Tool

CAKE CISMA Invasive Species Management Prioritization Tool

County:	Latitude:	Longitude:
Site Description:		

Criteria

Value Score

Ecological Criteria

1. Total infestation size: How large is the invasive infestation (total area covered by treatable invasives)?

Individual/Few/Several	10	
<1,000 Sq Ft (Half Tennis Court)	7	
1,000 Sq Ft to 0.5 Acre	5	
0.5 Acre to 1.0 Acre (Football Field w/o End Zone)	3	
> 1.0 Acre	1	

2. Density of infestation: How substantial is the infestation?

Sparse - scattered individual stems or very small stands	5	
Patchy - a mix of sparse and dense areas	3	
Dense - greater than 40% of the area	2	
Monoculture - nearly 100% of the area	1	

3. Habitat Quality: What is the habitat quality and structure development (relative to similar natural community types)?

Excellent- This area is an excellent example of a natural community (e.g. dominated by native plant species; diversity of plant species and growth forms, features such as hummocks, woody debris, open space and cover; and moderate wildlife habitat features such as breeding, rearing, and nursery areas)	5	
Good - Not excellent, but still a good example of a natural community (e.g. some diversity of plant species and growth forms, moderate to sparse hummocks, woody debris, open space and cover; and moderate wildlife habitat features such as breeding, rearing, and nursery areas.)	3	
Poor - Degraded habitat, poor example of a natural community (e.g. very low diversity of native plant species and growth forms, almost no hummocks, woody debris, open space and cover; and very sparse wildlife habitat features such as breeding, rearing, and nursery areas)	1	

4. Is there an adjacent vector of spread (boat launch, public trail, roadway, river etc.)

Yes	5	
No	0	

Species Criteria

1. Degree to which invasive specie(s) will displace native flora/fauna

EDRR Species	10	
High - Likely to displace 80% or more in this location	7	
Medium - Likely to displace 40% to 80% in this location	3	
Low - Site conditions or other factors limit displacement to 40% or less	1	

Human Values Criteria

1. Ownership: Property ownership/location (select all that apply)

Cake Partner lands	2	
Other	1	

2. Aesthetics/Recreational/Subsistence/Cultural: What is the severity of the impacts of the invasive

Severe - entirely blocking or damaging the use, view, passage or enjoyment of site or adjacent area	3	
Moderate - partially (greater than 20%) blocking or damaging the use, view, passage or enjoyment of the site or adjacent areas	2	
Low - little to no blockage or damage the use, view, passage or enjoyment of site or adjacent area	1	

3. Human safety hazard: Is the invasive infestation causing a human safety hazard or concern

Significant hazard - blocking views along major roads and intersections, fire-prone dry thatch accumulation adjacent to homes and buildings, toxic to humans/pets/livestock.	5	
Moderate hazard - currently not, but has the potential to block views along roads and intersections, some dry thatch adjacent to buildings, etc.	3	
No apparent safety hazard	0	

Feasibility/Coordination of Treatment

1. Nearby treatment sites: Are there sites nearby where invasive treatment is planned

Yes - This site is near (e.g., within 1 mile radius) another site where invasive treatment is planned and will be conducted in synchronization with pooled resources, etc.	2	
Maybe - Unsure, at this point, if nearby treatment is being planned.	1	
No - The site is not near any other planned treatment sites.	0	

2. Difficulty of treatment: How difficult would treatment be at this location?

Very Easy - easy access to the entire invasive species infestation, and you have access to the proper equipment. Minimal natural resources impacts (i.e., native vegetation/habitat) from treatment with the proper use of best management practices.	5	
Moderate - easy to moderate accessibility to the infestation, and you have access to the proper equipment. Using best management practices will minimize negative impacts to native vegetation/ habitat.	1	
Difficult - Difficult or impossible to access the entire Invasive species infestation, or you do not have access to the proper equipment. Treatment may cause excess damage to natural resources.	-5	

3. Likelihood of elimination

High - elimination possible	5	
Medium - multiple year treatment	3	
low - containment primary goal	2	
no - control from spreading	1	

Total Score:

Appendix 9. Best Management Practice Resources

Invasive Plant Disposal

[https://www.michigan.gov/documents/invasives/Invasive Plant Disposal Guide accessible word 626157_7.pdf](https://www.michigan.gov/documents/invasives/Invasive_Plant_Disposal_Guide_accessible_word_626157_7.pdf)

Midwest Invasive Species Information Network (MISIN)

<https://www.misin.msu.edu/>

Wisconsin DNR Invasive Species Resource Page

<https://dnr.wi.gov/topic/Invasives/>

Michigan Invasive Species Coalition

<http://www.michiganinvasives.org/>

Midwest Invasive Plant Network's Invasive Plant Control Database

<https://mipncontroldatabase.wisc.edu/>

Michigan Natural Features Inventory

<http://mnfi.anr.msu.edu/invasive-species/invasives.cfm>

Integrated Pest Management for Nuisance Exotics in Michigan Inland Lakes

https://www.michigan.gov/documents/deq/deq-water-great-lakes-aquatics-IPM-manual_249296_7.pdf

Invasives.org

<https://www.invasive.org/>

Fire Effects Information System (Information on best management practices, reproductive biology, ecology, etc)

<https://www.feis-crs.org/feis/>

Integrated Pest and Crop Management Publications on BMPs

<http://ipcm.wisc.edu/downloads/>

Appendix 10. EDR Flier from the CAKE CISMA

Additional EDR Fliers: <https://cakecisma.wixsite.com/mysite/species-watchlist>

KEEP A LOOKOUT!

FOR INVASIVE PLANTS IN NORTHERN MI!

EARLY DETECTION CAN HELP PREVENT AN INVASION AND PROTECT YOUR LAND

W: WETLAND ~ U: UPLAND ~ F: FOREST ~ M: MEADOW ~ D: DUNES ~ A: AQUATIC

 <p>COMMON BUCKTHORN (<i>RHAMNUS CATHARTICA</i>) W, F, M</p>	 <p>CANADA THISTLE (<i>CIRSIMUM ARVENSE</i>) U, M</p>	 <p>*EUROPEAN FROGBIT (<i>HYDROCHARIS MORSUS-RANAE</i>) A</p>	 <p>*FLOWERING RUSH (<i>BUTOMUS UMBELLATUS</i>) W, A</p>
 <p>GARLIC MUSTARD (<i>ALLIARIA PETIOLATE</i>) U, F</p>	 <p>INVASIVE PHRAGMITES (<i>PHRAGMITES AUSTRALIS</i>) W, A</p>	 <p>JAPANESE BARBERRY (<i>BERBERIS THUNBERGII</i>) U, F, M</p>	 <p>GIANT KNOTWEED (<i>FALLOPIA SACHALINENSIS</i>) U, F, M</p>
 <p>JAPANESE KNOTWEED (<i>FALLOPIA JAPONICA</i>) U, F, M</p>	 <p>MULTIFLORA ROSE (<i>ROSA MULTIFLORA</i>) U, F, M</p>	 <p>ORIENTAL BITTERSWEET (<i>CELASTRUS ORBICULATUS</i>) U</p>	 <p>PURPLE LOOSESTRIFE (<i>LYTHRUM SALICARIA</i>) W, A</p>
 <p>AUTUMN OLIVE (<i>ELAEOAGNUS UMBELLATA</i>) U, F, M</p>	 <p>BABY'S BREATH (<i>GYPHOPHILA PANICULATA</i>) D, M</p>	 <p>BLACK/PALE SWALLOW-WORT (<i>VINCETOXICUM NIGRUM/ROSSICUM</i>) U, F, M</p>	 <p>EURASIAN WATERMILFOIL (<i>MYRIOPHYLLUM SPICATUM</i>) A</p>

FOR TRAINING MODULES AND WAYS TO REPORT A SIGHTING: WWW.MISIN.MSU.EDU

* NOT YET IN OUR COUNTY- CRITICAL TO REPORT SIGHTINGS

Appendix 11. Recommended Planting Guidelines for Municipalities from the Northwest Michigan ISN

Available: https://www.leelanau.cc/downloads/isn_planting_guide_for_municipalities_final.pdf



Recommended Planting Guidelines for Municipalities

Many plants originally introduced for use in ornamental landscapes have since become invasive. Invasive plants increase management costs for local government, land managers, and farmers, while also restricting recreational activities like hunting, fishing, mushrooming, hiking, and birding that are key both to the lifestyle and economy in northern Michigan. To address these challenges, the Northwest Michigan Invasive Species Network (ISN) recommends the following planting guidelines for municipalities, homeowners associations, and other interested groups. ISN partners developed the lists of recommended and prohibited plants below based on their collective experience managing natural areas across the region, as well as with input from the City of Ann Arbor's invasive plant list and with Michigan Natural Features Inventory. For more information about ISN, including a list of partner organizations, visit HabitatMatters.org.

Partners in the Invasive Species Network recommend prohibiting the use of invasive plants, while also strongly encouraging the use of native plants.

Class 1 List: Many locally uncommon plants that cause serious problems in other regions have the potential to arrive through ornamental landscaping activities.

Class 2 List: Roughly half of northwest lower Michigan's Top 20 Least Wanted Invasive Species are still planted in ornamental landscapes.

Class 3 List: Provides a catch-all for plants that pose any recognized invasive threat to the region.

Class 4 List: Covers grass species that, although problematic, have less of an impact when regularly mowed.

For identification assistance or to report a species occurrence, visit the Midwest Invasive Species Information Network at MISIN.msu.edu. For management advice, visit the Michigan Department of Natural Resources' invasive species website (Michigan.gov/invasivespecies), or Midwest Invasive Plant Network's control database (MIPNcontroldatabase.wisc.edu). Find out about what's going on in northwest lower Michigan on our website, HabitatMatters.org.

Native plants are strongly encouraged for all community landscapes. Native plants pose no threat of becoming invasive and provide a host of critical ecological benefits for which literally no other plants will suffice. Since invasive plants do not respect political boundaries, ISN encourages local municipalities not only to accept these recommended planting guidelines but also to encourage neighboring communities to adopt similar guidelines.



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Definitions

This document references “native,” “non-native,” and “invasive” categories of plant species. The definitions for these categories, listed below, derive from Executive Order 13112 issued on February 3, 1999.

- “Native species” means, with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.
- “Non-native species” means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.
- “Invasive species” means a non-native species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Native Plant Recommendations

Recommended Plants for Ornamental Landscapes

Native plants bring beauty and life to landscapes. Sporting a wide variety of colors, shapes, and textures, native plants can meet most landscaping needs. Over 400 species of native plants are available commercially in Michigan. Native plants create habitat for birds and butterflies, adding a living dimension of beauty to the landscape. Living landscapes allow children the opportunity for natural exploration at home, which encourages lifelong learners. Native plants are also part of our natural heritage. Communities that preserve, enhance, and showcase their natural and cultural heritages have economies that consistently outperform those of other communities.¹ Planting native is planting nature; re-connecting our home landscapes with the natural world carries enduring benefits for the entire region.

For more information regarding native plants for use in ornamental landscapes, visit HabitatMatters.org/other-information. Suggested plants listed below, with a few additions, are borrowed from Ann Arbor's Natural Areas Preservation program:

Native Trees		
Common Name	Scientific Name	Class
fir, balsam **	<i>Abies balsamea</i>	large>40'
maple, black *	<i>Acer nigrum</i>	large>40'
maple, striped	<i>Acer pensylvanicum</i>	small<30'
maple, red **	<i>Acer rubrum</i>	large>40'
maple, sugar	<i>Acer saccharum</i>	large>40'
maple, mountain	<i>Acer spicatum</i>	small<30'
serviceberry, shadblow * / **	<i>Amelanchier arborea</i>	small<30'
serviceberry, allegheny * / **	<i>Amelanchier laevis</i>	small<30'
birch, yellow * / **	<i>Betula alleghaniensis</i>	large>40'
birch, river */ **	<i>Betula nigra</i>	large>40'
birch, paper * / **	<i>Betula papyrifera</i>	large>40'
musclewood **	<i>Carpinus caroliniana</i>	small<30'
hawthorn, dotted	<i>Crataegus punctata</i>	small<30'
beech, American	<i>Fagus grandifolia</i>	large>40'
tamarack; eastern larch * / **	<i>Larix laricina</i>	large>40'
ironwood; hop-hornbeam	<i>Ostrya virginiana</i>	medium 30-40'
spruce, black **	<i>Picea mariana</i>	medium 30-40'
pine, jack *	<i>Pinus banksiana</i>	large>40'
pine, red	<i>Pinus resinosa</i>	large>40'

¹ Howe, Jim, Ed McMahon, and Luther Propst. *Balancing Nature and Commerce in Gateway Communities*. Washington D.C.: Island Press, 1997.

pine, white	<i>Pinus strobus</i>	large>40'
aspen, bigtooth * / **	<i>Populus grandidentata</i>	large>40'
aspen, trembling * / **	<i>Populus tremuloides</i>	large>40'
cherry, black *	<i>Prunus serotina</i>	large>40'
oak, white *	<i>Quercus alba</i>	large>40'
oak, northern pin	<i>Quercus ellipsoidalis</i>	large>40'
oak, northern red *	<i>Quercus rubra</i>	large>40'
cedar, northern white * / **	<i>Thuja occidentalis</i>	medium 30-40'
basswood	<i>Tilia americana</i>	large>40'
hemlock, eastern	<i>Tsuga canadensis</i>	large>40'

*Above average salt tolerance

**Suitable for runoff areas

Native Shrubs

Common Name	Scientific Name
alder, speckled * / **	<i>Alnus rugosa</i>
serviceberry, round-leaved	<i>Amelanchier sanguinea</i>
leadplant	<i>Amorpha canescens</i>
bearberry *	<i>Arctostaphylos uva-ursi</i>
chokecherry, black *	<i>Aronia prunifolia</i>
new jersey tea	<i>Ceanothus americanus</i>
buttonbush * / **	<i>Cephalanthus occidentalis</i>
sweet-fern *	<i>Comptonia peregrina</i>
dogwood, alternate-leaf	<i>Cornus alternifolia</i>
dogwood, silky **	<i>Cornus amomum</i>
dogwood, roundleaf	<i>Cornus rugosa</i>
dogwood, red-osier * / **	<i>Cornus sericea</i>
hazelnut, beaked	<i>Corylus cornuta</i>
honeysuckle, bush *	<i>Diervilla lonicera</i>
Leatherwood	<i>Dirca palustris</i>
trailing arbutus	<i>Epigaea repens</i>
Wintergreen	<i>Gaultheria procumbens</i>
witch-hazel *	<i>Hamamelis virginiana</i>
holly, Michigan *	<i>Ilex verticillata</i>
juniper, ground *	<i>Juniperus communis</i>
juniper, creeping *	<i>Juniperus horizontalis</i>
sheep-laurel	<i>Kalmia angustifolia</i>

honeysuckle, American fly	<i>Lonicera canadensis</i>
partridge berry	<i>Mitchella repens</i>
sweet gale *	<i>Myrica gale</i>
holly, mountain	<i>Ilex mucronata</i>
ninebark	<i>Physocarpus opulifolius</i>
cinquefoil, shrubby *	<i>Potentilla fruticosa</i>
chokecherry * / **	<i>Prunus virginiana</i>
sumac, staghorn *	<i>Rhus typhina</i>
currant, wild black	<i>Ribes americanum</i>
gooseberry, prickly	<i>Ribes cynosbati</i>
currant, swamp red	<i>Ribes triste</i>
rose, wild	<i>Rosa blanda</i>
rose, swamp **	<i>Rosa palustris</i>
blackberry, highbush	<i>Rubus allegheniensis</i>
dewberry, northern	<i>Rubus flagellaris</i>
raspberry, wild red	<i>Rubus strigosus</i>
willow, pussy * / **	<i>Salix discolor</i>
willow, sandbar **	<i>Salix exigua</i>
elderberry, American *	<i>Sambucus canadensis</i>
elder, red-berried	<i>Sambucus racemosa</i>
meadowsweet * / **	<i>Spiraea alba</i>
snowberry *	<i>Symphoricarpos albus</i>
yew	<i>Taxus canadensis</i>
blueberry *	<i>Vaccinium angustifolium</i>

blueberry, velvetleaf *	<i>Vaccinium myrtilloides</i>
viburnum, mapleleaf	<i>Viburnum acerifolium</i>

* Above average salt tolerance

**Suitable for runoff areas

Native Wildflowers

Common Name	Scientific Name
anemone, Canada **	<i>Anemone canadensis</i>
anemone, wood	<i>Anemone quinquefolia</i>
aster, big-leaved #	<i>Aster macrophyllus</i>
aster, smooth #	<i>Aster laevis</i>
baneberry, red #	<i>Actaea rubra</i>
baneberry, white #	<i>Actaea pachypodia</i>
bee balm #	<i>Monarda fistulosa</i>
bellwort	<i>Uvularia grandiflora</i>
black-eyed susan #	<i>Rudbeckia hirta</i>
blazing star, dwarf #	<i>Liatris cylindracea</i>
bloodroot #	<i>Sanguinaria canadensis</i>
blue cohosh **	<i>Caulophyllum thalictroides</i>
bluebead-lily	<i>Clintonia borealis</i>
blue-eyed grass	<i>Sisyrinchium angustifolium</i>
boneset # / **	<i>Eupatorium perfoliatum</i>
bunchberry	<i>Cornus canadensis</i>
canada mayflower	<i>Mainthemum canadense</i>
cardinal flower # / **	<i>Lobelia cardinalis</i>
columbine, wild #	<i>Aquilegia canadensis</i>
coneflower, cut-leaved **	<i>Rudbeckia laciniata</i>
coneflower, purple	<i>Echinacea purpurea</i>
coreopsis, sand # / *	<i>Coreopsis lanceolata</i>
culver's root	<i>Veronicastrum virginicum</i>
dutchman's breeches	<i>Dicentra cucullaria</i>
evening primrose	<i>Oenothera biennis</i>
foam flower #	<i>Tiarella cordifolia</i>
foxglove beard-tongue	<i>Penstemon digitalis</i>
gay-wings	<i>Polygala paucifolia</i>
gentian, closed **	<i>Gentiana andrewsii</i>

withe-rod, wild raisin	<i>Viburnum cassinoides</i>
nannyberry * / **	<i>Viburnum lentago</i>

golden ragwort **	<i>Senecio aureus</i>
goldenrod, early	<i>Solidago juncea</i>
goldenrod, grass-leaved #	<i>Euthamia graminifolia</i>
goldenrod, gray	<i>Solidago nemoralis</i>
goldthread	<i>Coptis trifolia</i>
hairy beardstongue *	<i>Penstemon hirsutus</i>
harebell	<i>Campanula rotundifolia</i>
hepatica, round-lobed #	<i>Hepatica americana</i>
hepatica, sharp-lobed #	<i>Hepatica acutiloba</i>
herb robert	<i>Geranium robertianum</i>
iris, wild blue flag # / * / **	<i>Iris versicolor</i>
jack-in-the-pulpit # / **	<i>Arisaema triphyllum</i>
jewelweed **	<i>Impatiens capensis</i>
joe-pye weed # / **	<i>Eupatorium maculatum</i>
leek, wild **	<i>Allium tricoccum</i>
lobelia, great blue # / **	<i>Lobelia siphilitica</i>
loosestrife, fringed # / **	<i>Lysimachia ciliata</i>
lupine	<i>Lupinus perennis</i>
marsh marigold **	<i>Caltha palustris</i>
meadow-rue	<i>Thalictrum dioicum</i>
meadow-rue, purple **	<i>Thalictrum dasycarpum</i>
michigan lily	<i>Lilium michiganense</i>
milkweed, butterfly #	<i>Asclepias tuberosa</i>
milkweed, common	<i>Asclepias syriaca</i>
milkweed, poke	<i>Asclepias exaltata</i>
milkweed, swamp # / **	<i>Asclepias incarnata</i>
miterwort; bishop's cap **	<i>Mitella diphylla</i>
miterwort, naked **	<i>Mitella nuda</i>
monkey-flower **	<i>Mimulus ringens</i>
rattlesnake weed	<i>Hieracium venosum</i>
sarsaparilla, wild **	<i>Aralia nudicaulis</i>
skullcap, mad-dog **	<i>Scutellaria lateriflora</i>

sneezeweed	<i>Helenium autumnale</i>	sunflower, woodland	<i>Helianthus divaricatus</i>
solomon's seal, downy #	<i>Polygonatum pubescens</i>	sweet-cicely, hairy	<i>Osmorhiza claytonii</i>
solomon's seal, false #	<i>Smilacina racemosa</i>	thimbleweed #	<i>Anemone virginiana</i>
solomon's seal, starry false #	<i>Smilacina stellata</i>	trillium, large-flowered	<i>Trillium grandiflorum</i>
spiderwort	<i>Tradescantia ohiensis</i>	trout lily, yellow **	<i>Erythronium americanum</i>
spikenard	<i>Aralia racemosa</i>	turtlehead **	<i>Chelone glabra</i>
spring beauty, carolina #	<i>Claytonia caroliniana</i>	twinlineflower	<i>Linnaea borealis</i>
squirrel corn	<i>Dicentra canadensis</i>	twisted-stalk, rose	<i>Streptopus roseus</i>
starflower	<i>Trientalis borealis</i>	vervain, blue # / **	<i>Verbena hastata</i>
strawberry, wild #	<i>Fragaria virginiana</i>	violet, downy yellow	<i>Viola pubescens</i>
sunflower, maximillian	<i>Helianthus maximiliani</i>	violet, long spurred	<i>Viola rostrata</i>

* Above average salt tolerance. Salt tolerance data not available for the majority of native herbaceous plants.

**Suitable for runoff areas

Recommended for beginning gardeners because of their ease of propagation and season-long attractiveness

Native Vines, Grasses, Rushes, Sedges, and Ferns

Vines

Common Name	Scientific Name
moonseed	<i>Menispermum canadensis</i>
grape, riverbank **	<i>Vitis riparia</i>
thicket creeper	<i>Parthenocissus inserta</i>
virgin's bower **	<i>Clematis virginiana</i>

Grasses, Rushes, and Sedges

Common Name	Scientific Name
bluestem, big	<i>Andropogon gerardii</i>
bluestem, little *	<i>Schizachyrium scoparium</i>
bottlebrush grass	<i>Hystrix patula</i>
bulrush, hardstem **	<i>Scirpus acutus</i>
bulrush, softstem **	<i>Scirpus validus</i>
June grass	<i>Koeleria macrantha</i>
rush, path	<i>Juncus tenuis</i>
rush, soft-stemmed **	<i>Juncus effusus</i>

sedge **	<i>Carex comosa</i>
sedge **	<i>Carex crinita</i>
sedge	<i>Carex intumescens</i>
sedge, Pennsylvania	<i>Carex pensylvanica</i>
sedge, tussock **	<i>Carex stricta</i>
wild-rye, Canada	<i>Elymus canadensis</i>
wild-rye, Virginia **	<i>Elymus virginicus</i>
wood grass, long-awned	<i>Brachyelytrum erectum</i>
wool-grass **	<i>Scirpus cyperinus</i>

Ferns

Common Name	Scientific Name
bracken fern	<i>Pteridium aquilinum</i>
christmas fern	<i>Polystichum acrosichoides</i>
cinnamon fern **	<i>Osmunda cinnamomea</i>
interrupted fern	<i>Osmunda claytoniana</i>
lady fern, northern **	<i>Athyrium filix-femina</i>
maidenhair fern	<i>Adiantum pedatum</i>
oak fern	<i>Gymnocarpium dryopteris</i>
ostrich fern	<i>Matteuccia struthiopteris</i>

rattlesnake fern	<i>Botrychium virginianum</i>	woodfern, evergreen **	<i>Dryopteris intermedia</i>
royal fern **	<i>Osmunda regalis</i>	woodfern, goldie's	<i>Dryopteris goldiana</i>
sensitive fern **	<i>Onoclea sensibilis</i>		
woodfern; crested shield fern **	<i>Dryopteris cristata</i>	Fern Ally	
woodfern, clinton's **	<i>Dryopteris clintoniana</i>	horsetail, water **	<i>Equisetum fluviatile</i>

* Above average salt tolerance. Salt tolerance data not available for the majority of native vines, grasses, rushes, sedges, and ferns.

**Suitable for runoff areas

Suggested Invasive Plant Guidelines

Class I Plants – Planting Prohibited; Management required

The plants below are not yet common in our region, but have proven highly invasive in similar regions. Although plants like kudzu or water hyacinth might be surprising, populations of both species now overwinter in Michigan. Preventing new introductions and managing existing populations while small is the most affordable approach to safeguarding natural resources.

Common Name	Scientific Name	Type
black alder *	<i>Alnus glutinosa</i>	Tree
flowering rush ^ *	<i>Butomus umbellatus</i>	Forb
plumeless thistle ^	<i>Carduus acanthoides</i>	Forb
musk thistle ^	<i>Carduus nutans</i>	Forb
brazilian water-weed *	<i>Egeria densa</i>	Aquatic
water-hyacinth *	<i>Eichhornia crassipes</i>	Aquatic
reed manna grass *	<i>Glyceria maxima</i>	Grass
giant hogweed ^ *	<i>Heracleum mantegazzianum</i>	Forb
Japanese hops *	<i>Humulus japonicus</i>	Vine
hydrilla *	<i>Hydrilla verticillata</i>	Aquatic
European frog-bit *	<i>Hydrocharis morsus-ranae</i>	Aquatic
Indian balsam *	<i>Lagarosiphon major</i>	Aquatic
dotted duck-weed *	<i>Landoltia punctata</i>	Aquatic
moneywort *	<i>Lysimachia nummularia</i>	Forb
European water-clover *	<i>Marsilea quadrifolia</i>	Aquatic
Japanese stiltgrass	<i>Microstegium vimineum</i>	Grass
parrot feather *	<i>Myriophyllum aquaticum</i>	Aquatic
lesser naiad *	<i>Najas minor</i>	Aquatic
sacred lotus *	<i>Nelumbo nucifera</i>	Aquatic

yellow floating heart *	<i>Nymphoides peltata</i>	Aquatic
cotton thistle *	<i>Onopordon acanthium</i>	Forb
coltsfoot *	<i>Petasites hybridus</i>	Forb
amur cork-tree *	<i>Phellodendron amurense</i>	Tree
phragmites (non-native) ^	<i>Phragmites australis</i>	Grass
water lettuce *	<i>Pistea stratioides</i>	Aquatic
Japanese knotweed ^ *	<i>Polygonum cuspidatum</i>	Forb
mile-a-minute-weed	<i>Polygonum perfoliatum</i>	Forb
giant knotweed ^ *	<i>Polygonum sachalinense</i>	Forb
kudzu	<i>Pueraria lobata</i>	Vine
giant salvinia *	<i>Salvinia spp.</i>	Aquatic
water chestnut *	<i>Trapa natans</i>	Aquatic
black swallow-wort *	<i>Vincetoxicum nigrum</i>	Vine
pale swallow-wort *	<i>Vincetoxicum rossicum</i>	Vine

* Ornamental plant.

^ Planting, growing, or transporting this species is prohibited by the Michigan Natural Resources and Environmental Protection Act (Act 451 of 1994, as amended), available online at http://www.michigan.gov/mdard/0,4610,7-125-1568_2390_36653-11250--,00.html

Class 2 Plants – Planting Prohibited; Management Recommended

The plants below are all on the Top 20 list of the most serious threats to natural areas in northwest Michigan. Management is strongly recommended but not required due to the potential costs involved. If complete removal is not realistic for the site, a plan should be developed to minimize the potential for spread to natural areas.

Common Name	Scientific Name	Type
garlic mustard	<i>Alliaria petiolata</i>	Forb
Japanese barberry *	<i>Berberis thunbergii</i>	Shrub
oriental bittersweet *	<i>Celastrus orbiculatus</i>	Vine
Canada thistle ^	<i>Cirsium arvense</i>	Forb
European swamp thistle	<i>Cirsium palustre</i>	Forb
bull thistle ^ *	<i>Cirsium vulgare</i>	Forb
Russian olive *	<i>Elaeagnus angustifolia</i>	Shrub
autumn olive *	<i>Elaeagnus umbellata</i>	Shrub
leafy spurge ^	<i>Euphorbia esula</i>	Forb
baby's breath *	<i>Gypsophila paniculata</i>	Forb

dame's rocket *	<i>Hesperis matronalis</i>	Forb
lyme grass *	<i>Leymus arenarius</i>	Grass
honeysuckle(s) (non-native) *	<i>Lonicera spp.</i>	Shrub
purple loosestrife ^ *	<i>Lythrum salicaria</i>	Forb
wild parsnip	<i>Pastinaca sativa</i>	Forb
Ribbon grass (aka reed canary grass) *	<i>Phalaris arundinacea</i>	Grass
common buckthorn *	<i>Rhamnus cathartica</i>	Shrub
glossy buckthorn *	<i>Rhamnus frangula</i>	Shrub
multiflora rose *	<i>Rosa multiflora</i>	Shrub
narrow-leaved cattail	<i>Typha angustifolia</i>	Forb

* Ornamental plant.

^ Planting, growing, or transporting this species is prohibited by the Michigan Natural Resources and Environmental Protection Act (Act 451 of 1994, as amended), available online at http://www.michigan.gov/mdard/0,4610,7-125-1568_2390_36653-11250--,00.html

Class 3 Plants – Planting Prohibited

The plants listed below are all either invasive in the region or are showing signs of becoming invasive in this or in similar regions, and should not be planted.

Common Name	Scientific Name	Type
velvetleaf ^	<i>Abutilon theophrasti</i>	Forb
amur maple *	<i>Acer ginnala</i>	Tree
norway maple *	<i>Acer platanoides</i>	Tree
Snow-on-the-mountain (aka goutweed) *	<i>Aegopodium podagraria</i>	Forb
horse-chestnut	<i>Aesculus hippocastanum</i>	Tree
quack grass ^	<i>Agropyron repens</i>	Grass
tree-of-heaven *	<i>Ailanthus altissima</i>	Tree
chocolate-vine *	<i>Akebia quinata</i>	Vine
amaranth species	<i>Amaranthus spp.</i>	Forb
false indigo *	<i>Amorpha fruticosa</i>	Shrub
turquoise berry *	<i>Ampelopsis brevipedunculata</i>	Vine
common burdock	<i>Arctium minus</i>	Forb
yellow rocket ^	<i>Barbarea vulgaris</i>	Forb
common barberry *	<i>Berberis vulgaris</i>	Shrub
smooth brome *	<i>Bromus inermis</i>	Grass

butterfly bush *	<i>Buddleja spp.</i>	Shrub
roving bellflower	<i>Campanula rapunculoides</i>	Forb
bitter cress	<i>Cardamine impatiens</i>	Forb
spotted knapweed ^	<i>Centaurea maculosa</i>	Forb
mouse-ear chickweed	<i>Cerastium fontanum</i>	Forb
celandine *	<i>Chelidonium majus</i>	Forb
lamb's quarters	<i>Chenopodium album</i>	Forb
chicory	<i>Cichorium intybus</i>	Forb
lily-of-the-valley *	<i>Convallaria majalis</i>	Forb
field bindweed ^	<i>Convolvulus arvensis</i>	Forb
crown vetch	<i>Coronilla varia</i>	Forb
orchard grass	<i>Dactylis glomerata</i>	Grass
Jimsonweed ^	<i>Datura stramonium</i>	Forb
queen-anne's-lace ^ *	<i>Daucus carota</i>	Forb
chinese yam	<i>Dioscorea oppositifolia</i>	Vine
common teasel	<i>Dipsacus fullonum/sylvestris</i>	Forb
cut-leaved teasel	<i>Dipsacus laciniatus</i>	Forb
indian strawberry	<i>Duchesnea indica</i>	Forb
barnyard grass	<i>Echinochloa crusgalli</i>	Grass
great hairy willow-herb *	<i>Epilobium hirsutum</i>	Forb
winged wahoo *	<i>Euonymus alatus (including 'compacta')</i>	Shrub
spindle tree *	<i>Euonymus europaea</i>	Shrub
wintercreeper *	<i>Euonymus fortunei</i>	Vine
cypress spurge *	<i>Euphorbia cyparissias</i>	Forb
tall fescue *	<i>Festuca arundinacea</i>	Grass
meadow fescue *	<i>Festuca pratensis</i>	Grass
white bedstraw	<i>Galium mullugo</i>	Forb
sweet woodruff *	<i>Galium odoratum</i>	Forb
avens	<i>Geum urbanum</i>	Forb
ground ivy	<i>Glechoma hederacea</i>	Forb
english ivy *	<i>Hedera helix</i>	Vine
orange day lily *	<i>Hemerocallis fulva</i>	Forb
common St. John's-wort *	<i>Hypericum perforatum</i>	Forb
yellow flag *	<i>Iris pseudacorus</i>	Forb
kalopanax *	<i>Kalopanax septemlobus</i>	Tree
golden archangel *	<i>Lamiastrum galeobdolon</i>	Forb
everlasting pea *	<i>Lathyrus latifolius</i>	Forb
motherwort	<i>Leonurus cardiaca</i>	Forb

silky bush-clover	<i>Lespedeza cuneata</i>	Forb
border privet *	<i>Ligustrum obtusifolium</i>	Shrub
common privet *	<i>Ligustrum vulgare</i>	Shrub
butter-and-eggs	<i>Linaria vulgaris</i>	Forb
european fly honeysuckle *	<i>Lonicera xylosteum</i>	Shrub
birdfoot trefoil *	<i>Lotus corniculatus</i>	Forb
money plant *	<i>Lunaria annua</i>	Forb
white sweet clover	<i>Melilotus alba</i>	Forb
yellow sweet clover	<i>Melilotus officinalis</i>	Forb
white mulberry *	<i>Morus alba</i>	Tree
forget-me-not *	<i>Myosotis scorpioides</i>	Forb
perilla mint *	<i>Perilla frutescens</i>	Forb
timothy	<i>Phleum pratense</i>	Grass
Austrian pine *	<i>Pinus nigra</i>	Tree
Scotch pine *	<i>Pinus sylvestris</i>	Tree
English plantain ^	<i>Plantago lanceolata</i>	Forb
common plantain	<i>Plantago major</i>	Forb
Canada bluegrass	<i>Poa compressa</i>	Grass
lady's thumb *	<i>Polygonum persicaria</i>	Forb
white poplar *	<i>Populus alba</i>	Tree
Lombardy poplar *	<i>Populus nigra var. italica</i>	Tree
rough-fruited cinquefoil *	<i>Potentilla recta</i>	Forb
callery pear *	<i>Pyrus calleryana</i>	Tree
sawtooth oak *	<i>Quercus acutissima</i>	Tree
tall or common buttercup	<i>Ranunculus acris</i>	Forb
lesser-celandine *	<i>Ranunculus ficaria</i>	Forb
buckthorn	<i>Rhamnus utilis</i>	Shrub
black jetbead *	<i>Rhodotypos scandens</i>	Shrub
bristly locust	<i>Robinia hispida</i>	Shrub
black locust *	<i>Robinia pseudoacacia</i>	Tree
curly dock ^	<i>Rumex crispus</i>	Forb
white willow *	<i>Salix alba</i>	Tree
crack willow *	<i>Salix fragilis</i>	Tree
basket willow *	<i>Salix purpurea</i>	Shrub
bouncing bet *	<i>Saponaria officinalis</i>	Forb
bladder campion	<i>Silene cucubalus</i>	Forb
white catchfly	<i>Silene pratensis (lychnis alba)</i>	Forb
bittersweet nightshade ^	<i>Solanum dulcamara</i>	Forb

perennial sow thistle [^]	<i>Sonchus arvensis</i> (s. <i>Uliginosus</i>)	Forb
common chickweed	<i>Stellaria media</i>	Forb
common tansy *	<i>Tanacetum vulgare</i>	Forb
common dandelion	<i>Taraxacum officinale</i>	Forb
field hedge parsley	<i>Torilis arvensis</i>	Forb
Japanese hedge parsley	<i>Torilis japonica</i>	Forb
red clover	<i>Trifolium pratense</i>	Forb
white clover *	<i>Trifolium repens</i>	Forb
Chinese elm, lace bark elm *	<i>Ulmus parvifolia</i>	Tree
siberian elm *	<i>Ulmus pumila</i>	Tree
mullein *	<i>Verbascum thapsus</i>	Forb
wayfaring tree *	<i>Viburnum lantana</i>	Shrub
European highbush cranberry *	<i>Viburnum opulus</i>	Shrub
cow-vetch	<i>Vicia villosa</i>	Forb
bigleaf periwinkle *	<i>Vinca major</i>	Vine
periwinkle *	<i>Vinca minor</i>	Shrub

* Ornamental plant.

[^] Planting, growing, or transporting this species is prohibited by the Michigan Natural Resources and Environmental Protection Act (Act 451 of 1994, as amended), available online at http://www.michigan.gov/mdard/0,4610,7-125-1568_2390_36653-11250--,00.html

Class 4 Plants – Mowing Recommended

These species should only be planted in areas that will be mowed on a regular basis to prevent the plants from reseeding, and should only be planted outside of wetland areas, natural feature open space, or other natural areas.

Common Name	Scientific Name	Type
See agrostis gigantea	<i>Agrostis alba</i>	Grass
Redtop	<i>Agrostis gigantea</i>	Grass
See agrostis stolonifera	<i>Agrostis palustris</i>	Grass
Creeping bent	<i>Agrostis stolonifera</i>	Grass
Velvet grass	<i>Holcus lanatus</i>	Grass
Perennial rye grass	<i>Lolium perenne</i>	Grass
Kentucky bluegrass	<i>Poa pratensis</i>	Grass
Bluegrass	<i>Poa trivialis</i>	Grass

Appendix 12. Oakland County GIS Database and Desktop Analysis Tool

Source: Strategic invasive species management plan for Oakland County

Appendix L: GIS Database and Desktop Analysis Tool

To broaden utilization of the GIS database, selected data layers were compiled, coded, and integrated into a formal database model to serve as an on-going decision support tool for OC CISMA partners and land managers, as they assess risk, prioritize control options, and implement the strategic plan. Using the “map calculator” function, users can interact with multiple data themes to perform basic analytics and produce culturally and ecologically focused overlays that will strengthen the user’s ability to visualize and calculate the distribution of assets and threats across the landscape, and more cost-effectively evaluate management issues and opportunities.

Figures 1 and 2, below, explain and demonstrate the various input layers and options, as well as the process for analysis and producing map outputs. Additional instructive guidance can be developed to maximize the utility of the database tool, to optimize strategic invasive species prevention and control efforts. A full listing of data layers is provided with the GIS project files.

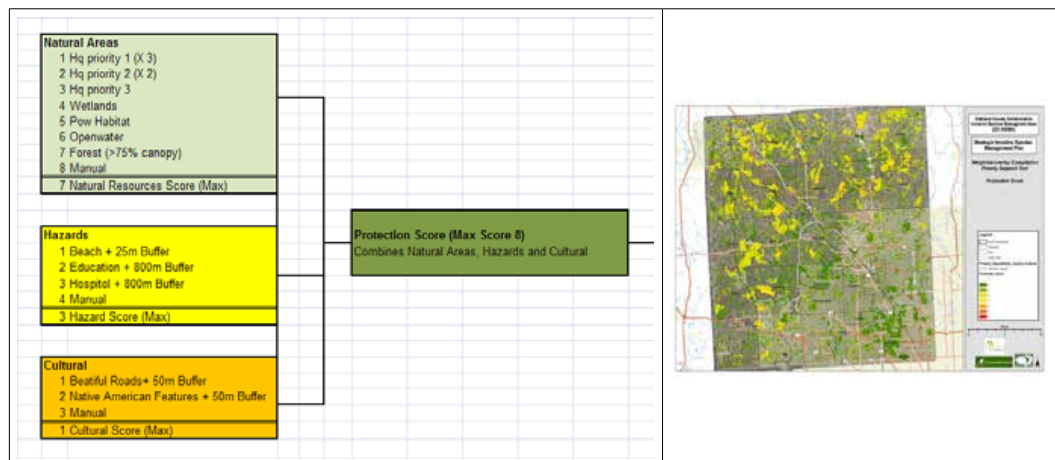


Figure 1. The flow chart above shows the various GIS data layers that have been grouped into categories of Natural Areas, Environmental Hazards, and Cultural features, coded (1 or 0), and integrated into the database model. The graphic to the right shows the compilation of all listed features. In ArcGIS, the user can quickly weight and sum different data combinations to visualize, evaluate and prioritize landscape conditions and patterns in response to critical questions, concerns or interests. The map output shown in Map Figure 5 utilized data from Natural Areas 1-4 and 7 to generate a Protection Score to identify protection priorities.

Appendix L: GIS Database and Desktop Analysis Tool



Figure 2. As in the previous example, the flow chart above shows the different features that were compiled in the database, in this case for identifying areas associated with the threat of dispersal (mobilization) of invasive species. The map output shown in Map Figure 6 used the summation of Source (1-7) and Vectors (1-6) with road ROWs associated with interstates (X's 3) and highways (X's 2) being weighted higher than the other variables. By combining Asset and Threat scores, one can begin ranking and prioritizing specific areas for strategic actions, as shown in Map Figure 7.


The database tool can also be used to evaluate other risk assessment, prioritization, planning, implementation, and monitoring actions. For example, to:

- Protect valuable natural assets by prioritizing monitoring and removal of invasives from and proximate to existing sensitive high quality habitats and rare species populations. Figures 9 and 10 provide examples of such threat ranking analysis featuring wetlands/open water (Figure 9) and forest/woodland assets (Figure 10). In these examples, the “overlay input” utilized that applied to Figure 7, which weighted pathways for dispersal along interstate and highway transportation corridors higher than other pathway variables. This was due to the prioritization of *Phragmites* as the species of interest and its observed prevalence and safety risk in these locations. In a subsequent analysis, the overlay input might be adjusted to weight more heavily boat landings and water courses for the spread of other selected species.
- Inform and prioritize management of wildfire and other hazard issues, such as treatment and control of large, dense stands of *Phragmites* near hospitals, schools, landfills or other high-use areas, which may represent a higher hazard risk than other areas, and therefore efforts may assist in preventing catastrophic wildfire events. Figure 11 provides an example of threat ranking analysis featuring schools and hospitals as assets, again with overlay input as applied previously to the analysis in Figures 7, 9, and 10.
- Inform and prioritize management efforts along transportation and utility ROW's, which are relatively easy to access, easy to treat, and serve as major dispersal pathways for invasive species. Consider hitting these areas fast and early to gain ground and to get high treatment coverage per investment, while eliminating future threats and lost ground associated with dispersal and transport through the larger area.

Appendix L: GIS Database and Desktop Analysis Tool

- Inform and prioritize management and monitoring efforts, to identify areas of past treatment and likely areas for ongoing efforts with land owners interested in or historically participating in continuing land stewardship and management. These areas could be a higher priority for collaboration and integration with this project and may represent valuable areas for demonstration projects.
- Prioritize headwater reaches of watersheds to maximize management from upstream-to-downstream settings to minimize the risk of re-population of downstream sites from upstream invasive species populations.
- Prioritize and maximize protection of connectivity of sites that provide wildlife migratory linkages between high quality natural areas, thus minimizing invasive seed and propagule dispersal into sensitive areas via animal traffic.
- Identify areas where invasive species are widespread and abundant, where long-term management is aimed at population suppression and resource protection (see invasion curve graphic in Figure 8). In such areas, management may be given lower priority due to the need for greater investments over a longer time period to reduce the population size and seedbanks to achieve control success, and the likely need for significant restoration investments to stabilize the site and re-establish native vegetation more resilient to re-invasion. On the other hand, if funding is available and there is strong partner interest and commitment, the sooner a treatment program is started, the sooner it will achieve some level of success and reduce a major dispersal source.

Appendix 13. State of Michigan Response Plan for Aquatic Invasive Species in Michigan

			Michigan Department of Environmental Quality Michigan Department of Natural Resources Michigan Department of Agriculture and Rural Development POLICY AND PROCEDURE		
Original Effective Date: February 3, 2014		Subject: Response Plan for Aquatic Invasive Species in Michigan			
Revised Date:		Number: QOL-1-2014		Page 1 of 10	

A Quality of Life (QOL) Policy and Procedure cannot establish regulatory requirements for parties outside of the QOL. This document provides direction to QOL staff regarding the implementation of rules and laws administered by the QOL. It is merely explanatory; does not affect the rights of, or procedures and practices available to, the public; and does not have the force and effect of law.

INTRODUCTION:

The most effective and efficient means of reducing the effect of invasive species beyond prevention is to respond rapidly, prudently, and efficiently to new invasions or existing outlier populations of invasive species. Even the best prevention program cannot keep all invasive species out, but a program that responds prudently, uses cost-effective methods, relies on science-based decision-making, and engages key stakeholders will help minimize the threat of invasions negatively affecting the waters of Michigan.

This response plan for aquatic invasive species (AIS) is an internal, interagency decision support tool for the Michigan Department of Environmental Quality (MDEQ), Michigan Department of Natural Resources (MDNR), and Michigan Department of Agriculture and Rural Development (MDARD). This plan outlines the steps to follow after receiving a report of an AIS and serves as a guide for determining when a response is appropriate and what type of response should be considered. The plan has varying degrees of application, relevance, and utility, depending upon the details of a particular invasion or report.

ACKNOWLEDGEMENTS:

This policy and procedure was produced by the State of Michigan's AIS Core Team (see below) and was heavily influenced and guided by similar AIS response plans from the Invasive Species Council of Pennsylvania and the Ohio Department of Natural Resources' Division of Wildlife.

AUTHORITY:

Communication and collaboration with pertinent agency staff, management, stakeholder, and other groups is critical throughout the plan and should be carefully considered during each action. Michigan has established an AIS Core Team composed of representatives from each of the state agencies with environmental or natural resource responsibilities: MDEQ's Water Resources Division and Office of the Great Lakes; MDNR's Fisheries Division, Wildlife Division, Parks and Recreation Division, Forest Resources Division, and Law Enforcement Division; MDARD's Pesticide and Plant Pest Management Division and Animal Industry Division; and the Michigan Department of Transportation's Project Planning Division. The AIS Core Team should

EQ0103 (12/2013)

Michigan Department of Environmental Quality
Michigan Department of Natural Resources
Michigan Department of Agriculture and Rural Development
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be kept informed of new reports of AIS and subsequent action, or nonaction, as a result of this response plan.

In general, the MDEQ, MDNR, and MDARD share responsibility for AIS policy, legislation, regulation, education, monitoring, assessment, management, and control. In the event of a newly-identified AIS in Michigan waters, the departments will work together to identify a lead agency depending on the taxa of concern, the location of the issue, and existing agency authority.

The MDNR is responsible for conserving, protecting, and managing the use and enjoyment of the state's natural resources with a focus on fisheries, wildlife, parks and recreation, forests, mineral and fire management, land and facilities, and law enforcement. In particular, the MDNR's Fisheries and Wildlife Divisions are currently involved in response activities for Bighead carp (*Hypophthalmichthys nobilis*), Silver carp (*H. molitrix*), Sea lamprey (*Petromyzon marinus*), and several priority invasive aquatic plants, respectively. MDNR's Forest Resources Division actively works to prevent and control invasions of non-native insects and diseases, such as emerald ash borer and beech bark disease that impact forest resources and habitat.

The MDARD protects the food, agricultural, environmental, and economic interests of the citizens of Michigan and is positioned to provide expertise on emergency response, as well as invasive aquatic plants and organisms in trade.

The MDEQ is responsible for protecting and sustaining the health of the state's citizens and natural resources. Within the MDEQ, the Water Resources Division is responsible for coordinating the implementation of Michigan's AIS State Management Plan. The MDEQ also houses the Office of the Great Lakes, which has lead responsibility for the state's role in the development of interjurisdictional policies, programs, and initiatives affecting the water and related natural resources of the Great Lakes-St. Lawrence River Basin. The Office of the Great Lakes is a primary point of contact for many regional Great Lakes' entities.

POLICY:

The MDEQ, MDNR, and MDARD will coordinate response to AIS threats while operating under existing authorities and areas of expertise.

PROCEDURES:

The response action steps given below and diagrammed in Figure 1 should be followed chronologically, but the process may end at varying points depending upon the details of each specific situation. In addition, this plan is designed to complement and be used in conjunction with other existing response plans (e.g., Michigan's AIS State Management Plan, Michigan's Asian Carp Management Plan, and the Asian Carp Binational Rapid Response Plan). The response flowchart (Figure 1) is intended to accompany the narrative section of the response plan, below, but can also be used as a summary/overview of the response plan actions. Action 1 commences upon receiving a report of an AIS.

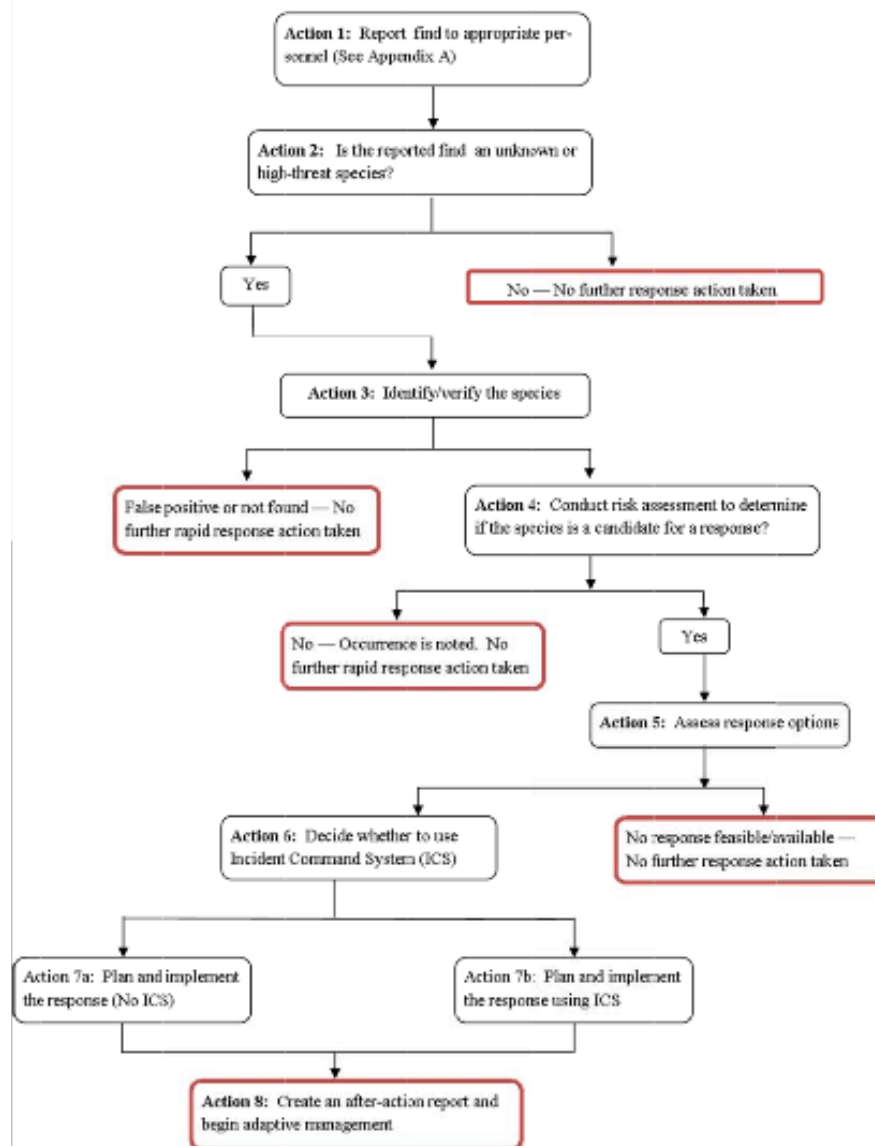
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Figure 1: AIS Response Flow



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Action 1: *Report finding of invasive species to appropriate personnel*

Reports of invasive species come from a wide variety of sources, including the general public, partner organizations, and state agencies. The agency receiving the report will record the information listed below on the *Invasive Species Reporting Work Sheet* (Appendix A) and, if necessary, use Appendix B, *Contacts for Invasive Species Information in Michigan* (also online at www.michigan.gov/invasivespecies), to direct the report to the proper state agency staff. Transferred reports of high-priority species (Appendix C) should be confirmed as having been received by appropriate staff to ensure timely response and so that the information is not inadvertently lost.

The following information should be recorded by/from the person submitting a report of a new invasive species:

- Name and contact information (phone and e-mail) of reporter and/or data collector.
- Type of AIS being reported (e.g., fish, invertebrate, plant, etc.).
- Common and scientific name of species being reported (if known).
- Date of observation.
- Location of observation (water body, township, county, latitude/longitude, and any additional details), habitat, and environmental condition of the site.
- Photos, if available (photos are a priority for preliminary identification).
- Additional detailed information (e.g., approximate size, physical description, estimate percent cover for plants, living or preserved specimens obtained, etc.).

Action 2: *Is the report an unknown or high-threat species?*

When an AIS report is received, the appropriate staff (as determined from Action 1, above) uses his or her best professional judgment to determine threat level and priority. If any of the following high-threat priority species are reported from a credible source with an appropriate level of documentation (photos, detailed description, etc.), and species identification and verification (Action 3) is initiated:

- Silver carp (*Hypophthalmichthys molitrix*)
- Bighead carp (*Hypophthalmichthys nobilis*)
- Grass carp (*Ctenopharyngodon idella*)
- Northern snakehead (*Channa argus*)
- Red swamp crayfish (*Procambarus clarkia*)
- Parrot feather (*Myriophyllum aquaticum*)
- European frog-bit (*Hydrocharis morsus-ranae*)
- Flowering rush (*Butomus umbellatus*)
- Brazilian elodea (*Egeria densa*)
- Hydrilla (*Hydrilla verticillata*)
- Water chestnut (*Eleocharis dulcis*)
- Water hyacinth (*Eichornia crassipes*)

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- Water lettuce (*Pistia stratiotes*)
- Nutria (*Myocastor coypus*)
- Any unknown aquatic plant or animal

Note: If the reported species is for any of the three Asian carp species shown above (Silver, Bighead, Black, and/or Grass), Michigan's Asian Carp Management Plan¹ and status report² should be used in conjunction with this more generalized response plan.

High-threat/priority reports may also include invasive species that represent previously-known invasive species from Michigan but are also:

- Outlier populations/occurrences – invasive species that may already be present in Michigan, but are being reported in a unique, new regional location (e.g., first occurrence for the Upper Peninsula, etc.).
- Threats to rare and endangered native species and/or habitat.
- A leading edge of an expanding invasive species occurrence.

If the reported species does not meet the above criteria, no further response action is taken using this procedure. The outcome of this action should be reported back to the original person or entity that submitted the report. The report may be noted, recorded, or shared with other entities, as appropriate.

Action 3: Identify/verify the species

Once it has been determined that a report is for a high-threat priority species, the agency with jurisdictional authority and/or the appropriate personnel, as identified in Appendix B, will facilitate verification of the report and/or specimen. If the report includes tribal lands, the appropriate department tribal coordinators need to be contacted. In some cases, Action 3 can occur in collaboration with the risk assessment in Action 4.

Newly-reported AIS must be verified by an expert who is recognized by the responding agency. When possible, and deemed necessary, specimens should be verified by a second expert and voucher specimens should be retained and stored properly for future analysis. A site visit may also be necessary for species identification/verification if a specimen or sufficient evidence was not provided. In some instances, the information provided from the initial report in Action 1 may be enough to properly identify a species and verify its existence. This is particularly true if a voucher specimen is provided by the original reporter. Proper permitting should be obtained for federal or state restricted and prohibited invasive species during this action.

¹ Clapp, D. F., J. L. Mistak, K. M. Smith, and M. A. Tonello. 2012a. Proposed 2010 plan for the prevention, detection, assessment, and management of Asian carps in Michigan waters. Michigan Department of Natural Resources, Fisheries Special Report 60, Lansing.

² Clapp, D. F., J. L. Mistak, K. M. Smith, and M. A. Tonello. 2012b. Status report for the proposed 2010 plan for the prevention, detection, assessment, and management of Asian carps in Michigan waters, April 2012. Michigan Department of Natural Resources, Fisheries Special Report 61, Lansing.

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If the reported species is confirmed to be a native species (*false-positive* report), or a known occurrence of an AIS, then no further response action is taken. Similarly, if the species is unable to be found or located as reported, the responding agency may use its best professional judgment to end the response action or conduct a more thorough search. The report may be noted in a log to track common misidentifications and other reporting trends. Results from this action may be communicated to relevant partners and stakeholders, as appropriate.

Initial communication with key partners, stakeholders, and other appropriate entities should be considered during this action. For example, if the reported AIS has been verified to be an invasive plant species regulated under the federal noxious weed list or an injurious species regulated under the Lacey Act, Title 16 of the United States Code, §§ 3371-3378, as amended, the U.S. Department of Agriculture and/or the U.S. Fish and Wildlife Service should be notified. Entities with jurisdictional and/or management authority for the location of the infestation should also be considered for contact during this action. In some cases, property owners may need to be contacted for permission so that verification can occur. A press release or other public notification should also be considered after positive verification has occurred to facilitate additional detections, to aid in containment and limit the spread of the invasion, as well as to raise awareness about the issue.

Action 4: *Conduct risk assessment to determine if the species is a candidate for response*

Confirmation of a new occurrence of a high-threat priority AIS in the state or watershed will result in a risk assessment of the invasion and specific situation. In some cases, this process can occur in collaboration with Action 3, above. AIS reports being considered as part of this action are deemed to represent high-threat priority AIS. The specific details of a particular occurrence or invasion (magnitude, location, etc.) will inform the decision about whether a response is feasible and necessary. The risk assessment conducted as part of Action 4 is intended as an information gathering process to determine the potential environmental, economic, or human health threat, and evaluate if the AIS and the particular details of the occurrence make it a candidate for a response. There are some quantitative and concrete criteria that can be used for the assessment; however, best professional judgment of the circumstances will be used to determine if a response is appropriate to minimize threat.

The agency with jurisdictional authority and/or the appropriate personnel, with the assistance from other sources if needed, will conduct the risk assessment and record related details on the *Invasive Species Response Risk Assessment Work Sheet* (Appendix D). The following factors may be used:

- Is the species a new invasion to the state or to a geographic location within the state?
- Is the species known to cause significant impacts in its native range and/or is the species known to be invasive outside of its native range?
- Is there knowledge of the source of introduction and risk of reintroduction or further spread?
- Was the invasion detected early?
- Is the infestation small and localized?

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- Can the species be quarantined/contained while control measures are planned and implemented?
- Is there acceptance that not responding will have serious impacts?
- Is the location public or directly connected to public resources (i.e., public land or water)?
- How quickly should a response occur?

Following the risk assessment, the invasion should be classified as either low-, high-, or unknown risk. If the outcome is low risk, the occurrence is noted but no further response action is taken using this plan. If the outcome is high or unknown risk, proceed to Action 5.

Results from this action may be communicated to relevant partners and stakeholders, per the discretion of the responding agency. Nearby property owners (individuals and/or associations), municipalities (city, township, or county), and other relevant parties should be considered. Many of these entities may be valuable resources for conducting the risk assessment and may be able to provide information that might not otherwise be available to the responding agency.

The lead responding agency should also consider a press release during this action to raise awareness for the issue and stay in front of misinformation, rumors, and general questions. The press release should include mention of the initial report, confirmation of species identification, biological information, and appropriate results from the risk assessment in Action 4. Lastly, the press release should also give a general description of the next steps ("assess response options," etc.) and provide a point of contact for questions and additional information.

Action 5: Assess response options

To determine the appropriate response options, previously-obtained scientific information on the species and the infestation will be used to evaluate response availability and feasibility. The agency with jurisdictional authority and/or the appropriate personnel, with the assistance from other sources, as appropriate, will assess the response options using best professional judgment. This assessment may include, but is not limited to, additional questions such as:

- Are known successful treatment/response options available?
- Are there serious environmental issues or regulatory hurdles that will lead to delays or greatly increase the cost of the response?
- Are there threatened or endangered species present?
- Is the AIS in a high-priority, natural community?
- Is the AIS in the vicinity of a public utility?
- Is the AIS on tribal lands? If yes, then appropriate tribal department coordinators should be contacted.
- Are there social or economic reasons to treat?
- Are there concerns with infrastructure or human safety?
- If permits are needed, can they be obtained in a timely manner?
- Is there a need for law enforcement or investigation associated with the infestation?
- What are the unintended or nontarget impacts of the response options?

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- Does the response require multiple uses or long-term control?
- Is there adequate physical access to the site?
- Will permission be necessary and available from local landowners?
- What are the current funding conditions for response efforts?
- Can response efforts be conducted by agency staff or will response efforts require contract assistance (or both)?
- Are there opportunities for collaboration with stakeholders and partner agencies?
- Are there regulatory requirements for the management and disposal of any materials removed during a response?

While some response options are focused on eradication, it is important to also consider options such as biological control, monitoring, and education and outreach efforts. If eradication is not feasible or desirable, alternate options may be useful for preventing further spread of the AIS or raising awareness in other locations that could potentially become invaded. In some instances, no response may be feasible or available and, therefore, no further response action may be taken. The results of Action 5 should be shared with appropriate partners, federal agencies, local municipalities, property owners, and other relevant entities to ensure consistent and accurate sharing of information. Once the assessment of response options is complete, proceed to Action 6.

Action 6: *Decide whether to use an Incident Command System (ICS)*

The first step in planning a response is to determine if an ICS is appropriate. Certain response scenarios can benefit from a highly coordinated and structured format, such as an ICS. An ICS is a systematic tool used for the command, control, and coordination of emergency responses and is commonly used by federal and state agencies to respond to emergency events such as floods, fires, and other high-threat situations. See Appendix E for more details on an ICS and how to implement the system for AIS response.

As with many of the above actions, determining whether or not to use an ICS in a response to AIS is ultimately decided using best professional judgment. Specific factors to consider include:

- Are federal resources or federal agencies involved?
- Is the response jurisdictionally or operationally complex (multiple agencies involved, several levels of authorities, AIS invasion and response cross state/federal borders, etc.)?
- Is the response action outside of the "routine operations" of the responding agency?
- Is chemical control part of the response action?
- What is the scale of the response action (local, regional, statewide, etc.)?
- Is there a significant threat to public health and safety?

An AIS response that does NOT involve an ICS typically includes a response that is within routine operations of the lead responding agency and is jurisdictionally simple (only one agency has clear authority).

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If an ICS will NOT be used for response planning and implementation, proceed to Action 7a. If an ICS will be used, proceed to Action 7b.

Action 7a: Plan and implement the response (no ICS)

This action involves the logistical and operational planning and implementation for the chosen response and is performed by the agency with jurisdictional authority and/or the appropriate personnel, with assistance from other sources, as appropriate. While Action 7a does not involve ICS protocols, some elements of an ICS may be used where applicable. For example, it may be beneficial to appoint an incident commander and a command team for decision-making.

In general, planning and implementing an AIS response without using an ICS should:

- Follow standard decision support and chain of command protocols of the lead responding agency.
- Follow standard lead responding agency policies for communication, safety, operations, logistics, equipment, personnel, and finance/spending.

The AIS Core Team should be notified of response planning and implementation. Additionally, communication should continue with any of the entities contacted during the previous actions to keep everyone updated and informed of progress. A second press release may be issued during this action to notify constituents and the general public of the response process and progress.

Once the response has been implemented, proceed to Action 8.

Action 7b: Plan and implement the response using ICS

This action uses the ICS to plan and ultimately implement a response. For more details about an AIS response involving an ICS, refer to Appendix E. The following are general steps/guidelines for an AIS response that involves an ICS:

Planning Phase:

- Appoint Incident Commander/Unified Command (IC/UC).
- IC/UC review of all previous information obtained during Actions 1-5.
- IC/UC refers to ICS flowchart to determine current status within the ICS "Planning P" (see Appendix E, Figure 2).
- Proceed as directed by IC/UC following the "Planning P" (appoint appropriate officers, etc.).
- Develop an Incident Action Plan (see Appendix E).

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Implementation Phase:

- Carry out the Incident Action Plan (IAP) following the "Planning P" (see Appendix E).
- Follow policies developed by IC/UC and appropriate ICS officers.
- Follow protocols and procedures developed by, and under the direction of, IC/UC and appropriate ICS officers.

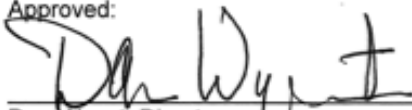
Once ICS response planning and implementation are complete, proceed to Action 8.

Action 8: *Create an after-action report and begin adaptive management*

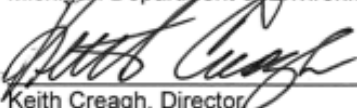
An after-action report will be produced after each response to summarize and document the process from the initial report of the invasion through the conclusion of the response implementation. While a full after-action report is only needed for responses that continue beyond Action 4, other reports of AIS that end prior to Action 4 should still be documented for future reference and decision support.

Adaptive management is a process for continually improving management policies and practices by learning from the outcomes of operational programs. Adaptive management is crucially important to the implementation of a response to AIS. Ideally, adaptive management will include an evaluation of response effectiveness, mitigation and/or restoration of treatment areas, an assessment of reintroduction risks, and post-procedure monitoring. Additionally, education and outreach efforts should continue during the adaptive management phase of the response plan to help articulate/communicate outcomes of the response.

Approved:



Dan Wyant, Director
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Appendix A: Invasive Species Reporting Work Sheet



Quality of Life Group

Departments of Environmental Quality, Natural Resources, and Agriculture and Rural Development

Invasive Species Reporting Work Sheet

Reporter's Contact Information:

Name (first and last):

Phone:

E-mail:

Type of invasive species being reported (check one):

- | | | | |
|---------------------------------|---------------------------------------|--|--|
| <input type="checkbox"/> Fish | <input type="checkbox"/> Invertebrate | <input type="checkbox"/> Aquatic Plant | <input type="checkbox"/> Terrestrial Plant |
| <input type="checkbox"/> Mammal | <input type="checkbox"/> Bird | <input type="checkbox"/> Unknown | |

Common name:

Scientific name (if known):

Physical description (approximate size, color, density, etc.):

Specimen obtained: ☐ Yes ☐ No

Date of observation:

Location of observation (county, township, and/or water body):

Coordinates (latitude/longitude):

Additional location details (habitat, environmental conditions, etc.):

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Appendix 14. Photographic Monitoring Protocol



MDNR: PRD: Stewardship Unit

Photographic Monitoring Protocols

Photographic monitoring (photo-monitoring) is a common technique used to track changes in vegetation over time. The basic photo-monitoring process involves taking repeat photographs from the exact same point in exactly the same way (i.e., keeping all other variables – height, azimuth, season, time of day, etc. – constant from photo to photo). The number of points and position of the photos are determined subjectively to capture changes over time. There are two general types of photo-monitoring: photo-plots and photo-points. Photo-plots are generally small ($< 1/4 \text{ m}^2$) permanent plots of ground that are periodically photographed from above (i.e., perpendicular to the ground) to document changes in groundcover vegetation over time. Photo-points are permanent points from which photographs are taken of the landscape (i.e., parallel to the plane of the ground) at predetermined angles (azimuths). The Stewardship Unit (SU) frequently uses photo-points to qualitatively document changes in vegetation structure and composition over time. Photo-points are strategically located in positions where vegetation changes due to management can be tracked. By comparing pre- and post-management photographs, we can assess whether management is progressing in the desired direction. The SU photo-monitoring protocol was developed based on the techniques of the Michigan Chapter of The Nature Conservancy, the National Park Service, and the US Forest Service.

Establishing Photo-points (should be done prior to management activities)

- Locate a place on the ground that will provide an optimal view of the landscape to be monitored.
- Mark the exact location of the permanent point on the ground with a marker (fence post, re-bar, aluminum tube, nail, or plastic survey stake, as appropriate). A large metal nail or magnetic object should always be buried a couple inches below ground surface a few inches away from the actual marker so that if the marker is pulled by vandals or lost due to vegetation growth, flooding, etc. it can be relocated by a combination of GPS and a metal detector.
- Use a high-precision GPS unit to determine the position of the point in the field. After returning to the office, import the GPS location into the SU GIS photo-monitoring database.
- Describe the location of the point in writing on the "Photographic Monitoring Location Record" form. Record azimuths and distances to the 2-3 nearest permanent or semi-permanent landmarks (i.e., large boulder, large witness tree, burn line, etc.) and fill out remaining information on the form completely.
- Take one initial set of photographs as described below. The initial set of photos should ideally include photos from all seasons if possible, and include at least one set of high-resolution digital photos or black & white prints for archival purposes.

Taking Repeat Photographs

- Repeat photographs will be taken at strategic times as needed to illustrate landscape changes over time at each point (typically leaf-off [early spring/late fall], early summer, and/or late summer, depending on the type of vegetation).
- A 3 or more-megapixel digital camera with 35mm (35mm SLR equivalent) lens is used. Images are stored in high resolution (low compression) jpg format. (Currently, we use either a 7 megapixel Canon Powershot G6 camera or a 3 megapixel Canon PowerShot Pro90 IS camera). Our alternate method (used prior to digital or when the digital cameras are not available) is to use a 35 mm SLR camera with 35-50 mm lens and color slide film (100-200 ASA). Additionally, under the alternate method,

black & white prints are taken pre-management and at least once every 10 years to document long-term trends, as it is more stable than color slide film over long periods of time (> 40-50 years).

- Record all data on the standard "Photographic Monitoring Data Sheet" developed for photo-monitoring.
- Find the permanent photo-point on the ground. Look for the metal marker, using GPS, written directions, and/or a metal detector if necessary to find the point.
- Set up the camera on a tripod directly over the marked photo-point at the height recorded for the initial set of photographs (generally 1.4 – 1.6 m above the ground).
- Record date, time, photographer name, weather (light conditions), camera, lens, film type, and ASA (for non-digital cameras) on field form.
- Position a reference target board ("zebra board") upright exactly 10 m from the camera at one of the predetermined azimuths (recorded in the initial session). The target board is 1 dm wide by 1.5 m long, painted with 50 cm-wide white-black-white alternating bands. Use a ground tape to measure the 10 m distance from the camera to the target board. Photo azimuths (typically 1-3 per point) will be permanently determined at the first session, and will be designed to best illustrate the results of management at that location.
- While looking through the camera, center the viewfinder on the target board, about 1 dm (~ 4 inches) below the top of the board. For digital cameras, use the "landscape" setting (or equivalent) to maximize depth of field. For film cameras, stop down the lens as much as possible (higher f-stop) to maintain high depth-of-field. Use a shutter speed of 1/60 second or faster when there is any noticeable wind. Take one photograph. Record the frame number, f-stop, shutter speed, camera height, azimuth, and focal distance on the field form.
- Repeat the above two steps for the remaining photo angles at the point.
- Photos should be carefully organized and labeled (whether digital or 35mm film) for archival purposes. Imagine someone needing to find a specific photo at a specific angle 50 years from now and organize/store the photos accordingly. Current protocol for SU is to save digital photos with a filename that includes park, photopoint number, azimuth, and date (example: FC_4A_214_20090915). In addition, photos are currently stored and cataloged in Adobe Photoshop Elements software. Digital files are saved on a network drive, organized by park, and periodically archived to CD-ROM.