Invasive Plant Management Plan

For

Natural Education Reserve

Grand Traverse County, Michigan

2012

Prepared by Robin Christensen, Invasive Species Program Coordinator

Jessica Beachy, Invasive Species Technician

Grand Traverse Conservation District

1. INTRODUCTION

A. Description and Purpose of the Natural Education Reserve

(Natural Education Reserve Management Plan, Johnson and Purdy (2009))

Mission Statement: "To provide safe, enjoyable, quiet recreational experiences and environmental education opportunities while protecting the resource for visitors to the Reserve."

Vision Statement: "To enhance and protect the integrity of the Grand Traverse Natural Education Reserve to provide for quiet recreation and environmental education for generations to come."

Located in Grand Traverse County, Michigan, the Grand Traverse Natural Education Reserve (NER) is a 505 acres reserve just three miles south of Traverse City, on Cass and Keystone Roads. Of the 505 acres, 356 acres is owned by Grand Traverse County, 95 acres is owned by the Charter Township of Garfield, and 54 acres is owned by the City of Traverse City. Since the 95 acre north section of the NER is owned and managed by Garfield Township, its invasive species results are referenced in this document but covered in more detail in a separate plan for all Garfield Township parks.

The Boardman River is a prominent feature and great asset to the NER as well as the entire Grand Traverse Region. Two earthen dams along the Boardman River create Sabin and Boardman Ponds within the NER. Grand Traverse County and the City of Traverse City have completed a two-year study to determine the fate of three hydroelectric dams, including the two dams within the NER. That survey determined that the three dams along the River will be removed, starting with Brown Bridge Dam upriver in 2012, then Sabin Dam, and lastly Boardman Dam. In 2007, Boardman Dam was lowered approximately 17' due to insufficient spillway capacity and has seen very little restoration or maintenance in the exposed bottomlands.

The NER is host to a variety of flora and fauna. However, given its close proximity to urban landscapes it has also seen an array of invasive plants that have become fairly well established. Most infestations of invasive species are in relatively early stages as the populations are small and control efforts have been implemented in the past to minimize their spread. Because reservoir drawdown, dam removal, and subsequent ecosystem restoration will result in large areas of newly exposed soil, this Invasive Species Management Plan will focus on the entire NER as a whole knowing that areas surrounding the bottomlands will act as the main seed source for invasion.

Goals of this plan include:

1) Identify source areas on which to concentrate invasive plant control efforts before dam removal based on current distribution of invasive plants and dispersal methods.
2) Identify vulnerable sites within the bottomlands on which to concentrate invasive plant control after dam removal.
3) Prioritize invasive plant removal based on site characteristics, species characteristics, dispersal methods, abundance, and likeliness of successful control.
4) Provide a guide to prevent new infestations and minimize spread for disturbed and newly exposed soils.
5) Maintain high quality native habitat for listed species of conservation concern focusing on the many known natural features in the study area such as those outlined in the 2009 Natural Education Reserve Management Plan.

B. Inventory of plant species

In 1997, Greg LaCross identified six natural and six artificial (human disturbance) community types in the Grand Traverse County and City of Traverse City portions of the NER (Figure 1):

Natural Community Types

1. Emergent marsh
2. Hardwood-Conifer Swamp
3. Conifer Swamp
4. Northern Shrub Thicket
5. Mesic Northern Forest
6. Dry-mesic Northern Forest

Artificial Community Types

1. Reservoir
2. Former Impoundment
3. Current Impoundments
4. Powerline Easement
5. Conifer Plantation
6. Old Field

During the floristic survey, LaCross found 208 wetland species of which 184 are native. The average coefficient of conservatism of these species is 4.21 with a community quality index rating of 61.71. The survey found 168 upland species of which 107 are native. The average coefficient of conservatism is 2.65, with a quality index rating of 34.41. Wilhelm and Ladd (1986) noted that areas with a quality index "ranking above 35 possess sufficient conservatism and richness to be of profound importance from a regional perspective".

In 2011, a survey for invasive plants was conducted by the Grand Traverse Conservation District staff. The survey found 32 different invasive plants in the NER, 17 of which are on the region's 'Top 20' list (Figure 2-3). The 'Top 20' are those species that area land managers consider to pose the greatest threat to our high quality natural areas. Of the 32 invasive plant species found during the 2011 survey, sixteen were also present in the 1996 survey. Those species include bull thistle (*Cirsium vulgare*), Canada thistle (*Cirsium avense*), common forget-me-nots (*Myosotis scorpioides*), cow vetch (*Vicia villosa*), invasive honeysuckle (*Lonicera tatarica*), Japanese barberry (*Berberis Thunbergii*), purple loosestrife (*Lythrum salicaria*), mullein (*Verbascum thapsus*), narrow leaved cattail (*Typha angustifolia*), periwinkle (*Vinca minor*), spotted knapweed (*Centaurea stoebe)*, St. John's-wort (*Hypericum perforatum*), white sweet clover (*Melilotus alba*), and yellow sweet clover (*Melilotus officinalis*). In addition, motherwort (*Leonurus cardiaca*) and Norway maple (*Acer platanoides*) were found in the 1996 survey but not in the 2011. Both species are most likely still present at the NER but were missed given the 2011 survey was completed only once during the growing season instead of three times like the 1996 survey. While spotted knapweed was not identified by community partners as one of the 'Top 20', at the NER it is still considered a high threat in sensitive areas like the exposed bottomlands. All 'Top 20' species identified at the NER are aggressive and grow in dense patches that eventually reduce the vigor and establishment of the native vegetation that is required to sustain wildlife.

The most abundant 'Top 20' species found at the NER were autumn olive (*Elaeagnus umbellata),* bull thistle (*Cirsium vulgare*), Canada thistle (*Cirsium arvense*), phragmites (*Phragmites australis* subsp. *australis*), honeysuckle (*Lonicera spp.*), purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), and spotted knapweed (*Centaurea stoebe*).

Due to the 17' drawdown of Boardman Pond in 2007 and the 5' drawdown of Sabin Pond in 2010/11, the exposed bottomlands have been a hot spot for invasive species establishment. This is especially troublesome at Boardman Pond since little has been done to stop or slow the spread prior to 2011 because of limited time and resources. Boardman Pond bottomlands contain the highest populations of reed canary grass, phragmites, bull thistle, and Canada thistle – all of which have the potential to increase with the removal of the dam and exposure of the entire bottomlands. Invasive plants at Boardman Pond also pose a high risk of spreading downriver to the bottomlands of Sabin Pond and beyond.

Natural Education Reserve 2011 Survey Sections

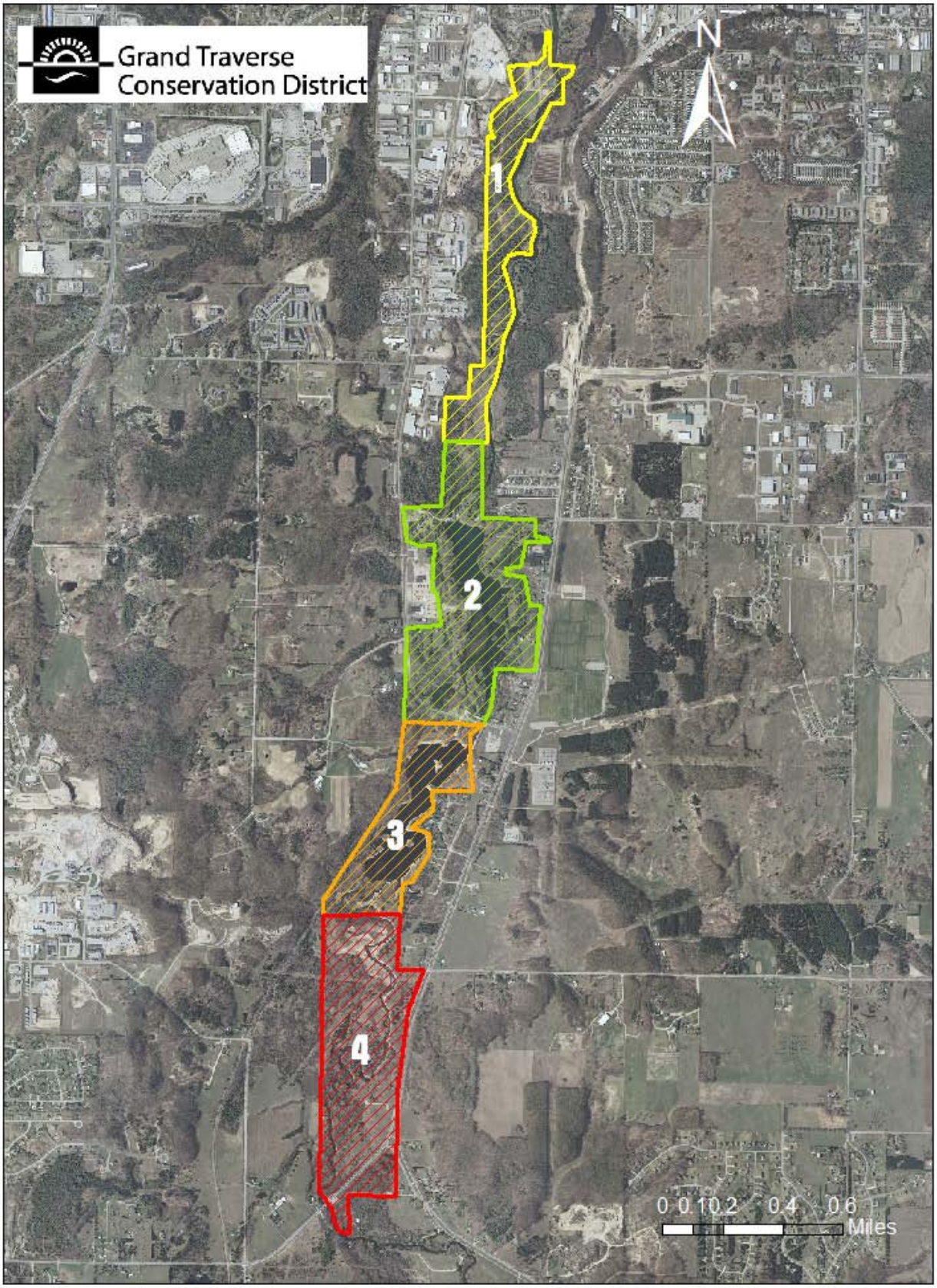
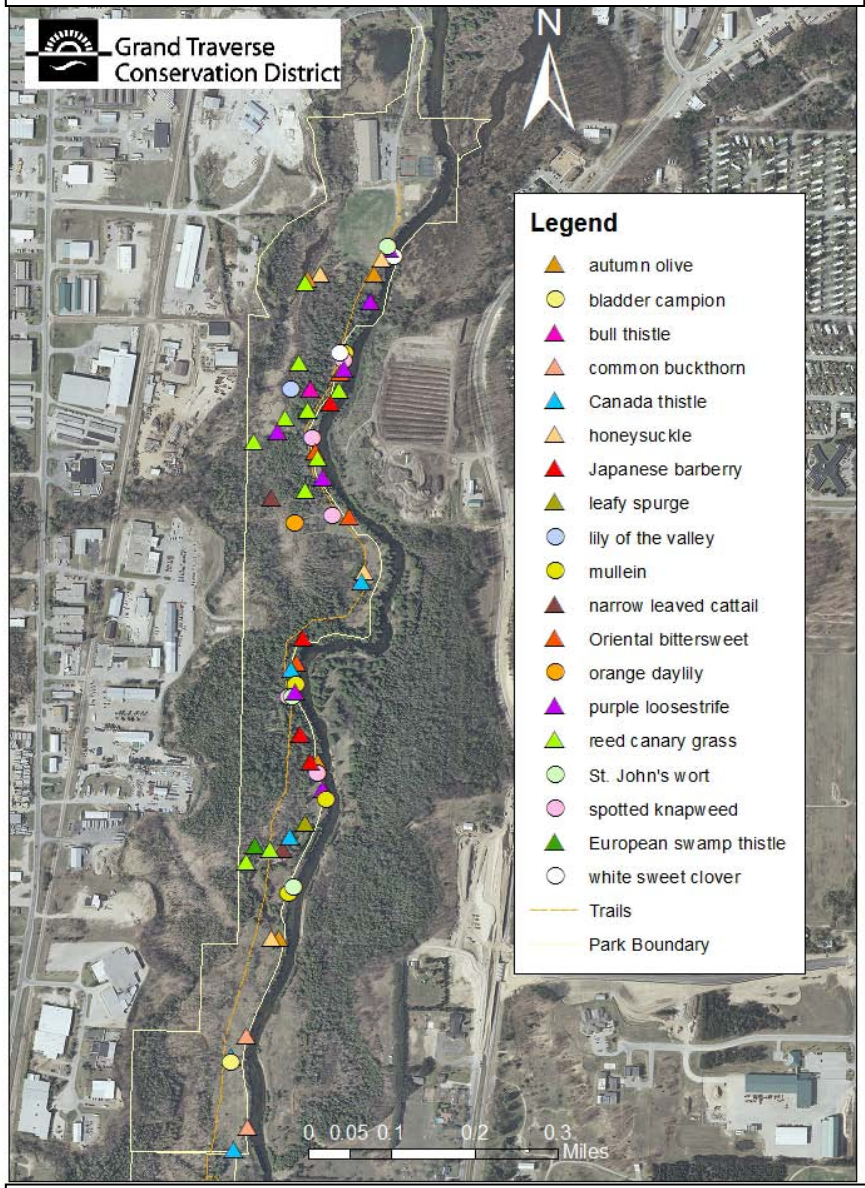


Figure 1. The Natural Education Reserve sections for 2011 invasive plant survey.

Section 1



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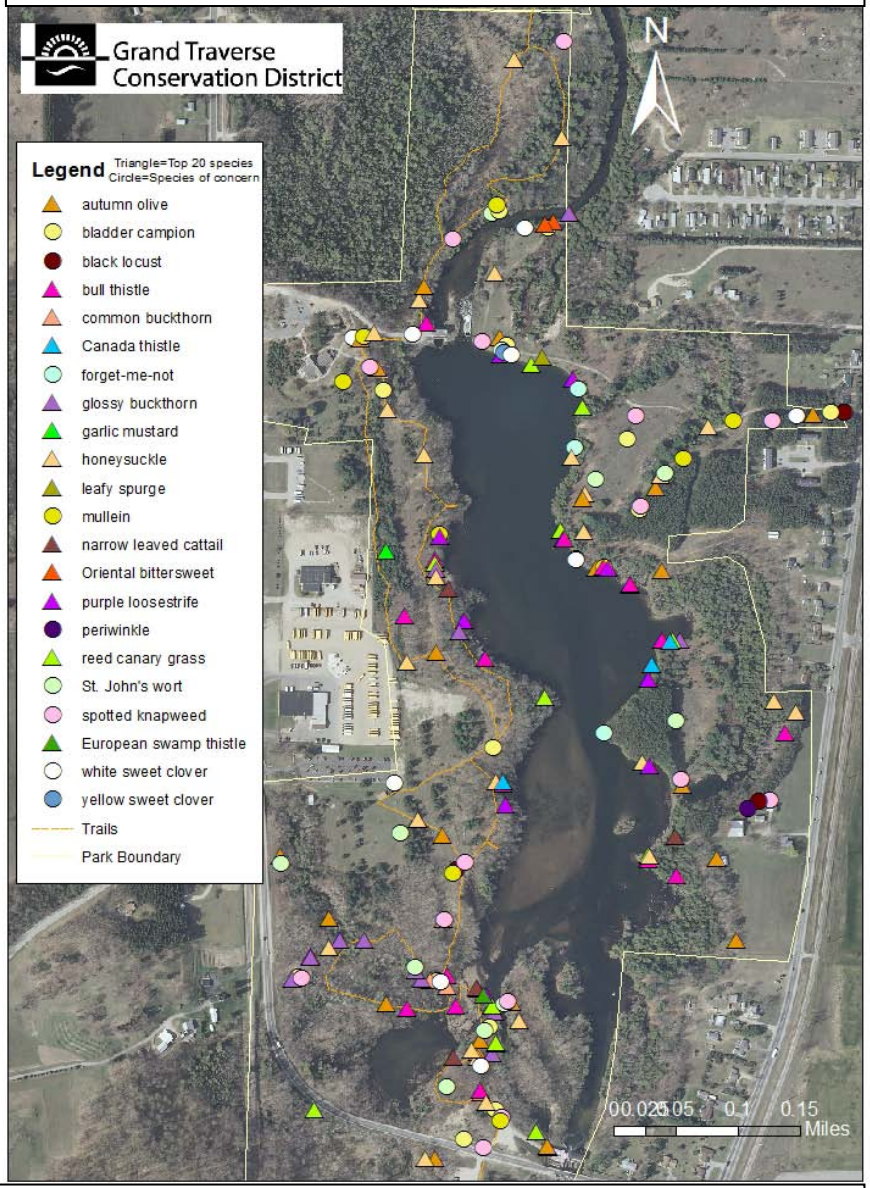
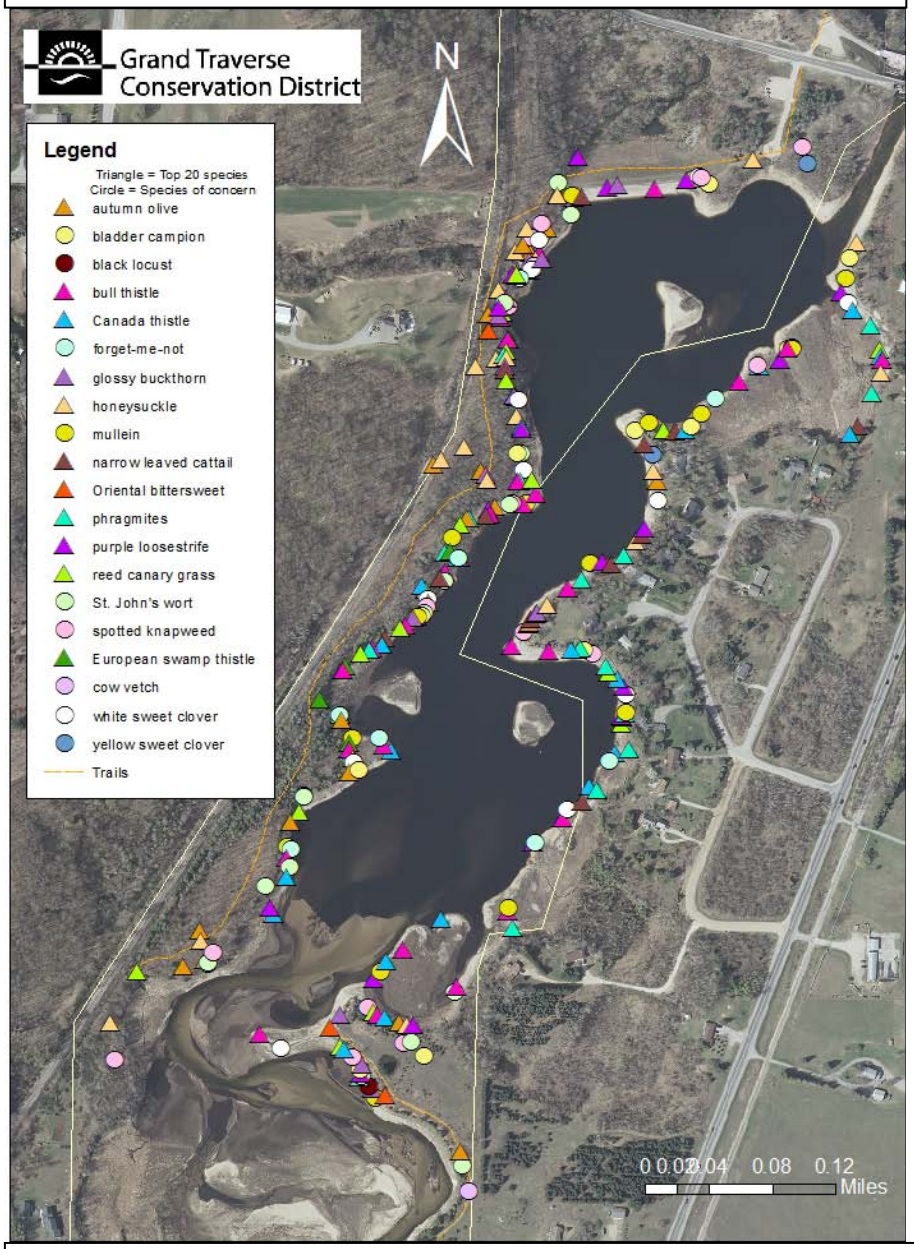


Figure 2. All species found in section 1 and 2 during the 2011 invasive plant survey for the Natural Education Reserve.

Section 3



Section 4

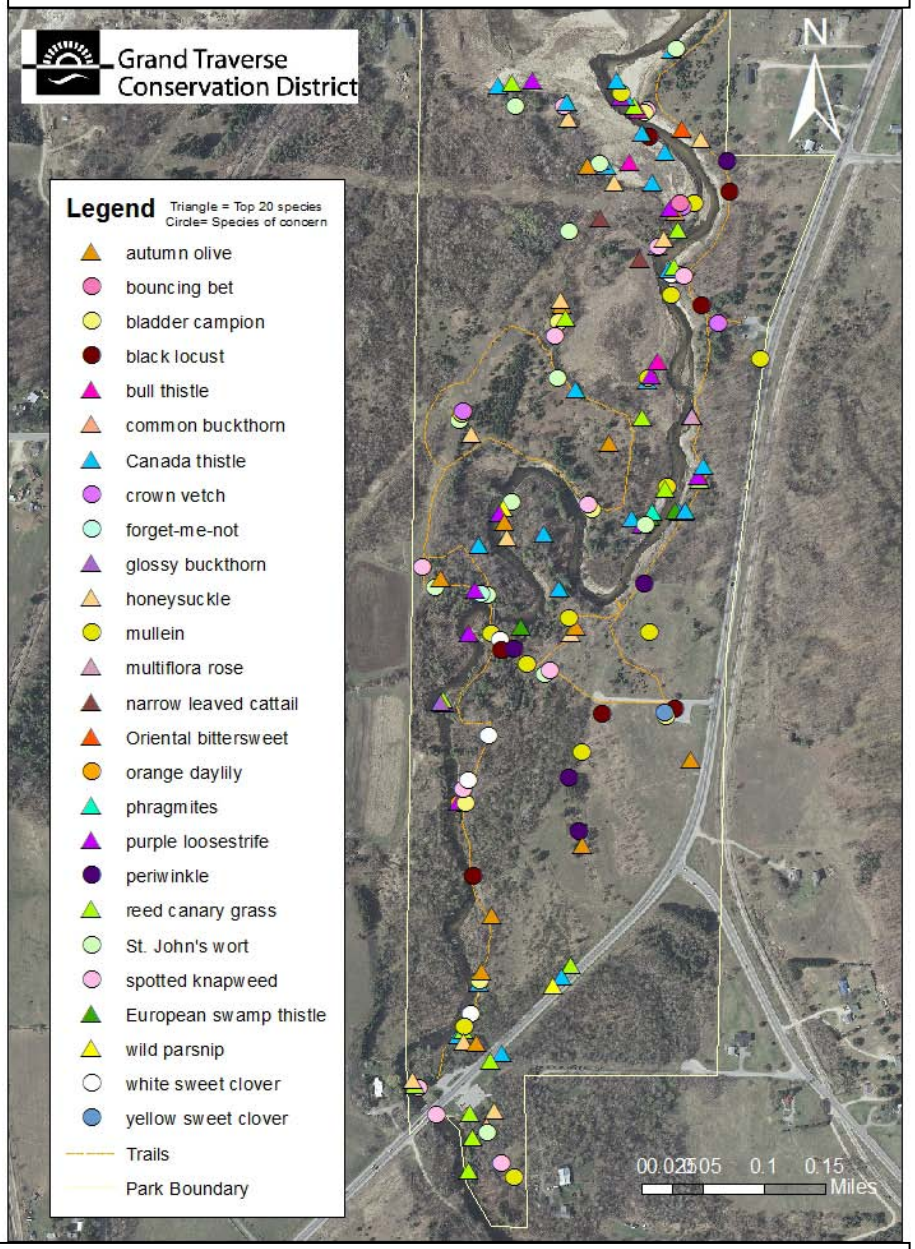


Figure 3. All species found in section 3 and 4 during the 2011 invasive plant survey for the Natural Education Reserve.

C. Description of invasive plant species found at the Natural Education Reserve

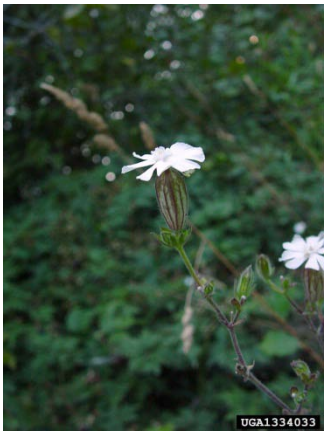
1. **Autumn Olive** *(Elaeagnus umbellata)*

(From, A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Deciduous shrub or small tree growing up to 6 m (20 ft) in height and 9 m (30 ft) wide.
Leaves: Simple, alternate, oval, 5-10 cm (2-4 in) long; margins entire, wavy; gray-green above, silvery scaly below; early leaf out (mid-March).
Stems/bark: Often thorny; silvery or golden brown, with brownish scales giving stems a speckled appearance.
Flowers: Fragrant; tubular; 4 petals and stamens; cream to light yellow; in clusters of 1-8; bloom from April to June.
Fruits/seeds: Drupe, 0.6 cm (0.25 in) in diameter; silvery with brown scales when immature, speckled red or yellow when mature; ripen September to October; begin to bear fruit at 3 to 5 years; each tree can produce 2-8 lbs. of seed per year; fruit eaten and seed dispersed by birds.
Habitat: Moderately shade tolerant; occurs in a variety of soil types (pH range of 4.8-6.5), thrives on infertile soils because of nitrogen-fixing root nodules; found in open woods, forest edges, roadsides, fence rows, meadows, sand dunes, and other disturbed areas.
Reproduction: By seed; also by root sprouting.
Similar species: Related invasive Russian olive (*E. angustifolia*) has longer, narrower, leaves, silver above and below.
Comments: Native to Asia. Invades disturbed areas, can out-compete native species; increases soil nitrogen levels which facilitates expansion of weedy and/or invasive species; had been widely recommended for conservation planting until invasive traits became apparent.

2. **Bladder Campion** (*Silene cucubalus)*

*(*Adapted from: Royer, F. and R. Dickinson. 1999. *Weeds of the Northern U.S. and Canada.* Lone Pine Publishing: Renton, WA.)



Habit: Herbaceous perennial, up to 1 m tall.
Leaves: Opposite, ovate to lance-shaped, 3-8cm long and 1-3 cm wide. Stalkless and appear pale green due to a white powdery film.
Stems/bark: Hairless stems branched from the base.
Flowers: Branched clusters of 5-30 white flowers, 10-20mm across; found at the end of branches; individual flowers composed of 5 united sepals, 5 petals and 3 styles; inflated calyx, 15-20 mm long, bladder-like with 20 pinkish white veins; deeply notched petals 14-16mm long;
Fruits/seeds: Round capsule 1cm long and enclosed by inflated calyx; 3-celled capsule contains numerous seeds; seeds re kidney-shaped, brown/grey, covered with rows of rounded bumps and 1-1.5mm long.
Habitat: Roadsides, fields
Reproduction: By seeds and root fragments
Similar species: Smooth catchfly (*S. scserei*), from Asia, has a non-inflated calyx 8-12 mm long and seeds less than 1 mm long.
Comments: Native to Europe and Asia. Invades disturbed areas, and can crowd beneficial plants.

3. **Black Locust** (*Robinia pseudoacacia)*

(From, A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Deciduous medium tree ranging in height from 12-25 m (40-82 ft) and 30-60 cm (12-24 in) in diameter; crown narrow, open, irregular with contorted branches.
Leaves: Alternate; pinnately compound with 7-21 leaflets per leaf; leaf 20-35 cm (8-14 in) long; ovate leaflets 2-5 cm (1-2 in) long and about half as wide, thin with smooth margins; hairless, dull bluish green above paler beneath, turning yellowish brown in fall.
Stems/bark: Twigs puberulent, becoming smooth, green to reddish brown, with zigzag shape and two spines at each node; bark is thick, tan to gray-brown, deeply furrowed; inner bark orange.
Flowers: White, irregular; very fragrant; dangling raceme of 10-25 flowers; bloom May-June.
Fruits/seeds: Seedpods form in the fall but persist over winter, pods are smooth, dark-brown, flat, and contain 4-8 small, flat, brown seeds.
Habitat: Very shade intolerant; can grow in many soil types except those with a high water table; formerly widely planted in Michigan and now found colonizing old fields, prairies, disturbed forests and woodlands.
Reproduction: By seed; also sprouts easily from roots and forms natural clones.
Similar species: Native honey locust (*Gleditsia triacanthos*) has smaller leaves; southern native bristly locust (*Robinia hispida*) is shrublike with brushlike hairs on stems and fruit; non-native false indigo (*Amorpha fruitcosa*) is shrublike with smaller leaves.
Comments: Native south of MI. Fixes nitrogen—may alter soil

4. **Bouncing Bet or Soapwort** (*Saponaria officinalis)*

((Adapted from: **Czarapata, E.J.** 2005. *Invasive Plants of the Upper Midwest*. The University of Wisconsin Press: Madison, WI.)

Habit: Herbaceous perennial in the Pink family reaching up to 0.3-0.7m tall
Leaves: Simple; opposite: oval/lance shaped; smooth margins; hairless; no leaf stem; 3-5 conspicuous veins on underside; join to form collar around stem; 5-8cm long, 2.5cm wide
Stems: Erect; generally unbranched; smooth; stout; swollen where leaves attach
Flowers: White or pinkish; 2.5 cm wide; 5 petals with indentation at the tips and small appendages at flower center; petals point back from center; found in dense, branched clusters at tops of stems; bloom July-Sept.
Fruits/seeds: Seedpods are cylindrical to oblong and contain many seeds
Habitat: Disturbed areas, roadsides, fields and pastures
Reproduction: By seeds and short rhizomes
Similar species: Native phlox species (*Phlox divericata, Phlox pilosa***)**
Comments: Native to Europe, all parts of plant are toxic, especially seeds and roots

5. **Bull Thistle** (*Cirsium vulgare)*

(From, A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Biennial or occasionally annual or monocarpic thistle ranging in height from 0.6-2 m (2-6.6 ft); has a deep taproot
Leaves: Forms a juvenile basal rosette, up to 1 m (3.3 ft) across. Mature stem leaves are alternate, hairy, and narrowly or broadly lance-shaped with irregular lobes and spiny toothed margins.
Stems: Upright, branching and hairy, with distinctive spiny wings.
Flowers: Numerous, large purple flowers, 3.8-5 cm (1.5-2 in) in diameter; clustered at the tops of stems and branches, bloom June- October; fragrant. .
Fruits/seeds: Seeds are small, light brown, with tufts of hair attached to the tip for wind dispersal; persistence in the seed bank varies with depth, site conditions.
Habitat: Found in disturbed sunny areas, roadsides, agricultural fields; invades prairie and riparian areas; shade intolerant.
Reproduction: By seed; bull thistle typically produces 100 to 300 seeds per flower and can have over 400 flowers per plant; may require cross-fertilization to produce fertile seed.
Similar species: Native thistles (*Cirsium muticum, C. discolor*) do not have spiny, winged stems. European swamp thistle (C. palustre) has spiny winged stems but its flowers are much smaller at 1.5 cm (0.8 in) or less in diameter.
Comments: Native to Europe, western Asia and northern Africa. This species is listed as a prohibited noxious weed by the Michigan Department of Agriculture.

6. **Canada Thistle** (*Cirsium arvense)*

(From, A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26)

Habit: Perennial, rhizomatous thistle ranging in height from 0.6-1.5 m (2-5 ft); forms large monocultures.
Leaves: Simple, alternate, lance-shaped; crinkly, tapering, with irregular lobes and spiny toothed margins.
Stems: Upright, slender and branching towards the top, becoming increasingly hairy with age.
Flowers: Numerous, purple-lavender flowers, small flower heads less than 2.5 cm (1 in) high, clustered at the tops of stems, bloom June-September; fragrant.
Fruits/seeds: Seeds are small, light brown; tufts of hair attached to the tip for wind dispersal; one plant produces between 1500-5000 seeds, which can germinate 8-10 days after flowering begins and persist in the seed bank for up to 20 years.
Habitat: Found in disturbed open areas, roadsides, agricultural fields; invades prairie and riparian areas; salt-tolerant; shade intolerant.
Reproduction: Primarily by creeping, laterally spreading rhizomes, but also by prolific seed production; dioecious, with separate male and female clones; some hermaphroditic forms.
Similar species: Native swamp thistle (*Cirsium muticum*) has an involucre with cobweb-like pubescence and may be sticky; pasture thistle (*Cirsium discolor*) has leaves that are white below; other non-native thistles have spiny winged stems.

7. **Common Buckthorn** (*Rhamnus cathartica)*

(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26)

Habit: Deciduous, woody shrub to small tree ranging from 3-7.5 m (10-25 ft) in height and reaching 25 cm (10 in) in diameter.

Leaves: Simple, oval, dark green, smooth and shiny; small teeth along margins; veins that curve from base towards leaf tip; sub-opposite (not quite opposite) but may also appear opposite or alternate.
Stems/bark: One to several stems from the base; stems branch towards the crown; twigs often have thorns near the tips; bark is brown to gray, peeling with age, dotted with vertical light-colored lenticels; inner bark is orange.
Flowers: Small, green-yellow, four-petaled, clustered in leaf axils; dioecious; bloom May-June; fragrant.
Fruits/seeds: Round, pea-size, black berries (on female plants only); persistent through the winter.
Habitat: Found along roadsides, woodland edges, prairies, old fields; somewhat shade tolerant.
Reproduction: By prolific fruit and seed production, seeds widely dispersed by birds.
Similar species: Native alder-leaved buckthorn (*Rhamnus alnifolia*) is less than 1 m (3 ft) in height with dark scales on winter buds; non-native glossy buckthorn (*Rhamnus frangula*) has shiny entire leaves, always lacks terminal thorn.
Comments: Native to Eurasia. Produces a dense shade that suppresses growth of woody seedlings, and herbaceous groundcover, reduces overall plant diversity; changes nutrient cycling; had been widely recommended for conservation planting until invasive characteristics became apparent.

8. **<u>Crown Vetch & Cow vetch</u>** (*Coronilla varia and Vicia villosa)*

*(*Adapted from: **Czarapata, E.J.** 2005. *Invasive Plants of the Upper Midwest*. The University of Wisconsin Press: Madison, WI.)

Habit: Herbaceous perennial in the legume family.
Leaves: Pinnately compound; alternate; 5-15cm long leaflets with no stalks, 15-25 pairs of oval 2cm leaflets
Stems/bark: Trail along ground, 0.5-2 m long; branched and hairless; plant cover rises 15-30cm above the ground. Stems are cow vetch have spreading hairs
Flowers: Pinkish lavender and white, pealike; arranged in rounded, 2.5 cm clusters on long stalks growing from leaf axils; bloom May/June through August. Flowers are blue to white on cow vetch
Fruits/seeds: Long narrow seedpods; pods contain few to several slender, brown seeds that can remain viable up to 15 years.
Habitat: Full sun/partial shade; fields, roadsides, disturbed lands, stream banks
Reproduction: By seed and a creeping rhizome root system.
Comments: Native to Europe, SE Asia and northern Africa. Often planted for erosion control along roadsides and waterways and easily escapes cultivation; forms dense mounds of vegetation that climb over and shade out other species.

9. **<u>European Swamp Thistle</u>** (*Cirsium palustre)*

(From, A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Herbaceous biennial ranging in height from 0.5-2 m (1.5-6.5 ft) tall.
Leaves: Thin, deeply lobed into pinnate segments, covered with loose matted hairs and spiny teeth along margins, up to 20 cm (8in) long; basal leaves longer than those higher in the stem in flowering plants; leaves of basal rosettes (first year plants) are spiny, deeply lobed, long and hairy below.
Stems: Thick, with spiny lengthwise wings along stem; sometimes reddish; branching at the top.
Flowers: Small, purple flower heads ranging from 1-1.5 cm (0.4-0.8 in) across; held in dense clusters; bloom June-August.
Fruits/seeds: Fruit is a tiny achene, attached to a fluffy "parachute".

Habitat: Prefers moist, acidic soil conditions, shade intolerant; found in ditches, wetlands, swamps, fens.
Reproduction: By wind dispersed seed.
Similar species: The native swamp thistle (*Cirsium muticum*) has an involucre with cobweb-like pubescence and may be sticky; neither it nor the non-native weed Canada thistle (*Cirsium arvense*) has spiny stems or flowers. Although the non-native bull thistle (*Cirsium vulgare*) also has spiny winged stems, its flowers are much bigger.
Comments: Native to Europe. European swamp thistle is considered a high priority invasive species in the Hiawatha National Forest and has spread widely throughout northern Michigan.

10. <u>Forget-me-not</u> (*Myosotis sylvatica)*
*(*Adapted from: Czarapata, E.J**.** 2005. *Invasive Plants of the Upper Midwest*. The University of Wisconsin Press: Madison, WI.)

Habit: Herbaceous perennial 15-20 cm tall.
Leaves: Simple; alternate; oblong, lance or spatula shaped; 2-7 cm long; without teeth
Stems/bark: Sprawling or weakly erect; downy; 15-50cm long
Flowers: Pale blue (sometimes white) with yellow eyes, 5 petals, bloom April to September.
Fruits/seeds: Shiny nutlet on spreading stalks
Habitat: Forests, well-drained rich soil
Reproduction: Abundant seed production
Similar species: Non-native true forget-me-not (*M. scorpiodes*) are found in wet areas (stream borders, shallow waters, wet soils)
Comments: Native to Eurasia, can become very dense eliminating native vegetation

11. <u>Garlic Mustard</u> (*Alliaria petiolata)*
(From, A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26)

Habit: Upright, herbaceous biennial growing up to 1 m (3 ft) tall.
Leaves: Simple, alternate, triangular, toothed; lower leaves rounded with cordate bases and palmate venation, up to 12 cm (4.75 in) long, scalloped edges, arranged in a basal rosette; upper leaves stalked.
Stems: Up to about 1 m (3 ft); typically one flowering stem per rosette but may be more.
Flowers: Numerous, small, white, four-petaled; usually in clusters at tops of stalks or in leaf axils; bloom late April-early June.
Fruits/seeds: Small, dark brown/black; in long narrow capsules; one plant can produce up to 3,000 seeds; seeds viable within a few days of flowering and remain viable for many years.
Habitat: Found in upland and floodplain forests, savannas, along trails, roadsides and disturbed areas; shade tolerant but also found in full sun; spreads rapidly.
Reproduction: By seed; preferentially outcrosses but may self; produces basal rosette the first year, flowers the second year.
Similar species: Basal leaves resemble those of ragworts (*Senecio* spp.), violets (*Viola* spp.) and kidney-leaved buttercups (*Ranunculus* spp.); fruiting structures similar to other mustards; can be distinguished by garlic odor when crushed.
Comments: Native to Eurasia. Dominates the ground layer of forests to the exclusion of almost all other herbaceous species; destroys mycorrhizal fungi needed by woody plants for regeneration.

12. <u>Glossy Buckthorn</u> (*Frangula alnus (Rhamnus frangula)*)
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Deciduous shrub or small tree growing up to 6 m (20 ft) tall, multiple stems at the base, crown spreading, trunk up to 25 cm (10 in) in diameter.
Leaves: Simple, alternate, oblong, 2.5-6 cm (1-2.5 in) long, untoothed or crenulate margins, dark green, shiny; smooth or slightly hairy below; veins turn toward tip near leaf margins; leaves present from mid-May to November.
Stems/bark: Brown-green, hairy, prominent lenticels, chunky bark; terminal buds rust colored; bark gray or brown; sapwood yellow; heartwood pinkish to orange.
Flowers: Small, greenish yellow, five-petaled; perfect; clusters of 2-6; bloom late May through September.
Fruits/seeds: Round, pea-sized, drupes with 3-4 seeds, red, ripening to black/dark purple in July through September; abundant; remain viable in the soil for 2 to 3 years.
Habitat: Sun and shade tolerant; occurs in a variety of soil and moisture conditions, from wet to very dry; found in pastures, fence rows, roadsides, wetlands, and woodland edges.
Reproduction: Primarily sexual; plants mature quickly; at any given time there can be flowers, partially ripened fruit (red) and fully ripened fruit (black) on the same plant.
Similar species: Native alder-leaved buckthorn (*Rhamnus alnifolia*) is less than 1 m (3 ft) tall, hairless twigs. Dogwoods (*Cornus* spp.) have opposite leaves rather than alternate.
Comments: Native to Eurasia. Forms dense thickets; was recommended for wildlife planting until invasiveness became apparent.

13. <u>Invasive Honeysuckle</u> *(*non-native *Lonicera spp.)*
(From, A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Upright deciduous shrubs 2-6 m tall.
Leaves: Simple; opposite; entire; oval, oblong or elliptic; short petioles. Produce leaves 1-2 weeks before native species and hold them later in the fall.
Stems/bark: Multiple; many branches; arching; sometimes develop roots where they touch the ground; bark is gray or tan; shaggy; older branches often hollow
Flowers: Abundant, pink to purplish red or white fading to yellow with age; tubular; arranged in pairs arising from leaf axils; fragrant; bloom in May and June
Fruits/seeds: Abundant; red to orange; paired berries; ripen in early summer; viable 2-3 years
Habitat: Thrive in sunny, upland sites including forest edges, roadsides, pastures and abandoned fields; also found in fens, bogs and on lakeshores; relatively shade intolerant.
Reproduction*:* By seed; fruit dispersed by birds; root fragments may resprout
Similar species: Native Canada honeysuckle (*L. canadensis*), American fly honeysuckle (*L. involucrata*), fly honeysuckle (*L. oblongifolia*) and swamp fly honeysuckle (*L. villosa*) are comparatively short and sparse and lack hollow stems on older branches. Dogwoods (*Cornus* spp.) have flowers and berries in clusters at the ends of their branches, not in the leaf axils.
Comments: Native of Asia; Common in urban areas and also occurs in rural areas where it was recommended for wildlife until its invasive traits became apparent; forms dense thickets; reduces tree and shrub regeneration, decreases overall plant diversity. There are four major species of invasive honeysuckle in northern Michigan; Amur honeysuckle (*Lonicera maackii*), Bell's honeysuckle (*Lonicera x bella*), Morrow's honeysuckle (*Lonicera morrowii*) and Tatarian honeysuckle (*Lonicera tatarica*). For information on distinguishing between species refer to Borland, Campbell, Shillo and Higman 2009 or Czarapata 2005.

14. Japanese Barberry (*Berberis thunbergii)*
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Spiny, deciduous shrub, typically 0.5-1 m (2-3 ft) tall.
Leaves: Simple, alternate, oval to spoon shaped with smooth margins, 1.3-2 cm (0.5-0.75 in) long; bright green above, lighter below, in clusters at each node, red to purple in the fall depending on the cultivar.
Stems/bark: Numerous, spiny, slightly curving; older stems gray; twigs and young stems turning reddish brown in winter; inner bark yellow.
Flowers: Small, yellow, stalked; single or in small clusters of 2-4 blossoms; bloom April-May.
Fruits/seeds: Small, bright red, egg-shaped berries found singly or in clusters on slender stalks; mature in midsummer; remain on stems into winter; often dispersed by birds, deer, turkey and grouse. Some cultivars appear to produce little or no fruit.
Habitat: Found along woodland edges, open woods, roadsides, stream banks, old fields; tolerates a range of soil, moisture and light conditions; can establish under forest canopy.
Reproduction: By seed; creeping roots and cut stumps; branches root freely where they touch the ground.
Similar species: American barberry (*B. canadensis*), which is not native to Michigan, has toothed leaves and usually three pronged spines.
Comments: Native to Japan. Barberry is a common horticultural species and frequently escapes from cultivation; deer herbivory minimal. The non-native common barberry (*B. vulgaris*) is also invasive but was eradicated from large parts of its range, including Michigan, in the early twentieth century as it is a host to black stem grain rust.

15. Leafy Spurge (*Euphorbia esula)*
(From, A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Herbaceous perennial ranging in height from 15-92 cm (6-36 in); root system can extend up to 6 m (~20 ft), with lateral roots near the surface.
Leaves: Simple, alternate, long, narrow, bluish green; usually pointed and drooping with smooth margins; exude white milky sap when crushed.
Stems: Upright stems that branch towards the top of the plant; dry stems may persist into the winter and following summer; stems also release white, milky sap when broken.
Flowers: Small, yellowish-green flowers with fused petals forming a cuplike structure; bloom mid-June to late-July.
Fruits/seeds: Smooth, oblong, gray-brown seeds in explosive capsules; one plant can produce up to 200 seeds; high germination rate; viable up to 8 years with adequate moisture.
Habitat: Roadsides, prairies, savannas, gravel pits, open areas.
Reproduction: By seed; also spreads rapidly through its persistent root system from crown and root buds that over-winter under the soil surface.
Similar species: Flowering spurge (*Euphorbia corollata*) has white flowers and erect leaves; invasive non-native Cypress spurge (*Euphorbia cyparissias*) has stem leaf blades less than 2.5 mm wide.
Comments: Native to Eurasia. This species is listed as a prohibited noxious weed by the Michigan Department of Agriculture; deep taproot, up to 4.5 m (15 ft) deep; tough, woody extensive root system may extend up to 10 m (33 ft); large root reserves allow plant to recover from most disturbances.

16. Lily-of-the-Valley (*Convallaria majalis)*
*(*Adapted from: Czarapata, E.J. 2005. *Invasive Plants of the Upper Midwest.* The University of Wisconsin Press: Madison, WI.)

Habit: Perennial forb 10-25 cm tall
Leaves: Basal; 2-3; entire; oval; 15 cm long; dark green
Flowers: Small, white, nodding bells in a one-sided raceme; bloom late spring; highly fragrant
Fruits/seeds: Pale red, small berries
Habitat: Forests, thickets, meadows, yards
Reproduction: By root system
Comments: Native to Eurasia; Often planted as groundcover, but can spread from cultivation through its root system. Plant parts are poisonous.

17. Mullein (*Verbascum thapsus)*
*(*Adapted from: Royer, F. and R. Dickinson. 1999. *Weeds of the Northern U.S. and Canada.* Lone Pine Publishing: Renton, WA.)

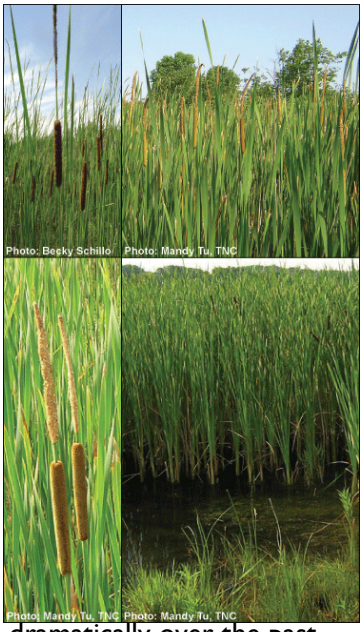
Habit: A biennial up to 2.5 m tall when in flower.
Leaves: Leaves of the first year rosette 15-45 cm long; covered in thick woolly, branched hairs; Stem leaves are alternate, 10-40 cm long and reduced in size upwards with bases running down the stem.
Stems/bark: Flowering stem rises in the second year from a deep taproot; up to 2.5 m tall.
Flowers: Dense compact spike; 20-50 cm long and 3 cm across; numerous yellow flowers, 2.5 cm across; stalkless; saucer shaped; composed of 5 united sepals, 5 united petals, 5 stamens and a single pistil; stames covered in white or yellow hairs.
Fruits/seeds: Fruit is a woolly ovate capsule 3-10 mm long; splits to release an average of 6000 seeds; seeds are oblong; dark grey/brown, less than 1mm long and 0.5 mm diameter; wrinkled surface with several intersecting ridges; each plant may produce over 180,000 seeds that may remain viable at least 100 years; require light and temperatures above 10□ C to germinate.
Habitat: Fields, degraded areas; establish most readily on bare soil, need 140 days of growing season,
Reproduction: By seed
Similar species: Black mullein (*V. nigrum*) has stamens covered in purple hairs; in woolly mullein (*V. phlomoides*) the leaf bases do not continue down the stem.
Comments: Introduced from Greece to North America as a medicinal plant**.**

18. Multiflora Rose (*Rosa multiflora)*
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Deciduous, dense, perennial shrub growing up to 5 m (16 ft) tall and 3-4 m (9-23 ft) wide, with long, slender, arching branches.
Leaves: Alternate, pinnately compound with 5-11 leaflets; leaflets 2.5 cm (1 in) long and finely toothed; base of leaf with a finely fringed stipule.
Stems/bark: Green-reddish, arching, with stout, recurved thorns.
Flowers: Numerous, white or slightly pink, five-petaled; up to 4 cm (1.5 in) wide; arranged in a panicle; bloom May-June.
Fruits/seeds: Fruits are small, clustered, hard, smooth, red rose hips that appear in September-October and last into winter; seeds yellowish and dispersed by birds and mammals, remain viable for 10 to 20 years.
Habitat: Found along roadsides, pastures, disturbed areas, forests and streambanks; tolerates a variety of soil conditions; prefers open, well-drained sites.

Reproduction: By seed; also by horizontal stems that root at the node and shoots that root at the tips.
Similar species: Native swamp rose (*Rosa palustris*) has broadbased recurved thorns but like all native roses, it has pink flowers and does not have fringed stipules.
Comments: Introduced from Japan and Korea in the 1800s; later promoted to control soil erosion, as a living fence and for wildlife food and cover until its invasive qualities became apparent; vulnerable to Japanese beetles and a number of other pests and diseases.

19. <u>Narrow-leaved Cat-tail</u> (*Typha angustifolia)*
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26)0



Habit: Aquatic, emergent perennial; 1.5-3 m (5-10 ft) tall.
Leaves: Upright, flat; up to 1 m (3 ft) long and 0.6-1.25 cm (0.25-0.5 in) wide with parallel veins; dark green.
Stems: Upright, 1-2 m (3-6 ft) long.
Flowers: Borne in terminal spikes; female flowers are dark brown, densely arranged, and located beneath the lighter male flowers; male and female sections separated by a 2-10 cm (1.75-4 in) gap (see circled gap in photo).
Fruits/seeds: Numerous, tiny, wind-dispersed seeds; up to 250,000 seeds/plant; viable in the seed bank for up to 100 years.
Habitat: Found in wetlands, ditches, stream and lake shores and wet depressions; tolerates high levels of silt, nutrients and salt.
Reproduction: By seed with establishment on bare soil and vegetatively by thick spreading rhizomes; also by fragmentation.
Similar species: Common cat-tail (*Typha latifolia*) does not have a gap between male and female sections of the spike, leaves are wider; narrow-leaved cat-tail hybridizes with the native cat-tail to produce *Typha xglauca*, which usually also has a gap between the male and female portions of the spike although gap size and leaf width are variable.
Comments: Native to Eurasia. The hybrid reproduces vegetatively and tolerates a greater range of conditions than either parent; cattail dominated habitat in the Midwest has increased dramatically over the past few decades as *T. angustifolia* and *T. xglauca* have spread.

20. <u>Orange Daylily</u> *(Hemerocallis fulva)*
(Adapted from: Swearingen, J., B. Slattery, K. Reshetiloff, and S. Zwicker. 2010. Plant Invaders of Mid-Atlantic Natural Areas, 4th ed. National Park Service and U.S. Fish and Wildlife Service. Washington, DC. 168pp. Available online at http://www.nps.gov/plants/alien/pubs/midatlantic/ (Accessed 2/21/12))

Habit: Erect perennial forb, 0.5-1m (2-4 ft) tall with round stems
Leaves: Long, linear, strap-like, bright green, 0.3-1m (1-3ft) long; curve toward the ground
Stems/Bark: round, 0.5-1 m tall with flowers at the tip
Flowers: Large, showy, orange, generally with some striping; Occur in clusters of 5-9 at tip of stalk; open one at a time for one day only. Blooms in summer
Habitat: Areas near home sites where it escapes from landscaping, wide range from fields, meadows to floodplains, moist woods and forest edges.
Reproduction: Thick tuberous roots produce new plants
Similar species: Native lilies, including Canada lily (*Lilium canadense*), wood lily (*Lilium philadelphicum*)and Turk's cap lily (*Lilium superbum*). Non-native lilyturf (*Liriope spicata*)
Comments: Native to Asia, commonly planted as an ornamental. Over 40,000 cultivars many of which may have the potential to become invasive.

21. <u>Oriental Bittersweet</u> *(Celastrus orbiculatus)*
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Deciduous, woody, twining vine.
Leaves: Simple, alternate, rounded, finely toothed, glossy; leaf tips acute or acuminate; 5-13 cm (2-5 in) long; turn yellow in fall.
Stems/bark: Light brown, often with noticeable lenticels; solid white pith; can climb 18 m (60 ft) high in trees and reach 10 cm (4 in) in diameter.
Flowers: Small; greenish yellow; five-petaled; clustered in leaf axils; bloom in May-June.
Fruits/seeds: Outer skin (green in summer and yellow orange in fall) covers a red, fleshy aril, which contains 3-6 seeds; fruits clustered in leaf axils; colorful fruit may persist through the winter.
Habitat: Found in grasslands, open woods, woodland edges, undisturbed forests, roadsides and fence rows; extremely shade tolerant.
Reproduction: By prolific seed production and spreading underground roots that form new stems.
Similar species: Native American or climbing bittersweet (*Celastrus scandens*) has elliptical rather than rounded leaves; flowers and fruits terminal rather than axillary; greenbriar (*Smilax* spp.) leaves are entire, not toothed and have parallel leaf veins.
Comments: Native to Asia. Oriental bittersweet hybridizes with American bittersweet, making it a genetic threat to the native species; reduce photosynthesis of the plants that they cover and girdle trees; the native bittersweet cannot be cut or transported without a bill of sale or proof of ownership under Michigan law.

22. <u>Periwinkle or myrtle</u> (*Vinca minor)*
*(*Adapted from: Czarapata, E.J. 2005. *Invasive Plants of the Upper Midwest.* The University of Wisconsin Press: Madison, WI.)

Habit: Perennial woody vine 15-20 cm tall
Leaves: Simple; opposite; shiny; evergreen (cultivars exist in other colors); up to 5 cm long; later at both ends with a short stem.
Stems/bark: Long, creeping, commonly root at nodes; mat-forming
Flowers: Blue-violet (sometime white); 2.5 cm wide; occur singly in leaf axils; 5 flaring petals with a white star-like center; bloom in early spring, sometimes into summer and fall.
Fruits/seeds: Brown, inconspicuous and beanlike.
Habitat: Forests, woodland edges, roadsides, rich moist soils
Reproduction: By root expansion and rooting where nodes touch the ground.
Comments: Native to Europe; commonly sold as groundcover for landscapes; can aggressively outcompete native ground layer species.

23. <u>Non-native Phragmites</u> (*Phragmites australis* subspecies *australis)*
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Stout, warm-season perennial grass ranging in height from 1.8-3.9 m (6-13 ft); forms dense stands, in contrast with the native subspecies which occurs in a colony of scattered stems.
Leaves: Flat, smooth leaf blades; 25-50 cm (10-20 in) long, 1-3.5cm (0.4-1.4 in) wide; hairy ligules; leaf sheaths stay attached after the stem senesces, in contrast with those of the native subspecies, which fall off easily.
Stems: Stems upright, rigid and hollow; dull yellowish; usually covered by the leaf sheath; the lower stems of the native subspecies are usually exposed, shiny and often reddish.

Flowers: Dense branched clusters on bearded axis at the end of each stem; becoming open and feathery at maturity.
Fruits/seeds: Seeds with white hairs below that are almost as long as the seed; prolific seeder.
Habitat: Found in wetlands, ditches, swales, stream and pond banks; tolerates road salt; responds rapidly to nutrient inputs.
Reproduction: Contrary to earlier beliefs, spreads easily and extensively by seed; also by an extensive, aggressive system of horizontal and vertical rhizomes that can live for 3-6 years.
Similar species: Non-native Phragmites is distinctive and much taller than most other grasses, particularly the non-native subspecies. Wild rice (*Zizania aquatica*), though quite tall, lacks the feathery appearance; large non-flowering plants of reed canarygrass (*Phalaris arundinacea*) appear similar but lack hairy ligules.

Comments: This species has been listed as a restricted species under Michigan law; forms dense, impenetrable stands.

24. <u>Purple Loosestrife</u> (*Lythrum salicaria)*
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Herbaceous, perennial, 0.5 to 2.0 m (1.5-6 ft) tall, densely pubescent, especially the upper part of the plant, pubescence variable; strongly developed taproot becomes woody with age.
Leaves: Lanceolate to almost linear, opposite or whorled; sessile to somewhat clasping; 3-10 cm (1-4 in); larger leaves at the base.
Stems: Four-angled; glabrous to pubescent.
Flowers: Numerous, purple (also white or light pink) with 5-7 petals; terminal spike-like inflorescences in axillary clusters of two to several; bloom July to October.
Fruits/seeds: Capsule with small seeds; prolific seed production.
Habitat: Shade intolerant but can tolerate up to 50% shade; found in disturbed wet areas; tolerates a wide range of soil types but prefers organic soils.
Reproduction: By seed; or vegetatively by resprouting from cut stems and regenerating from pieces of root stock.
Similar species: Native winged loosestrife (*Lythrum alatum*) has solitary flowers borne in axils of small bracts; fireweed (*Epilobium angustifolium*) has 4-petaled flowers and leaves taper at base.
Comments: Native to Eurasia. This species is restricted under Michigan law; attractive but persistent weed; spreads vigorously inmoist soil conditions; crowds out native wetland plant species.

25. <u>Reed Canarygrass</u> (*Phalaris arundinacea)*
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Cool-season, colonial, perennial grass ranging from 0.7-2.4m (2.5-8 ft) tall; forms dense monotypic stands; root system is a thick, fibrous mat of rhizomes.
Leaves: Flat, rough leaf blades; 1.9-2.6 cm (0.75-1 in) wide and up to 45 cm (1.5 ft) long; prominent transparent ligule.
Stems: Stems are upright; bluish-green in color.
Flowers: Found in crowded, branched clusters at the end of each stem; young clusters dense and spike-like, expanding at maturity.
Fruits/seeds: Small, shiny brown seeds; dispersed by water, humans, animals and machinery.
Habitat: Found in wetlands, ditches, stream and pond banks, and wet meadows.
Reproduction: Primarily through dense, mat-forming, spreading rhizomes; also by seed.
Similar species: Native blue joint grass (*Calamagrostis canadensis*) occurs in similar sites but is less robust and upright.

Comments: Native to North America and Europe; most Midwestern colonies thought to be escapes of cultivated and European forms. Reed canary grass is a cool-season grass; the invasive character of some *Phalaris* populations may be the result of agronomic breeding for vigorous growth and drought tolerance.

26. <u>Common St. John's wort</u> (*Hypericum perforatum)*
*(*Adapted from: Czarapata, E.J. 2005. *Invasive Plants of the Upper Midwest.* The University of Wisconsin Press: Madison, WI.)

Habit: Herbaceous perennial 0.3-0.5m tall.
Leaves: Simple; opposite; 2.5-5 cm long; oblong to elliptic; narrow; toothless; lack hair and petioles; dots resembling pinpricks can be seen when held up to the light
Stems/bark: Usually reddish; erect; branched; smooth; woody at the base
Root System: Long taproot with shallow rhizomes; tough
Flowers: Yellow; starlike; 5 petals with tiny black dots on edges; 1.2 cm long and 2.5 cm wide; numerous stamens; occur at ends of branches or stems in broad, branched round-topped clusters with 25-100 flowers; bloom July to September.
Fruits/seeds: Three-sections pods with numerous dark brown seeds; one plant can produce 100,000 seeds per year; dispersed by wind, the fur of animals, or other means; viable for 10 years
Habitat Fields, pastures, roadsides, open woods, dunes, disturbed ground; prefers sandy, dry soils.
Reproduction: Mainly by seeds although rhizomes can produce new plants.
Similar species: Can be distinguished from native species by the black dots of flower petal margins and it's clusters of multiple flowers.
Comments: Native to Europe and a widely used herbal. Only introduced and ecologically invasive species of the *Hypericum* genus in the upper Midwest

27. <u>Scotch Pine</u> *(Pinus sylvestris L.)*
(Adapted from: Barnes, B. and W. Wagner. 2004. Michigan Trees. University of Michigan Press, Ann Arbor. 447p.)

Habit: Medium to large size tree15-20 m (50-85 ft) tall and 25-30 cm (10-20in) diameter
Leaves/Needles: Clusters of 2; 5-10 cm long; stiff, thick broad; twisted, spreading slightly from a short sheath; blue-green to silver in color; persist 3-4 years.
Stems/Bark: Thin, pale gray with scaly ridges when young; moderately thick on older trees, orange brown and finely scaly on mid/upper trunk.
Fruit/Seeds: Monoecious; pollen cones present May-June, at base of new shoots in ovoid short-stalked clusters, 6mm long; composed of many sessile yellow pollen scales attached to a central axis. Seed cones ripen in autumn or winter of second season, falling when ripe; Pendent, stout-stalked, ovoid-conical, 5-8 cm long; seeds are reddish-brown 5-6 mm long, with wings 1.3-2 cm long.
Habitat: Upland species; grows especially well on sandy loam soils.
Reproduction: By seed.
Comments: Native to Europe; fast-growing, moderately long-lived, has a wide-spreading lateral root system and a distinct taproot when young.

28. <u>Spotted Knapweed</u> (*Centaurea stoebe (Centaurea maculosa))*
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Short-lived herbaceous biennial or perennial reaching 0.6-1.2 m (2-4 ft).
Leaves: All leaves pale or grayish green with rough fine hairs; basal leaves form a rosette which may persist for up to four years; basal and lower stem leaves up to 15 cm (6 in) long; leaflets deeply divided to irregularly lobed, tapered at both ends; upper stem leaves smaller with few or no lobes.
Stems: Stems rough, upright and branching.

Flowers: Numerous, pink-purple, terminal solitary flowers at the end of each stem; phyllaries with dark tips and fringed margins; bloom from July-September.
Fruits/seeds: Small brown wind-dispersed seeds; germinate throughout the growing season; remain viable for up to nine years.
Habitat: Roadsides and right-of-ways, old fields, pastures, undisturbed dry prairies, oak and pine barrens, and dunes and beaches during low water conditions.
Reproduction: By prolific seed production and to a lesser extent by lateral roots.
Similar species: Russian knapweed (*Centaurea repens*), diffuse or white-flowered knapweed (*C. diffusa*), black knapweed (*C. nigra*), and yellow star thistle (*C. solstitialis*) are related non-native invasive species. The best way to distinguish spotted knapweed is by the dark tips and fringed margins of its phyllaries.
Comments: Native to Europe. This species is listed as a prohibited noxious weed by the Michigan Department of Agriculture. It is alleleopathic and poses a serious threat to western rangelands; may cause skin reactions in some individuals.

29. <u>Sweet Woodruff</u> (*Galium odoratum)*
(Adapted from The Ohio State University plant list website http://hcs.osu.edu/hcs/tmi/plantlist/ga_ratum.html)

Habit: Perennial groundcover, 15-30 cm tall when in bloom, 10 cm tall when in foliage.
Leaves: Bright green when emergent, maturing to dark green; in tiered whorls of 6-8; lanceolate to narrow elliptical leaflets around thin grooved stems; 4 cm long; when crushed smells like freshly-mown hay
Stems/bark: Procumbent; may root at the nodes
Flowers: White; in terminal small inflorescences above the foliage in late May/early June
Fruits/seeds: Small and insignificant
Habitat: Partial to full shade; prefers rich, moist soils but can tolerate average, well-drained, dry thin soils
Reproduction: Procumbent rooting stems
Comments: Native to Europe and Mediterranean region; widely used as a groundcover in landscaping

30. <u>White Sweet Clover</u> (*Melilotus alba)*
(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Herbaceous annual or biennial that can grow up to 1.5 m (5 ft) tall; deep taproot, extensive lateral roots.
Leaves: Compound, alternate, clover leaves with three finely toothed leaflets.
Stems: Upright, many-branched; smooth; often hollow; leafy stems that may be spreading near the base give the plant a bushy appearance.
Flowers: Numerous, white, pea-like, fragrant; crowded onto elongated stems; bloom May-September.
Fruits/ Seeds: Fruit is a tiny, wrinkled seedpod containing 1-2 small, tough seeds; seeds may remain viable for up to thirty years; seed germination stimulated by burning.
Habitat: Found in open, dry, disturbed sites such as roadsides and old fields; also found in calcareous soils of sand dunes and prairies. Shade intolerant; will tolerate nutrient poor soils.
Reproduction: By prolific seed production; up to 350,000 seeds per plant.
Similar species: Resembles non-native yellow sweet clover (*Melilotus officinalis*) which has yellow rather than white flowers; seedlings may also resemble alfalfa (*Medicago* spp.), which has downy hairs on the leaf underside.
Comments: Native to Eurasia. Capable of nitrogen fixation. Has been planted for hay.

31. <u>Wild Parsnip</u> (*Pastinaca sativa)*

(From A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Tall, herbaceous biennial; up to 1.5 m (5 ft) in height; long, thick taproot.
Leaves: Long, pinnately compound leaves form a basal rosette during first year; basal leaves reach 15 cm (6 in) in length; mature plants with pinnately compound, alternate leaves of 5-15 oval, smooth, toothed leaflets.
Stems: Upright, unbranched, thick, hairy, grooved.
Flowers: Numerous, small, yellow, five-petaled, found in flat, terminal umbels, up to 15 cm (6 in) wide; lateral flowers of umbel often taller than central flowers; bloom June - mid-July.
Fruits/seeds: Seeds are large, flat, round, yellowish; seeds can remain viable for up to four years.
Habitat: Found in open habitats such as prairies, savannas and fens. Tolerates a range of soil and moisture conditions; shade intolerant.
Reproduction: By seed.
Similar species: Cow-parsnip and giant hogweed (*Heracleum* spp.) have white flowers and leaves with only 3 leaflets that are hairy or pubescent below, rather than smooth; prairie parsnip (*Polytaenia nuttallii*) has finely divided pinnately compound leaflets rather than the coarse pinnately compound leaves of wild parsnip.
Comments: Native to Eurasia. Chemicals found in leaves, stems, and flowers of wild parsnip can cause skin rashes, burns, and blisters, especially in the presence of sunlight; roadside mowing disperses seed.

32. <u>Yellow Sweet Clover</u> (*Melilotus officinalis)*

(From, A Field Guide to Invasive Plants in Michigan's Natural Communities. 2009. Available online http://mnfi.anr.msu.edu/education/InvasivePlantsFieldGuide.pdf (Accessed 1/26))

Habit: Herbaceous annual or biennial that can grow up to 1 m (3 ft) tall; deep taproot, extensive lateral roots.
Leaves: Compound, alternate, clover leaves with three finely toothed leaflets.
Stems: Upright, many-branched; often hollow; leafy stems that may be somewhat spreading near the base give the plant a bushy appearance.
Flowers: Numerous, yellow, pea-like, fragrant; crowded onto elongated stems; bloom May-September.
Fruits/ Seeds: Fruit is a tiny, wrinkled seedpod containing 1-2 small seeds that may remain viable for up to thirty years; seed germination stimulated by burning.
Habitat: Occurs in open, disturbed sites such as roadsides and old fields; invades prairies, savannas and dunes; shade intolerant; tolerates nutrient poor soils
Reproduction: By prolific seed production; up to 350,000 seeds per plant.
Similar species: Resembles non-native white sweet clover (*Melilotus alba*), which has white rather than yellow flowers; seedlings may also resemble alfalfa (*Medicago* spp.), which has hairs (pubescent) on the leaf underside.
Comments: Native to Eurasia. Capable of nitrogen fixation. Has been planted for hay.

2. OVERVIEW OF INVASIVE SPECIES MANAGEMENT PLAN

A. General Management Philosophy

Invasive species control is part of the overall restoration and management for the Natural Education Reserve. This plan focuses on native community preservation as the goal rather than the eradication of invasive plants. This invasive species plan uses an analytical approach as the basis of prioritization developed by Hiebert and Stubbendiech (1993). This approach has been used in several national park systems and reviewed by many ecologists. Using an analytical approach ensures that ecological knowledge is applied to the decision making process and that personal biases are minimized as much as possible. Alien Plants Ranking System v. 5.1 software (APRS, 2000) was developed based on this analytical approach and is used in this plan to rank all the 'Top 20' species found at the NER during the 2011 survey. Priority of invasive plant control is based 1) significance of impact, 2) ability to become a pest, and 3) difficulty of control. A description of each category is below:

1) Significance of Impact
   Takes into account where the species is invading (newly disturbed vs. mature natural community), size of the populations, effects on the ecological processes and structure of the native community, effects on management plan goals, and visual impact seen by an ecologist.
2) Ability to Become a Pest
   Takes into account the life history of the species (rate of increase, dispersal, habitats it invades, etc), rate of increase, dispersal method, and ability to outcompete native species.
3) Difficulty to Control
   Takes into account the size of the population, probability of success, side effects of control measures, restoration efforts, and biological control.

After all the 'Top 20' species are ranked, an urgency level of their impact and feasibility of control is assigned in order to determine which species should be addressed first. A 'high' level denotes that a delay in action will result in a large increase in effort required for successful control. A 'medium' level denotes that a delay in action will result in a moderate increase in effort required for successful control. A 'low' level denotes that a delay in action will result in little increase in effort required for successful control.

B. Results and Specific Actions

The most abundant 'Top 20' species found at the Natural Education Reserve (NER) are autumn olive, bull thistle, Canada thistle, phragmites, honeysuckle, purple loosestrife, reed canary grass, and spotted knapweed. Though not considered the 'Top 20', bladder campion, mullein, white sweet clover, and St. John's wort were also very abundant. The NER is 505 acres, yet the number of points with invasive species found was almost three times the number recorded at the 1,310 acre Brown Bridge Quiet Area only 10 miles away. These differences are probably largely due to the proximity to urban landscapes, land uses, and management histories between the natural areas.

The results of the ranking system show that Canada thistle, garlic mustard, Japanese barberry, narrow-leaved cattail, oriental bittersweet, phragmites, and reed canary grass are having the most serious impact and are the most difficult to control of all the invasive plants at the NER (Figure 4). The urgency level of these species is 'high', meaning that a delay in action will result in a large increase in effort required for successful control. Many of these species populations have exploded since the 2007 drawdown of Boardman Pond (Figures 6 & 8, section 3) and are providing a significant seed source for the surrounding area and habitats downriver, particularly Sabin Pond bottomlands.

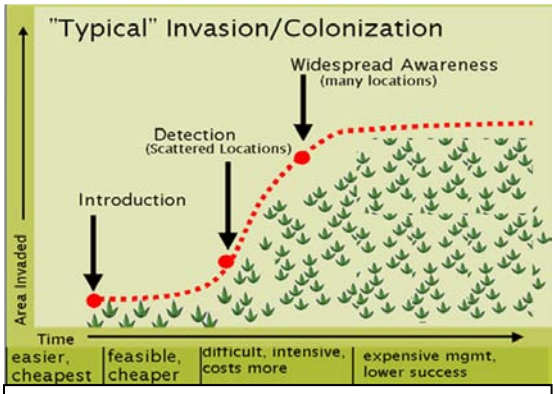
Reed canary grass infestation on the bottomlands of Boardman Pond.

Autumn olive, bull thistle, common buckthorn, European swamp thistle, glossy buckthorn, honeysuckle, leafy spurge, multiflora rose, purple loosestrife, and wild parsnip are having a less serious impact and are easier to control than the others (Figure 4). It's important to note that even through the impact scored lower, these species are still of great concern and considered by partner organizations as one of the highest threats to our highest quality natural areas. Because of this, these species are given an urgency level of 'medium', meaning that a delay in action will result in a moderate increase in effort required for successful control. Spotted knapweed was not ranked using the software since it is not considered one of the 'Top 20'. However, it has similar plant characteristics, habitat requirements, and control efforts to leafy spurge and should also be considered of medium urgency, especially in disturbed areas like the bottomlands.

The other species not included in the ranking system (e.g. bladder campion, forget-me-not, white sweet clover, etc.) are considered of low urgency, meaning that a delay in action will result in little increase in effort required for successful control (Figure 2 & 3). While these species are of the lowest threat, they are mostly found in relatively low population sizes and would be easy to control. Control measures should be explored for these low urgency species once all other higher urgency species are treated.

Volunteers hand pull bull thistle along exposed bottomlands of Boardman Pond.

Since the initial drawdown in 2007, the exposed bottomlands have been filling in with both native and non-native plants. A few work bees have occurred around the bottomlands of the pond to minimize the size of bull thistle populations. Despite these efforts, populations have continued to grow and the bottomlands are heavily impacted by this and many other invasive plants. In addition to the previous work bee control efforts, in the GTCD hired contractors to chemically treat Canada thistle, phragmites, oriental bittersweet, and reed canary grass along the river and bottomlands of Boardman Pond in late summer 2011. Bull thistle and European swamp thistle were hand pulled. While all three invasive thistles were found on the Boardman Pond bottomlands, Canada thistle was found in the largest patches while bull thistle was more scattered. The bottomlands of both Boardman and Sabin Ponds have the potential to be high quality habitat. Because of the four years of growth on the Boardman bottomlands, populations of invasive plants are larger than other surrounding areas but not unmanageable yet. It is imperative that this treatment work continue on high priority species in order to stop the spread down river to Sabin Pond and also stop the populations from growing larger and therefore costing more to treat down the road.



Rough cost estimate of invasive species control over the course of its colonization.

Regardless of priority level, preventing invasion or reinvasion of invasive species should be stressed over treatment. While there a lot of invasive plants at the NER, for the most part they are in manageable population sizes. It is easiest and most cost effective to control species while their populations are still small. Surveys should be done to detect new infestations of invasive plants. It is recommended that the exposed bottomlands (including upstream of the ponds) be surveyed annually for the high priority invasive plants during the first five years after dam removal and the frequency need reassessed after that time. It is also recommended that the rest of the NER be surveyed at a minimum of every three years, paying special attention to high traffic areas and areas where control efforts have occurred. This frequency will be critical to detect populations of garlic mustard, phragmites, and other high threat species. Trail stewards should be trained to identify certain species (e.g. garlic mustard) that they may see along the trails in order to aid in early detection.

During dam removal, restoration, and other activities, all off-road construction equipment – including track hoes, dozers, high lifts, skid steers, haul trucks, water trucks, mowers, and pick-up trucks if taken off road – should be thoroughly inspected prior to commencement of work. Any equipment with any visible signs of plant material, mud, or other debris that could contain seed or viable plant material from another job should not be allow on site. Equipment should be power washed clean on site at a predetermined location prior to entry into work zones and upon exiting. An example compliance log is provided in Appendix A and is intended for use during project implementation (AMEC, 2011). Access routes and construction laydown areas should try and avoid areas known to contain invasive species whenever possible.

Several invasive plant populations have been noted in locations adjacent to the NER. Currently, GTCD is treating Japanese knotweed in a landscape off Hartman Rd and should continue efforts in order to prevent the spread into surrounding natural areas. In the past few years, garlic mustard has been moving into Grand Traverse County. In the spring of 2012, GTCD staff pulled stands in private property near 3 Mile Road and on Wayne Hill. Additional populations have also been pulled at Hickory Meadows, Hannah Park, Northwestern Michigan College, and in landscaping in central neighborhood. A small population was found in 2011 and 2012 along the Sabin Loop trail of the NER and pulled. A lot of attention has been given to invasive phragmites in the region, especially along Grand Traverse

Bay. Quick response by local organizations and government officials has resulted in successful control efforts even though some smaller treatment still continues. Townships and local organizations (included GTCD) are now focusing on inland populations of phragmites, particularly those within the Forest Lakes Area and along roadsides. Approximately 18 stands of phragmites were found in the NER in 2011. All were located on the bottomlands of Boardman Pond but were relatively small in size (<1,000 ft^2).

Special attention should be given to recreation corridors and disturbed areas as seeds are easily spread through boot and tire treads, animal fur, and boats. These corridors include trails and trailheads, river access points, and utility corridors. With all the changes happening at the NER, land managers should also be careful to direct people to witness these changes from authorized access points, overlooks, and trails. Signs should be placed at trailheads or by unauthorized trails in order to educate the users on the importance of staying in designated areas. The best strategy for invasive plant control and bank stabilization is to establish a healthy and thriving native plant population. If vegetation gets trampled by foot traffic, it will become much harder to establish a native plant community and ward off invasive plants.

The use of herbicides should be minimized whenever possible to limit the effects on non-target organisms. If chemical treatment is determined to be the most feasible and effective method of control, then only chemicals designed for aquatic environments should be used in sensitive areas, both near water and upland. Aquatic herbicides are generally less residual in the soil and therefore have much less chance of impacting non-target species. Figure 9 shows the estimated treatment schedule for 2012 and beyond. The urgency is also noted on the figure. If money is limited, priority should be given to high urgency species.

C. Summary

To protect the Natural Educations Reserve's mission to *'provide safe, enjoyable, quiet recreational experiences and environmental education opportunities while protecting the resource for visitors to the Reserve'* invasive species management is critical. Priority should be giving to the high urgency species, Canada thistle, garlic mustard, Japanese barberry, narrow-leaved cattail, oriental bittersweet, phragmites, and reed canary grass. The newly exposed bottomlands are and will continue to be hot spots for invasive plants and should be monitored regularly and controlled according to urgency level to allow for the establishment of high quality riparian habitat. Catching infestations while they are small is the most cost effective approach beyond prevention.

D. Figures

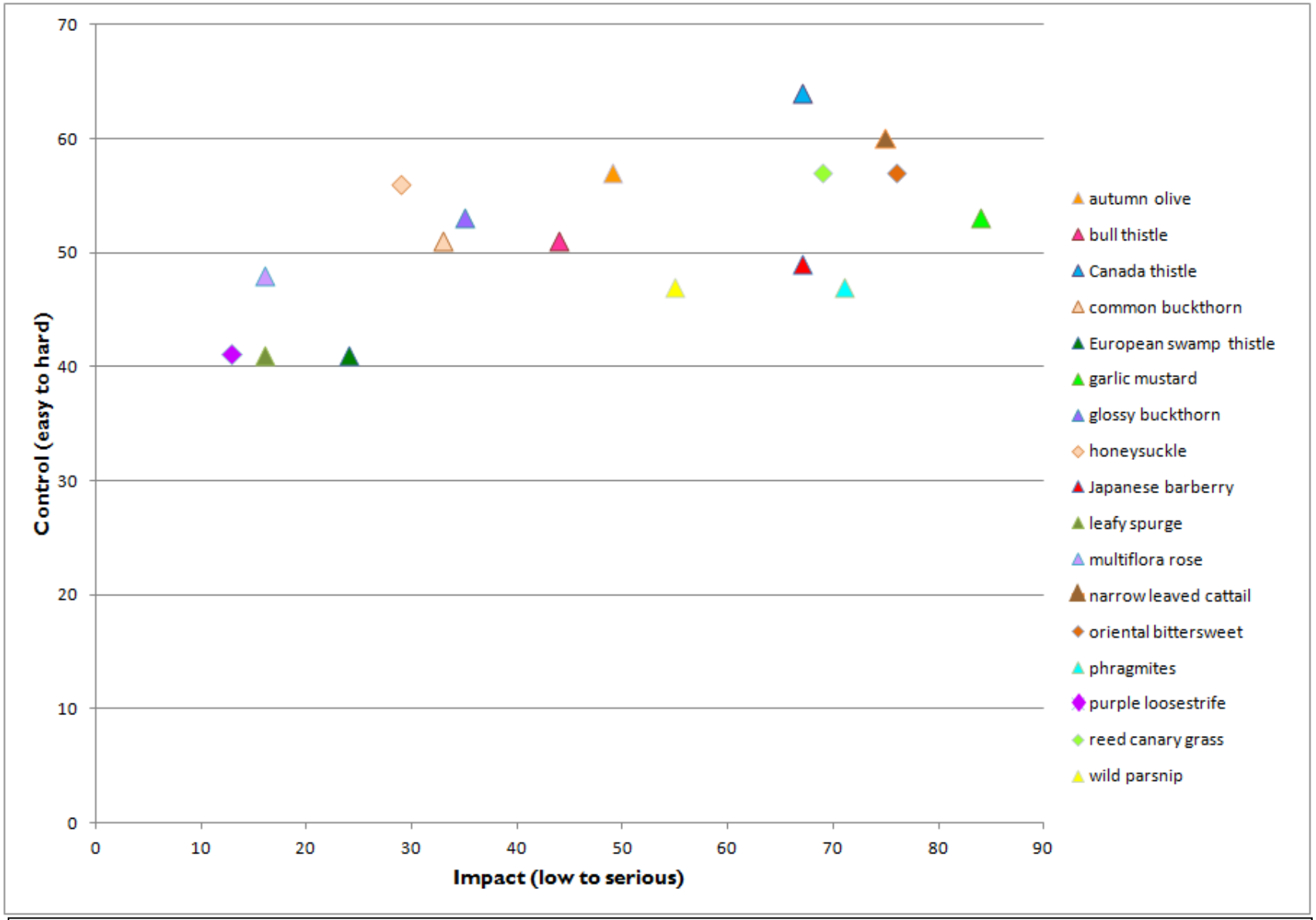
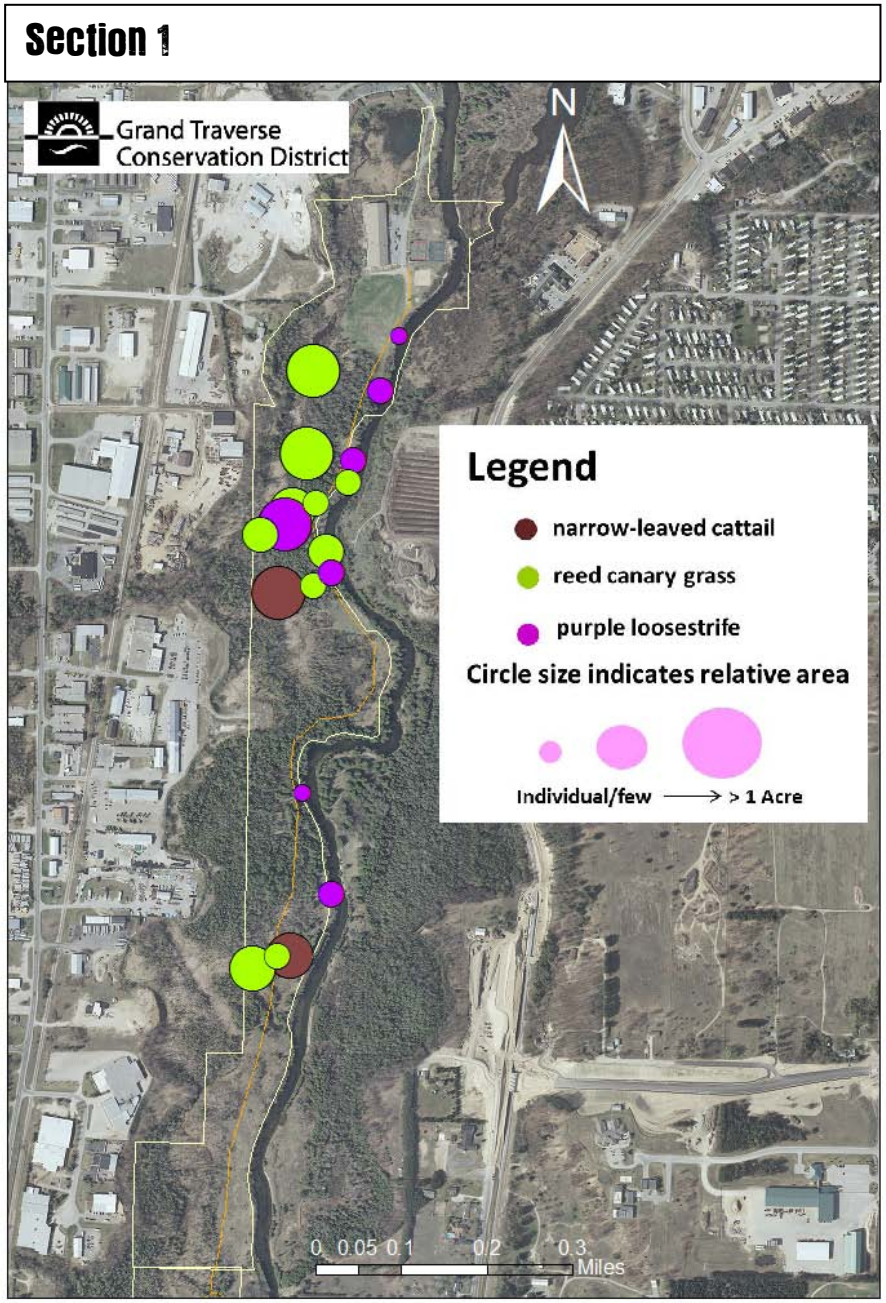


Figure 4. Level of impact vs. ease of control using the Alien Plants Ranking System (APRS, 2000) for the 'Top 20' invasive plants at the Natural Education Reserve, Grand Traverse County, Michigan.



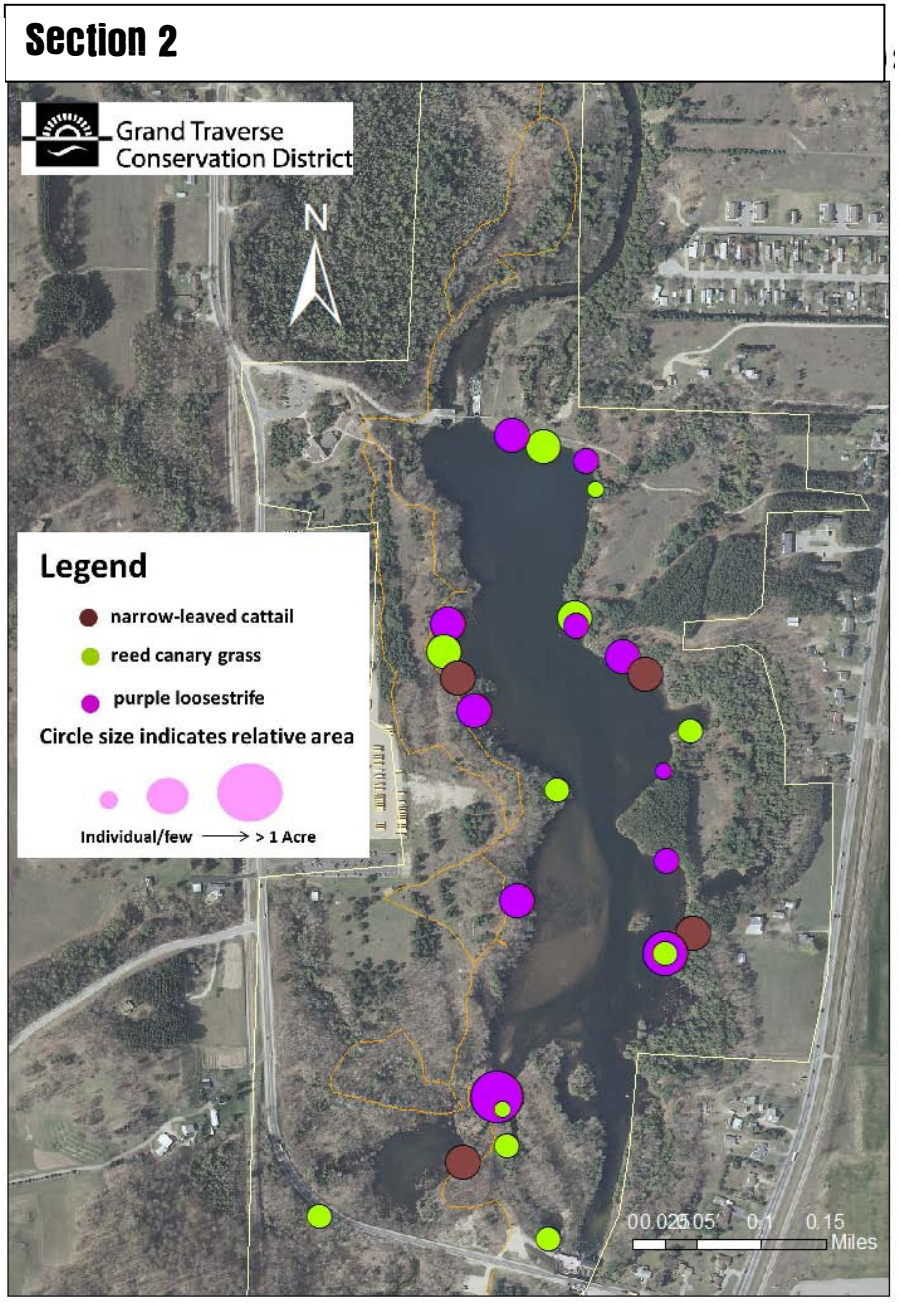
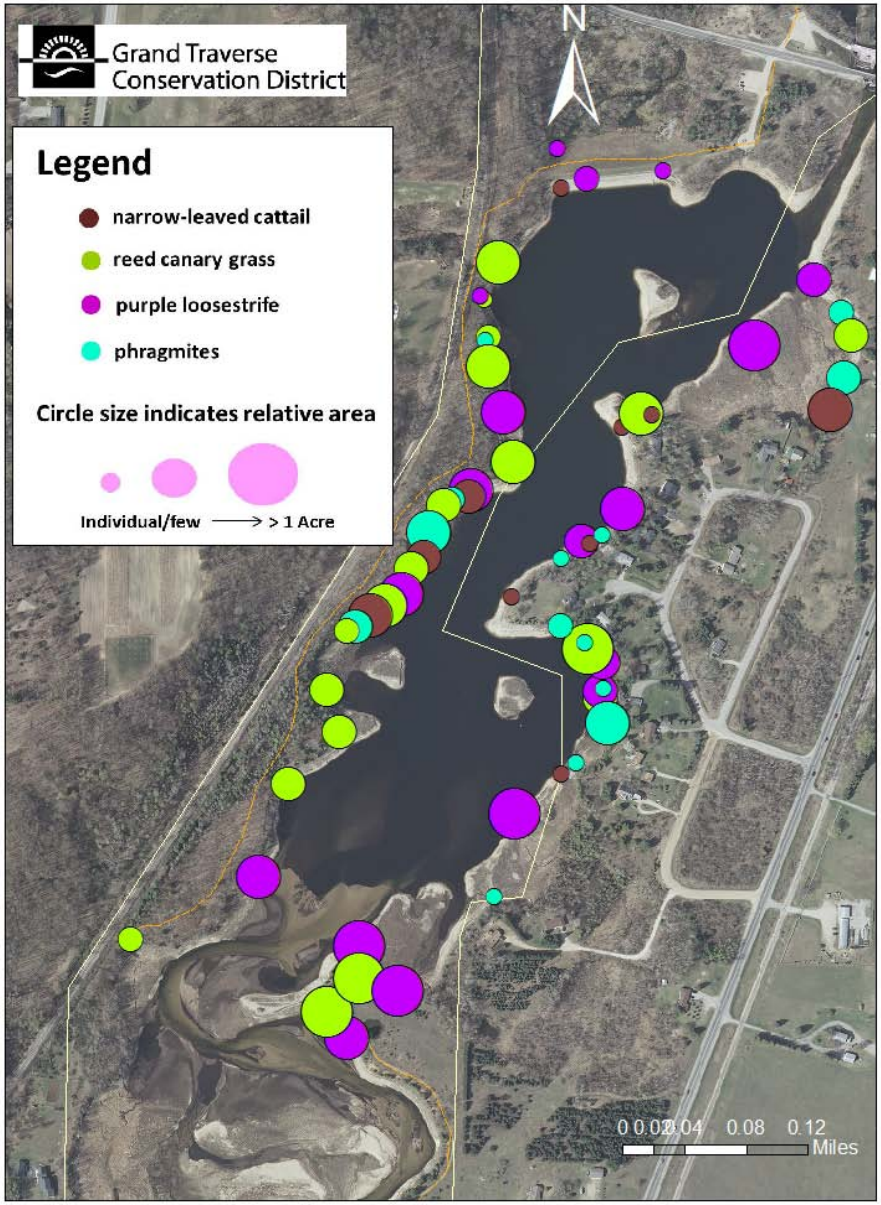


Figure 5. Size estimate of 'Top 20' invasive wetland species found in section 1 and 2 during the 2011 invasive plant survey for the Natural Education Reserve.

Section 3



Section 4

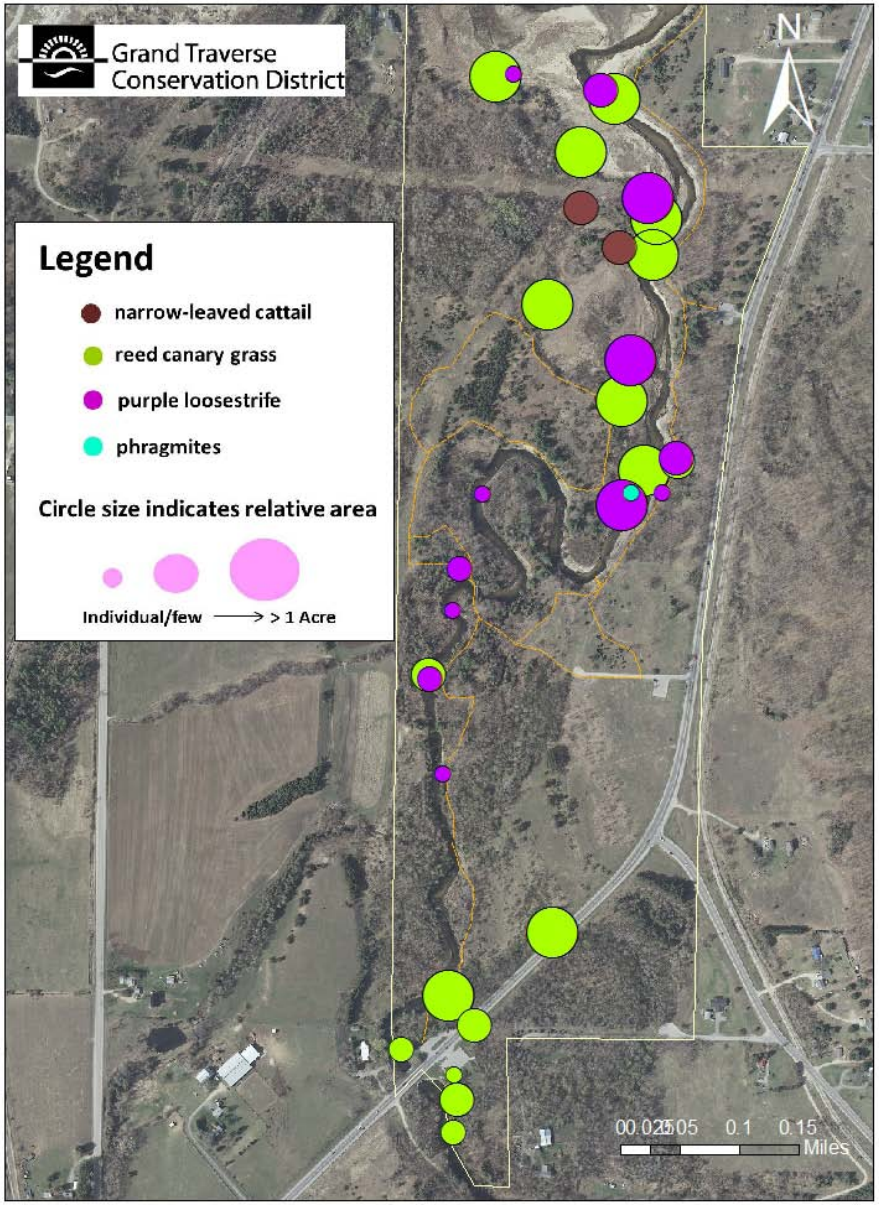
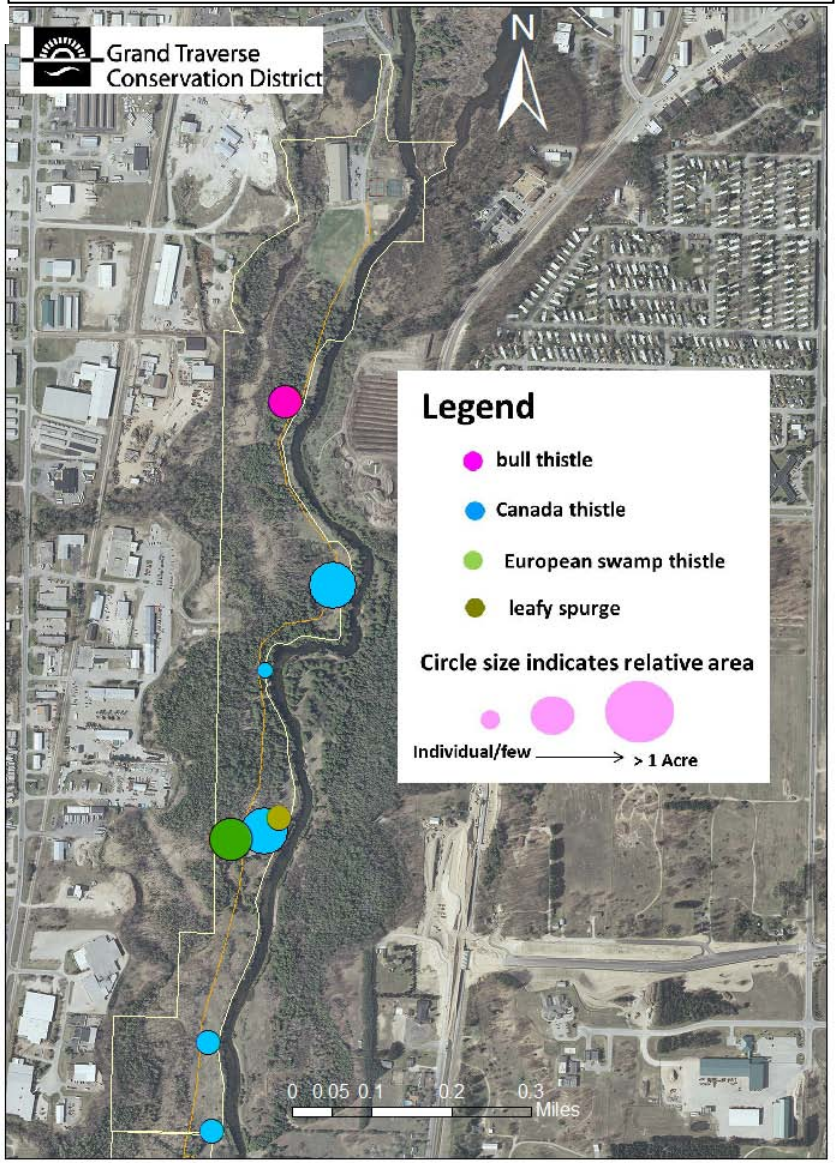


Figure 6. Size estimate of 'Top 20' invasive wetland species found in section 3 and 4 during the 2011 invasive plant survey for the Natural Education Reserve.

Section 1



Section 2

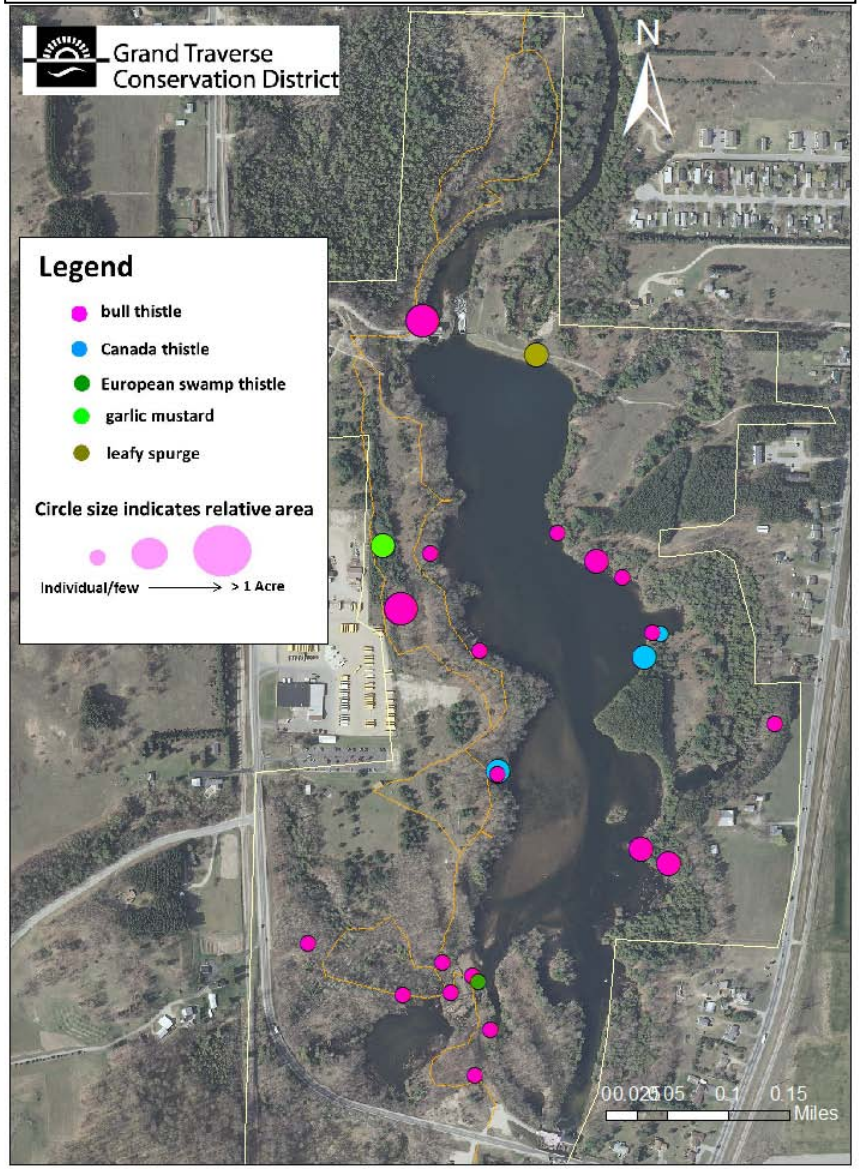
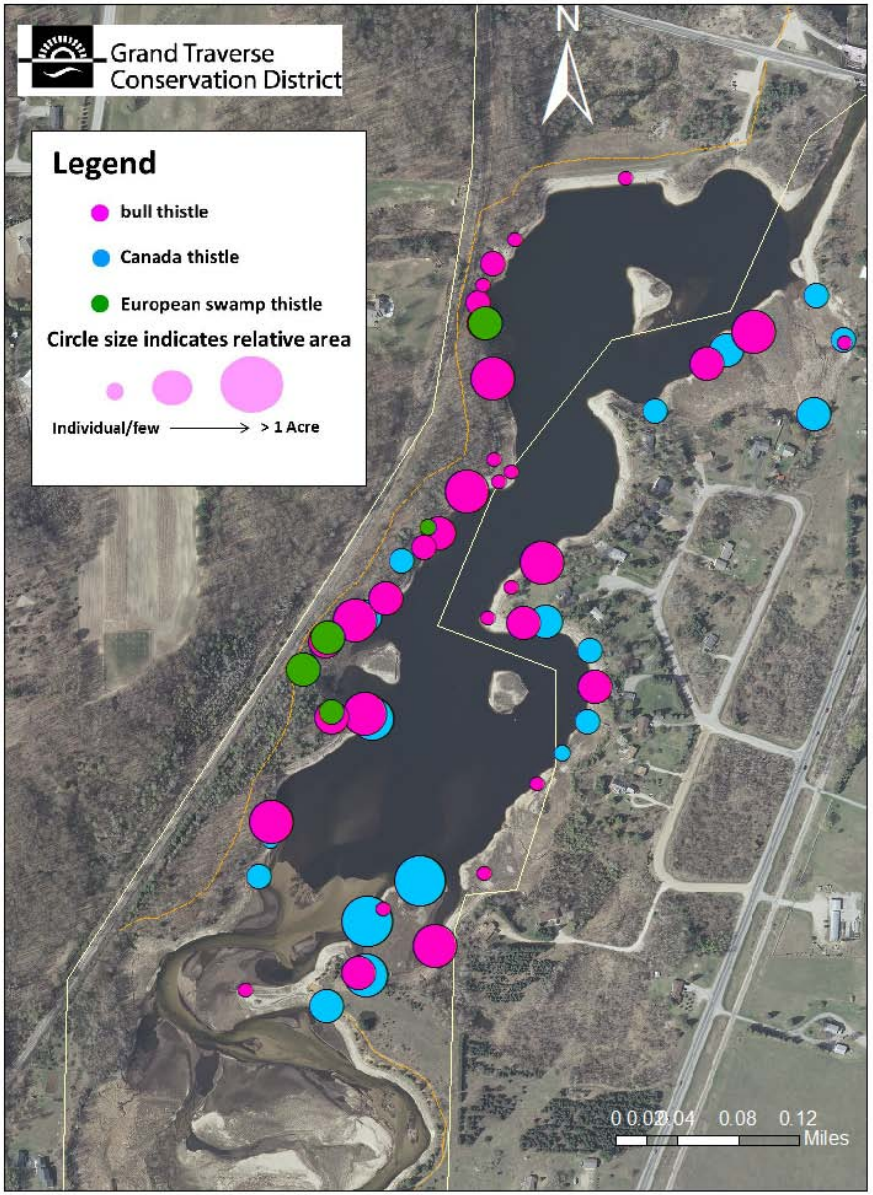


Figure 7. Size estimate of 'Top 20' invasive herbaceous species found in section 1 and 2 during the 2011 invasive plant survey for the Natural Education Reserve.

Section 3



Section 4

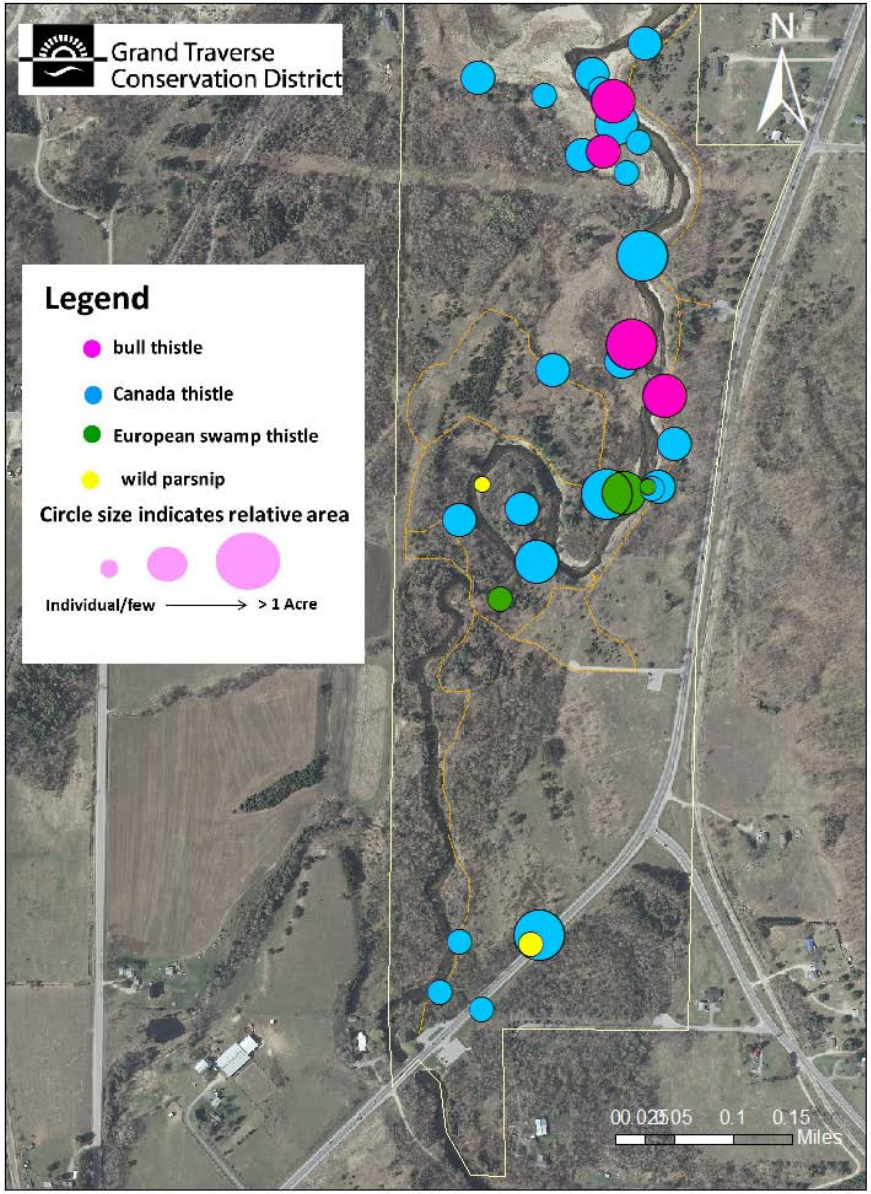
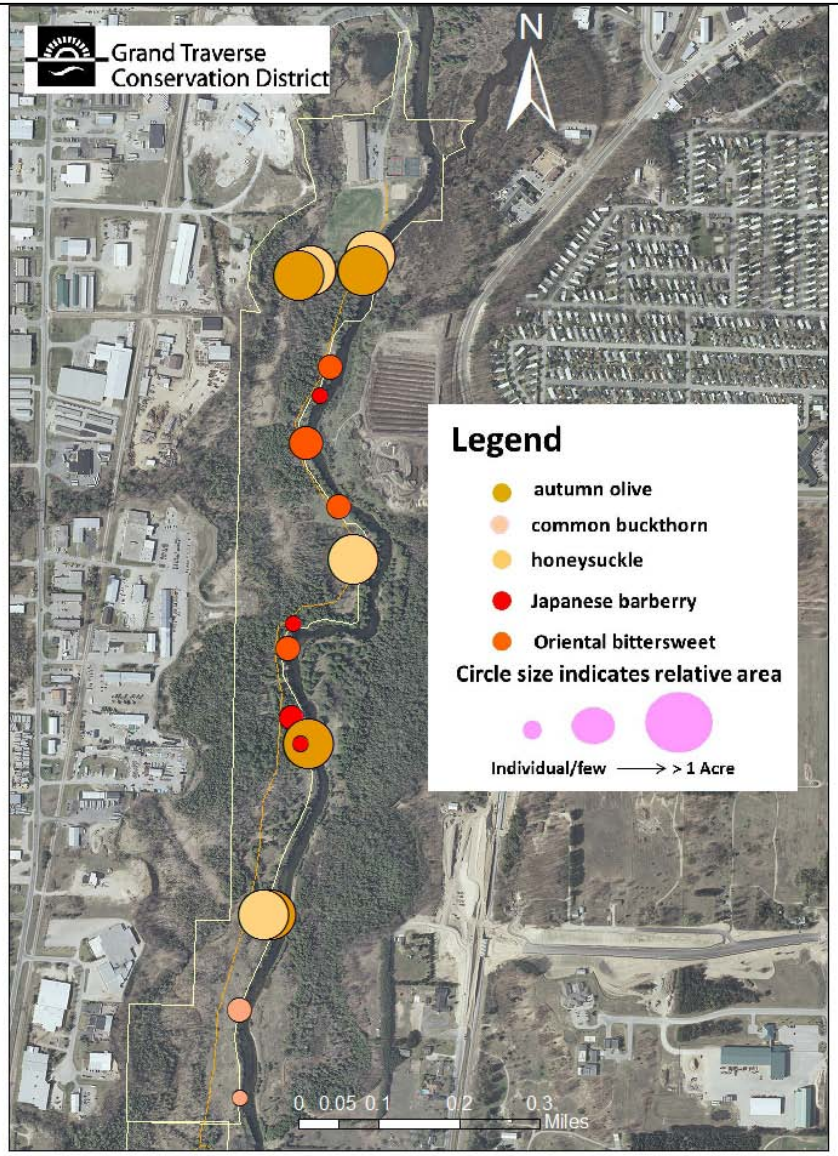


Figure 8. Size estimate of 'Top 20' invasive herbaceous species found in section 3 and 4 during the 2011 invasive plant survey for the Natural Education Reserve.

Section 1



Section 2

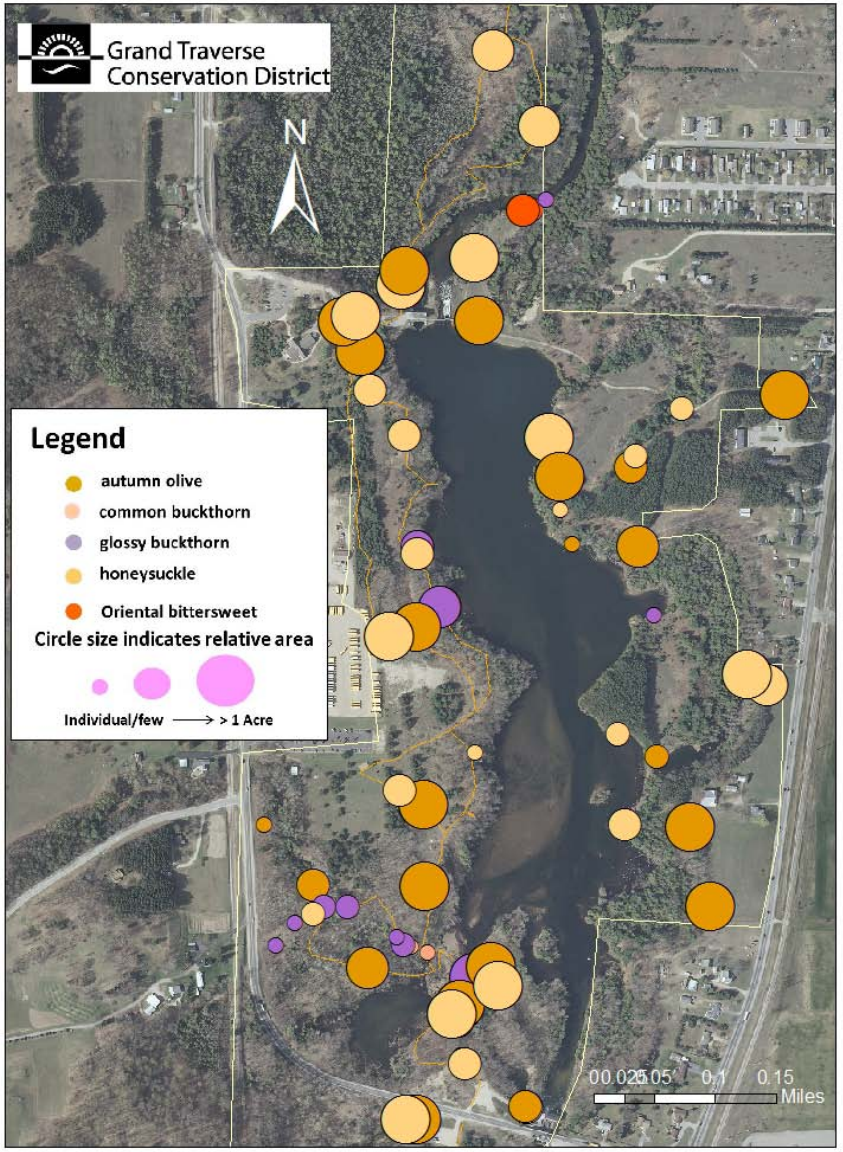
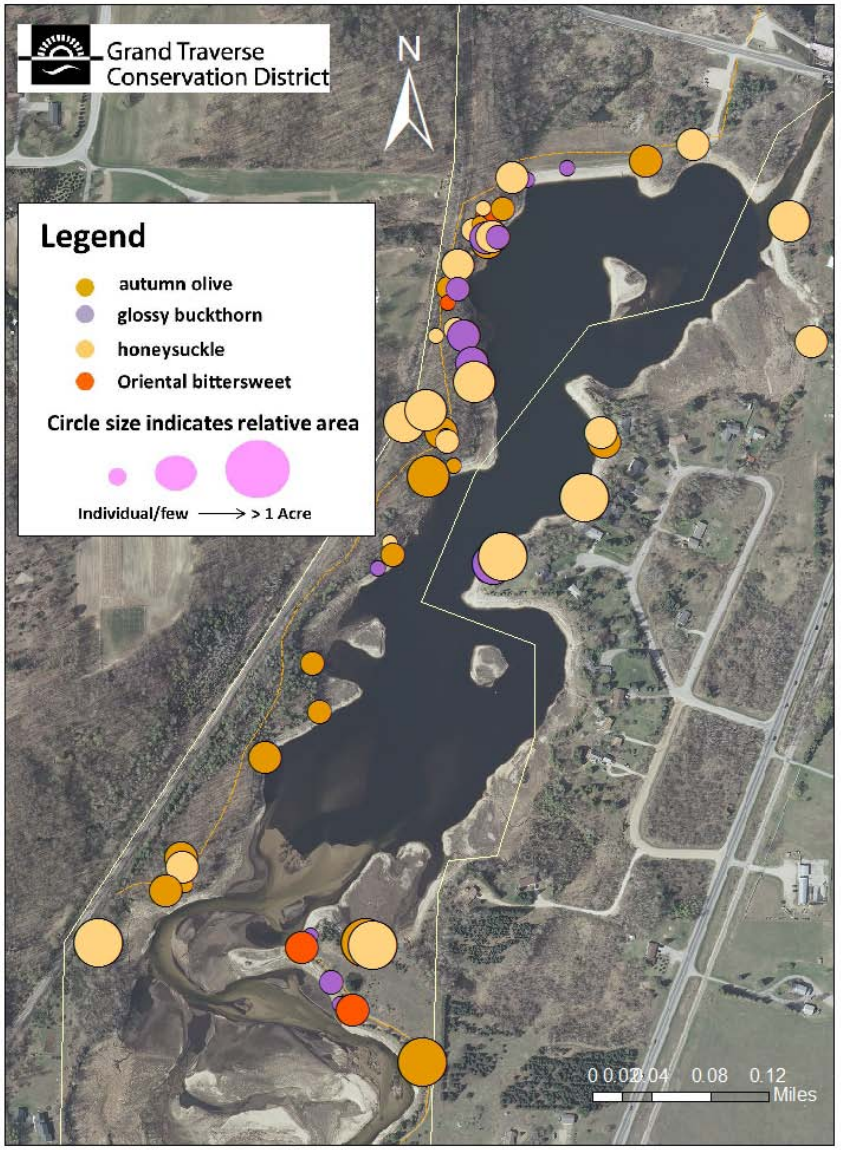


Figure 9. Size estimate of 'Top 20' invasive woody species found in section 1 and 2 during the 2011 invasive plant survey for the Natural Education Reserve.

Section 3



Section 4

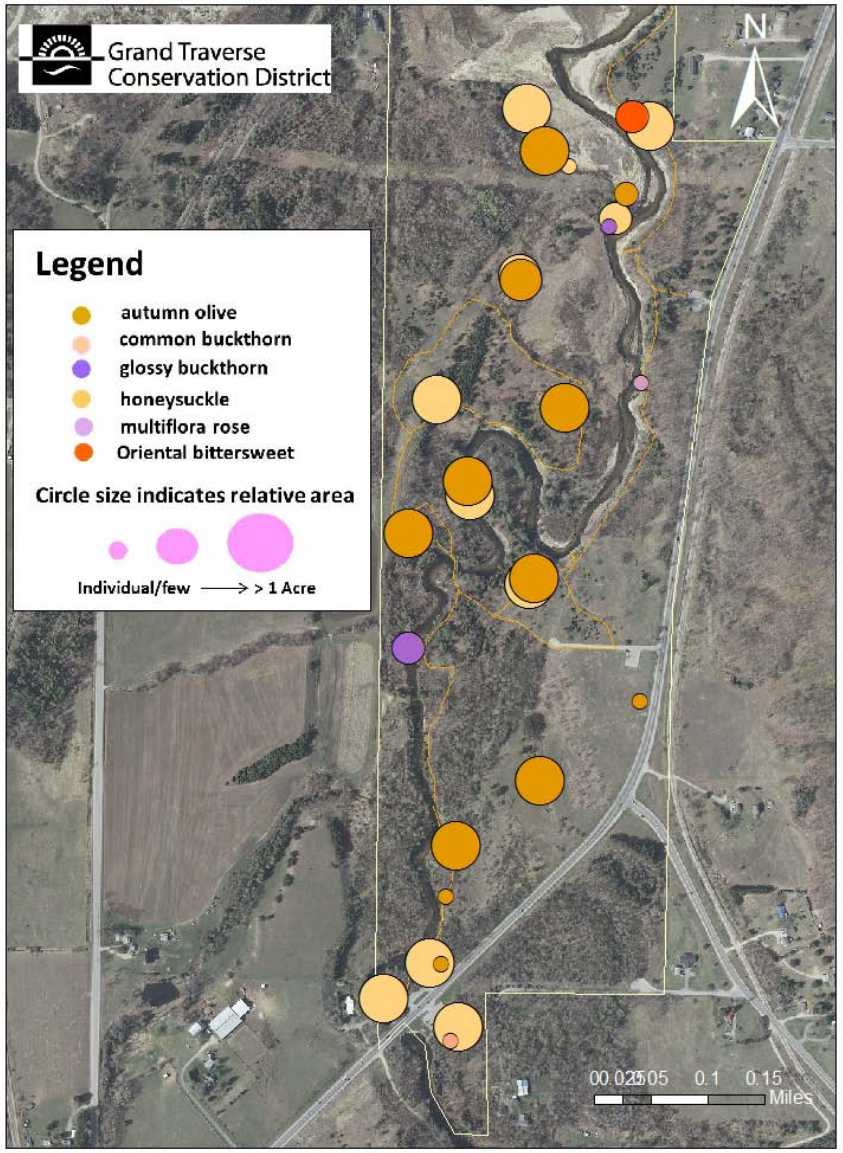


Figure 10. Size estimate of 'Top 20' invasive woody species found in section 3 and 4 during the 2011 invasive plant survey for the Natural Education Reserve.

Figure 11. Estimated treatment schedule at the Natural Education Reserve for 2012 and beyond based on species prioritization.

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Appendix 1.
Compliance Log

Boardman River Dams Removal Project

Invasive Species Management Compliance Log

Site Location:	**Date**:
Contractor Name:	**Personnel:**

Equipment Name/ID #:

Equipment Incoming: ☐ **Equipment Outgoing:** ☐

Location of Equipment's Last Use:

Equipment Type:

Scraper	☐	*Pick Up Truck	☐
Track Hoe	☐	Boat	☐
Back Hoe	☐	Tractor	☐
Skid Steer	☐	Seed Drill	☐
Dozer	☐	Mower	☐
Haul Truck	☐	ATV/Utility Vehicle	☐

Other ☐ Specify: _____

*Required if taken off-road

Equipment Decon Method:

Power Wash with Cold Water: ☐ Power Wash with Hot Water: ☐

Comments: