

**INVASIVE SPECIES CONTROL PLAN
AND
WETLAND BUFFER MAINTENANCE PLAN**

for

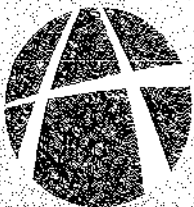
**ARBOR HILLS
CONDOMINIUM ASSOCIATION**

in

**Ann Arbor, Washtenaw County, Michigan
(T02S R06E Section 11)**

Atwell, LLC Project No. 08004831

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www.atwell-group.com
866.350.4200

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1.0 INTRODUCTION

Atwell, LLC (Atwell) was contracted by Arbor Hills Condominium Association in October 2010 to prepare an Invasive Species Control Plan and a Wetland Buffer Maintenance Plan to aid in the management of existing natural areas surrounding the low impact design of Arbor Hills Condominium development located west of M-23 and south of M-14 in the city of Ann Arbor, Washtenaw County, Michigan (T02S, R06E, Section 11). A *Site Location Map* is included in **Appendix I**.

The Invasive Species Control Plan and a Wetland Buffer Maintenance Plan (Natural Areas Management Plan) presented herein includes an Invasive Species Control Plan as well as an overall Wetland Buffer Maintenance Plan formulated to address existing conditions of natural wetlands, wetlands used for storm water retention (storm water retention basins), and the mitigated wetland located within the Arbor Hills Condominium development. This Natural Areas Management Plan will address recommendations presented in Atwell's Ecological Assessment dated February 3, 2010; evaluate additional management options regarding control of invasive species as well as maintenance and/or enhancement of wetland buffer areas; and re-assess current conditions based on the site visit conducted on October 29 for the purposes of drafting the Management Plan.

This Natural Areas Management Plan will provide an overview of invasive species observed within the natural areas the Arbor Hills Condominium development; identify specific locations within the natural areas assessed in January 2010 where treatment for specific invasive species may be necessary; discuss treatment options; and discuss potential planting or seeding plans. In addition, this Management Plan will discuss potential maintenance and enhancement of wetland buffer areas.

1.1 Summary of Ecological Assessment

The Ecological Assessment conducted in January of 2010 identified, classified, and assessed 10 wetland communities within the Arbor Hills Condominium development using the Michigan Rapid Assessment Method (MiRAM). The MiRAM is a rating system developed by the Michigan Department of Natural Resources and Environment (DNRE) designed to indicate a wetland's ecological conditions (integrity) and its potential to provide ecological and societal services (functions and values).

Three existing wetlands are currently used as storm water retention basins; six existing wetlands are natural systems; and one remaining natural wetland is part of the mitigated wetland system and utilized as a storm water retention basin. Based on the MiRAM scores obtained in January 2010, Atwell estimated that six of the 10 wetlands within the Arbor Hills Condominium development are in good ecological condition and considered medium to high quality. Of the remaining four, two are low quality and two are considered degraded but with good potential for improving their quality. Refer to *MiRAM Score Results and Categorization (January 2010)* in **Appendix II**.

1.2 Invasive Species

Invasive plants are introduced species that can thrive in areas beyond their natural range of dispersal. These plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor combined with a lack of natural enemies often leads to outbreak populations (U.S. Department of Agriculture). Some of the anthropogenic disturbances of urbanized regions may promote the invasion of exotic plant species (Ehrenfeld, 2008). Wetland systems within urbanized regions are affected by the adjacent land use, road density, and human population density. In urbanized regions, processes that could favor invasion include nutrient and pollutant input, decreased buffers, fragmentation, and ornamental plant propagation (Ehrenfeld, 2008).

The following invasive species are commonly found in urbanized wetland and upland ecosystems in the Midwest. The species listed below were located within some of the wetlands and/or buffers within the Arbor Hills Condominium development. Refer to the *Wetland and Invasive Species Location Map* in **Appendix I**.

1.2.1 Common Reed (Phragmites australis)

Common reed or Phragmites, is a tall, perennial grass that can grow to over 15 feet in height. Leaves are elongate and typically 1-1.5 inches wide at their widest point. Flowers form bushy panicles in late July and August and are usually purple or golden in color. Below ground, common reed forms a dense network of roots and rhizomes which can go down several feet in depth. The plant spreads horizontally by sending out rhizome runners which can grow 10 or more feet in a single growing season if conditions are optimal (Saltonstall, 2005). In Michigan, common reed is found growing in coastal and interior marshes, bogs, fens, swamps, lake margins, roadside ditches and other low wet areas. This species typically prefers the wetland-upland interface, though it can be found in dry uplands (Michigan Department of Natural Resources and Environment). This is a Facultative Wetland (FACW+) species.

1.2.2 Purple Loosestrife (Lythrum salicaria)

Purple Loosestrife is a perennial herbaceous plant that can grow from 4-10 feet tall. Leaves are lance shaped, attached in opposite pairs to a square or five sided stem. Flowers are pink to purple flowers with 5 to 6 petals surrounding a yellow center. This plant flowers from June to September and reproduces vegetatively through underground stems and germinates at high densities (Swearingen, 2005) (Marshall & Storer, 2002). This plant is most commonly found in wetlands, along streams and river banks, and in ditches or other wet disturbed wet soil areas (Marshall & Storer, 2002). This is an Obligate Wetland (OBL) species.

1.2.3 Common Buckthorn (Rhamnus cathartica)

Common buckthorn grows to a height of 20 feet with a spreading, irregular crown. The bark is rough gray/brown. The 3/8 inch glossy black fruit is borne in dense clusters at twig axils. Twigs have sub-opposite buds and a notable spine at tip. Leaves are elliptic, finely toothed, pointed and glossy dark green. Two strong diagnostic characteristics of buckthorn are the prolific berry clusters and leaves that stay dark green on the tree well into winter, long after natives have turned color and shed their leaves (Dziuk, 1998). Fruits ripen in August and September (Minnesota Department of Natural Resources). This species occurs in a large range of upland habitats. This is a Facultative Upland (FACU) species.

1.2.4 Glossy Buckthorn (Rhamnus fragula)

Glossy buckthorn grows to 18 feet in height, but is usually 10–12 feet tall and 8–12 feet wide. The bark is gray with prominent vertical lenticels; short lateral branches that end in thorns are often present. Leaves are alternate, oblong in shape, and 1-3 inches long with wavy margins but smooth rather than toothed (Rhoads & Block, 2004). This shrub produces small clusters of berry-like, 1/4" fruit that ripens progressively from a distinctive red-brown to a dark purple in August and September (Minnesota Department of Natural Resources). Glossy buckthorn often forms thick, even-aged thickets that exclude other shrubs and herbaceous species because of the dense shade created (Rhoads & Block, 2004). This species occurs in wetlands but it is also found in forests, old fields, and prairies. This is a Facultative (FAC+) species.

1.2.5 Exotic Bush Honeysuckle (Lonicera spp.)

There are several species of bush honeysuckle that cause most invasive problems including Amur, Morrow's, Pretty, Standish and Tartarian, which are commonly referred to as bush honeysuckles or *Lonicera spp.* Exotic bush honeysuckles are upright, generally deciduous shrubs that range from 6 to 15 feet in height. The 1-2 ½ inch, egg-shaped leaves are opposite along the stem and short-stalked. Older stems are often hollow. Pairs of fragrant, tubular flowers less than an inch long are borne along the stem in the leaf axils. Flower color varies from creamy white to pink or crimson. Flowering generally occurs from early to late spring, but varies for each species and cultivar. The fruits are red to orange, many-seeded berries. Native bush honeysuckles may be confused with these exotic species and cultivars, so proper identification is necessary (Williams, 2005). This species can form a dense shrub layer that alters habitats by decreasing light availability and depleting soil moisture. In addition, fruits of exotic bush honeysuckles are high in carbohydrates but lack the high-fat and nutrient-rich characteristics that migrating birds require (Williams, 2005). This is FACU species.

2.0 EXISTING CONDITIONS

2.1 Natural Areas

Existing Wetland A: This wetland area is located to the north of Ashburn road within Bayswater Green Commons. This is a small (less than three acre) forested (FO) wetland with scattered scrub-shrub (SS) wetland areas.

Existing Wetland B: This wetland is located to the east of wetland A, within Alwyeh Green Commons. This is a very small (less than ¼ acre) FO wetland.

Existing Wetlands C and D: Both wetlands are adjacent to US-23 and very small (less than ¼ acres). Wetland C is a FO, and Wetland D is a SS.

Existing Wetlands G and J: Both wetlands are adjacent to US-23. Wetland G is a very small (less than ¼ acre) emergent (EM) and SS wetland. Wetland J is a small (less than 3 acres) EM system.

Existing Wetland E: This wetland is located to the north of Alwyeh commons. This is a medium size (3 to 10 acres) FO and SS wetland with some emergent vegetation.

Existing Wetland F: This wetland is located within Ashburham Green Commons and includes a portion of Kilburn Park #1. This is a medium size (3 to 10 acres) FO and SS.

Existing Wetland H: This wetland is located in the northernmost section of AHCA within Lochaven Green Commons. This is a medium size (3 to 10 acres) EM with significant amount of open water.

Wetland I: This wetland is located in proximity to Kilburn Park #2. This mitigated wetland consists of four basins (one natural and three constructed wetlands) that make up an EM and a FO system.

2.2 Invasive Species Inventory

2.2.1 Common Reed

Notable densities of common reed were observed in Wetlands G, I, and J. Common reed was the dominant species in Wetlands G and J. The presence of common reed within wetland I appeared to be localized. In addition, a dense stand of common reed was observed in close vicinity of residences north of Wetland E (e.g., unit 193).

2.2.2 Purple Loosestrife

Purple loosestrife was observed in Wetlands E, F, G, H, and I. Establishment of this species did not appear to be in high densities.

2.2.3 Common Buckthorn

Common Buckthorn was observed in Wetland A, B, F, H, I, and D. Establishment of this species is high within these wetlands. The buffers of Wetlands F and H appear to exhibit the highest densities of this species. This species was common next to the sidewalk near Wetland A.

2.2.4 Glossy Buckthorn

Glossy Buckthorn was observed in Wetlands A, B, F, H, and J. Establishment of this species is moderate to high within these wetlands.

2.2.5 Exotic Bush Honeysuckle

Exotic bush honeysuckle were observed in high densities within the buffer of Wetland H and A. Other locations with smaller densities of this species or smaller inconspicuous specimens could also be located near Wetland F.

3.0 INVASIVE SPECIES MANAGEMENT METHODS

3.1 Chemical Control (Herbicides)

3.1.1 Common Reed

Two broad-spectrum (e.g., non-selective) herbicides, Glyphosate and Imazapyr are commercially available and known to control common reed effectively when used properly. Numerous methods may be used to apply these herbicides depending on the size of the common reed stand and existing site conditions (Michigan Department of Natural Resources and Environment).

Refer to the *Table 1. Herbicide Application Information* of the DNRE's Guide to the Control and Management of Invasive Phragmites **Appendix III**.

Herbicides are best applied in late summer/early fall after the plant has flowered either as a cut stump treatment or as a foliar spray. It is often necessary to do repeated treatments for several years to prevent any surviving rhizomes from re-sprouting (Saltonstall, 2005).

3.1.2 Purple Loosestrife

Herbicide can be used to spot treat small infestations of purple loosestrife. Spot treatment with a glyphosate type herbicide (e.g., Rodeo® for wetlands, Roundup® for uplands) is recommended for older plants. These herbicides may be most effective when applied late in the season when plants are preparing for dormancy. However, it may be best to do a mid-summer and a late season treatment, to reduce the amount of seed produced (Swearingen, 2005). Mid-summer through early fall (July 1-September 1) is effective because the plants are identifiable (Minnesota Department of Natural Resources). Herbicide can be applied to the ¼ or ½ of the leaf areas of each plant, a brief squirt may be sufficient (Minnesota Department of Natural Resources). These types of herbicides are non-selective and will kill most vegetation it contacts (Michigan Sea Grant).

3.1.3 Common Buckthorn and Glossy Buckthorn

Buckthorn management is labor intensive and effective control is difficult without some herbicide usage. Control strategies can include one or more of the following: cut stump treatments, basal bark treatments, foliar treatments, fire, crown removal, and mechanical removal (Dziuk, 1998).

Cutting followed by treatment of the stumps (e.g. cut stump) with glyphosate or triclopyr has proven effective either during the growing season or on mild days in the winter. Cutting alone results in vigorous sprouting from the stumps. Foliar applications of glyphosate can be made in the fall when many native species have become dormant but buckthorn is still actively growing (Rhoads & Block, 2004). Basal bark treatment is the application of a chemical to the lower bark of the tree (Dziuk, 1998) and works best on stems less than 2-3 inches in diameter (Minnesota Department of Natural Resources).

The best time to cut and chemically treat the stump is in late summer and throughout the fall (Minnesota Department of Natural Resources, 2010) but effectiveness of treatment of cut stumps during winter has also been reported (Wieseler, 2005). Refer to the *Table 2. Herbicides to Control Buckthorn* provided by the Minnesota Department of Natural Resources **Appendix III**.

3.1.4 Exotic Bush Honeysuckle

Chemical methods are one of the primary means of control of this species. Seedlings of exotic bush honeysuckles can be controlled by application of a systemic herbicide, like glyphosate (e.g., Roundup®), at a 1% solution, sprayed onto the foliage or applied by sponge (Williams, 2005); which should be done in fall when native species are dormant and bush honeysuckle is still green (IPSAWP, 2006). Well established stands of exotic bush honeysuckles are probably best managed by cutting the stems to ground level and painting or spraying the stumps with a slightly higher rate of glyphosate (2-3%) (Williams, 2005).

3.2 Mechanical Control

3.2.1 Common Reed

Mechanical control of common reed includes the use of weed whips, small mowers, brush hogs, and flair mowers or hand cutting of stems, and seed heads (Michigan Department of Natural Resources and Environment).

Mechanical treatments are most effective following an herbicide treatment to remove dead stems and promote native plant growth (Michigan Department of Natural Resources and Environment). This type of control may be effective at slowing the spread of established stands but is unlikely to kill the plant. Excavation of sediments may also be effective at control but if small fragments of root are left in the soil, they may lead to reestablishment (Saltonstall, 2005).

Prescribed burning after the plant has flowered, either alone or in combination with herbicide treatment, may also be effective. Burning after herbicide treatment also reduces standing dead stem and litter biomass which may help to encourage germination of native plants in the following growing season. Plants should not be burned in the spring or summer before flowering as this may stimulate growth (Saltonstall, 2005).

3.2.2 Purple Loosestrife

Small infestations (less than 1 acre) of young purple loosestrife plants and where a few isolated plants exist, removal by hand before seed set is preferable (Swearingen, 2005) (Michigan Sea Grant) (Minnesota Department of Natural Resources, 2010). It is critical to properly handle plant material after it is removed from a location to prevent re-sprout of seeds. Effective methods to handle seed heads include drying and burning plant materials, or placing plants in a close plastic bag in the sun for several days where high heat kills the plant and seeds (Michigan Sea Grant).

3.2.3 Common Buckthorn and Glossy Buckthorn

Hand pulling is effective in small infestations; however, re-sprouting may occur if portions of the roots remain. Repeated cutting can weaken plants, but re-sprouting may continue for some time (Rhoads & Block, 2004). This method can be the most expedient and environmental friendly course of action where plants are sparse (Dziuk, 1998). Larger trees can be readily dug, pulled and chopped out of the ground (Dziuk, 1998). Hand pulling is not practical on heavy colonized acreage (Dziuk, 1998).

Crown removal, an alternative mechanical technique, without chemical treatment temporarily eliminates fruit production; however stumps will re-sprout profusely (Dziuk, 1998).

Uprooting of ½ inch diameter seedlings by hand or up to 1 ½ inch diameter using a weed wrench is effective, but care should be taken to avoid excessive disturbance to the soil, which can release buckthorn seeds stored in the soil (Wieseler, 2005).

3.2.4 Exotic Bush Honeysuckle

Mechanical methods are one of the primary means of control of this species. Hand removal of seedlings or small plants may be useful for light infestations. In shaded forest habitats repeated clippings to ground level, during the growing season, may result in high mortality. Clipping must

be repeated at least once yearly because bush honeysuckles that are cut once and left to grow will often form stands that are more dense and productive than they were prior to cutting (Williams, 2005).

3.3 Biological Control

Biological control involves the use of animals, fungi, or microbial pathogens to control invasive plants (Higman & Campbell, 2009).

3.3.1 Common Reed

At this time no means of biological control are available in the United States for treating common reed infestations (Saltonstall, 2005).

3.3.2 Purple Loosestrife

Biological control is seen as the most effective candidate for effective long term control of large infestations of purple loosestrife. Three species of plant feeding beetles approved by the U.S. Department of Agriculture show promise as biological controls of purple loosestrife. These plant eating insects include a root-mining weevil (*Hylobius transversovittatus*), and two leaf, bud, and stem-feeding beetles (*Galerucella californiensis* and *Galerucella pusilla*) (Swearingen, 2005) (Michigan Sea Grant).

The Purple Loosestrife Project at Michigan State University and Michigan Sea Grant directs concern citizens to the Regional Cooperative Biological Control (CBC) Network to obtain further information and learn how to rear and release beetles in a specific area. The Ann Arbor contact provided is Linda Coughenour (L.coughenour@att.net) (734) 665-0701 (Michigan Sea Grant).

3.3.3 Common Buckthorn and Glossy Buckthorn

No biological control options are currently available for any of the non-native buckthorns (Rhoads & Block, 2004) (Dziuk, 1998).

3.3.4 Exotic Bush Honeysuckle

No biological control agents are currently available for these plants and any potential agents that might be considered would have to be specific to the exotic species (Williams, 2005) given the existence of native species of the same genus.

4.0 INVASIVE SPECIES CONTROL PLAN

An invasive species control plan for the Arbor Hills Condominium development should:

- Formulate general goals for each area targeted for management.
- Prioritize targeted areas in terms of cost/benefits of management activities in the long-term.
- Analyze feasible control methods and establish preferred methods for each specific target area and species.
- Plan implementation of invasive species control activities (schedule activities).
- Analyze projected costs involved in the implementation of management activities.

4.1 Wetland Areas

4.1.1 Common Reed

Common reed established within the Arbor Hills Condominium development (Wetlands G, I, J, and areas north of Wetland E) may be treated utilizing the *DNRE's recommended Management Strategy for low-density stands on wet or dry sites* outlined below (Michigan Department of Natural Resources and Environment):

- a) Treat common reed stands with herbicide early summer or late summer depending upon the type of herbicide used (See *Table 1. Herbicide Application Information* of the DNRE's Guide to the Control and Management of Invasive Phragmites **Appendix III**).
- b) Mechanically treat the site beginning in late summer or fall until prior to spring green-up, or when the ground is frozen for wet sites with hand tools, weed whips, or small mowers where dense stands of common reed are present.
- c) Check site the following growing season for common reed re-growth and spot treat with herbicide if needed.

Common reed is persistent and may recover and begin to re-establish if follow-up management is not implemented (Michigan Department of Natural Resources and Environment). Therefore annual maintenance is necessary for the success of restoration within Wetlands G, I, J, and areas north of Wetland E. Spot treatment with herbicide of these areas to maintain control of common reed and allow establishment of native vegetation is necessary to maintain long-term success. In some cases, native seeds normally present in the soil and may be sufficient to reestablish once common reed is not dominant (Michigan Department of Natural Resources and Environment); however, due to the small size and urban setting of Wetlands G, I, J, and areas north of Wetland E, these areas may benefit from seeding or planting of native species. Refer to *4.1 Proposed Native Species Alternatives*.

4.1.2 Purple Loosestrife

Purple loosestrife established within the Arbor Hills Condominium development (Wetlands E, F, G, H, and I) may be treated by mechanical methods in late June, July, and early August, when it is in flower, plants are easily recognized, and before it goes to seed (Minnesota Department of Natural Resources, 2010).

Regular monitoring for re-establishment of this species within these wetlands is necessary to prevent continued presence and/or increased densities. In the event that greater densities of purple loosestrife are detected, working with the Michigan Sea Grant to explore biological control may be an alternative approach to herbicide use. Planting of native species to replace the plants removed may be a good way to increase interspersions within those areas. Refer to *4.1 Proposed Native Species Alternatives*.

4.1.3 Common Buckthorn and Glossy Buckthorn

Common Buckthorn and Glossy Buckthorn within the Arbor Hills Condominium development (Wetland A, B, F, H, I, and D) may be treated late summer through fall (August-October)

utilizing both mechanical and chemical methods. Refer to the *Table 2. Herbicides to Control Buckthorn* provided by the Minnesota Department of Natural Resources **Appendix III**.

Complete eradication of these species within the Arbor Hills Condominium development may be challenging due to high densities observed within some of the wetlands/buffers and the ability of these plants to spread by wildlife. A potential management goal suitable for these areas may be a gradual replacement of these species with native species by wetland/buffer area, which will provide means of evaluating goals, control methods, and results within each wetland/buffer area prior to continuing with the next one.

4.1.4 Exotic Bush Honeysuckle

Exotic bush honeysuckle within the Arbor Hills Condominium development (Wetland H and A) may be treated best by utilizing both mechanical and chemical methods during late fall (October-November) when native vegetation is dormant and these species are still green. Note that although native bush honeysuckles were not directly observed during the October 29 site visit, they could also be present. Native bush honeysuckles within the Arbor Hills Condominium development could be confused with these exotic species and cultivars, so proper identification is necessary (Williams, 2005) before treatment activities begin.

As with common buckthorn and glossy buckthorn, complete eradication of bush honeysuckle within the Arbor Hills Condominium development may be challenging due to high densities observed within some of the buffers. Similarly, a potential management goal suitable for these areas may be a gradual replacement of these species with native species by buffer area, which will provide means of evaluating goals, control methods, and results within each buffer area prior to continuing with the next one.

4.2 Proposed Native Species Alternatives

Following successful treatment of invasive species located within the Arbor Hills Condominium development planting of native species to replace those removed from the landscape is recommended.

The scale of efforts to replace unwanted species with desirable alternatives; the resources needed to do such activities; and the long-term potential of re-introduction of replaced species should be considered and evaluated prior to any planting or seeding activities. Invasive species were located in both wetlands and upland buffer areas.

Specific planting plans may be developed upon completion of a detailed survey (e.g., landscape plan to scale) of each wetland/upland buffer that received treatment for target species identified in this Natural Areas Management Plan.

Various native plant nurseries provide seed and plant material for restoration and native landscapes. Nurseries offer seed mixes, plugs, whips, or bare roots. Atwell has previously worked with the following native plant nurseries: Alpha Nurseries, Inc. who offers a variety of native trees and shrubs and Nativescape, LLC, who offers seed mixes and plugs. The following chart indicates general plan for specific wetland/buffer areas within the Arbor Hills Condominium development.

Native Species Alternatives			
Wetland / Buffer	Invasive Species	Native Alternative	Comments
G, I, J (and area north of E)	Common Reed	Big Bluestem grass (<i>Andropogon gerardii</i>)	Planting of species indicated here or selected Nativescape emergent wetland seed mix*
		Blue Flag Iris (<i>Iris versicolor</i>) (or similar species)	
		Bluejoint grass (<i>Calamagrostis Canadensis</i>)	
		Bulrushes (<i>Scirpus spp.</i>)	
		Freshwater Cordgrass (<i>Spartina pectinata</i>)	
		*See below for alternative recommendation in Wetland G and J	
E, F, G,H,I	Purple Loosestrife	Marsh Blazing Star (<i>Liatris spicata</i>)	Planting of specific species. Nativescape seed mix in wetland I*
		Common Joe-pyc Weed (<i>Eupatorium maculatum</i>)	
		Fireweed (<i>Epilobium angustifolium</i>)	
		*See below for recommended seeding in wetland I	
A,D,F,G,J, B	Common Buckthorn	Hop-hornbeam (<i>Ostrya virginiana</i>)	Planting (whips or bare roots)
		Wild Crab Apple (<i>Malus coronaria</i>)	
		Witch-hazel (<i>Hamamelis virginiana</i>)	
		Hawthorns (<i>Crataegus spp.</i>)	
	Glossy Buckthorn	Nannyberry (<i>Viburnum lentago</i>)	Planting (whips or bare roots)
		Gray Dogwood (<i>Cornus racemosa</i>)	
		Common Elderberry (<i>Sambucus Canadensis</i>)	
A,H (possibly F)	Exotic Honeysuckle	Highbush Cranberry (<i>Viburnum opulus</i> var. <i>americanum</i>)	Planting (whips or bare roots)
		American Fly Honeysuckle (<i>Lonicera Canadensis</i>)	
		Chokecherry (<i>Prunus virginiana</i> var. <i>virginiana</i>)	

Many plant species can be classify based on their tolerance to road salt. Given the location of Wetlands G and Wetland J, selecting species that are tolerant to salt would be adequate for the conditions of wetlands G and J and would likely increase their restoration success. Nurseries such as Nativescape are able to customize seed mixes that better match site conditions.

Three of the retention basins within Wetland I could potentially be enhanced by professionally installing Nativescape seed mixes designed for wetland edges or stormwater detention basins. Professionally installed Wetland Edge Mix or Detention Basin Mix (applied at 30 or 40 pounds per acre respectively) would be appropriate options. The Detention Basin Mix is preferred because it includes species that will tolerate highly fluctuating water levels and poor water quality associated with urban stormwater wetlands.

4.3 Habitat Structures

Based on the October 2010 site visits, Atwell estimates that the placement of habitat structures for wildlife should not be considered a priority because appropriate cover (dead trees, snags, and stumps) appears to be available. Refer to the *Photographic Log* in **Appendix IV**. Because waterfowl was observed utilizing the open water component of Wetland H, a nest box appropriate for Wood Ducks (*Aix sponsa*) may provide added habitat availability to this species.

5.0 WETLAND BUFFER ASSESSMENT AND MAINTENANCE PLAN

Metric 2 of the MiRAM scoring system evaluates “Buffers and Intensity of the Surrounding Land Use.” Buffer areas possible in an urban setting such as the Arbor Hills Condominium development include: shrubby margins, forested areas, or lightly managed vegetative areas. Non-buffer areas present at the Arbor Hills Condominium development include: roads, road shoulders, houses, impervious surfaces, and mowed lawns.

Wetlands located between uplands and water resources act as agents of water quality control by sediment trapping, chemical detoxification, and nutrient removal when they intercept runoff from land before it reaches open water. Wetlands without upland buffers (i.e. landscape features that protect the biological, physical or chemical integrity of a wetland from surrounding disturbances) or wetlands located in areas of intensive land use are often subject to greater degrees of disturbance and degradation.

The buffer surrounding Wetland A is somewhat narrow due to the presence of residences located to east. However, these areas could be enhanced by controlling the presence of common buckthorn and exotic honeysuckle and replacing these invasive species with native alternatives indicated earlier in this Natural Areas Management Plan. Such activities will promote interspersions (e.g., heterogeneity of the vegetative community that provides ecological complexity).

Wetlands B, C, and D are partially connected to good quality upland scrub/shrub and forested communities that do function as buffers and act as agents of water quality control. Refer to the *Photographic Log* in **Appendix IV**. Wetland D and Wetland C are adjacent to US-23 as well, which limits available buffer. Buffer maintenance activities should focus on monitoring for and treating any establishment of common reed that may initiate in areas between the roadway and the wetland. Controlling for and removing common buckthorn as well as replacing these invasive species with native alternatives indicated earlier in this Natural Areas Management Plan will promote interspersions and enhance Wetland D and Wetland C.

The buffer surrounding Wetland E is of a satisfactory size that functions as an agent of water quality control. Buffer maintenance activities should largely be focused on treating the presence of high densities common reed that was located in the vicinity of residences north of Wetland E (e.g., near unit 193) and prevent their expansion into Wetland E. Professional installation of Nativescape Detention Basin Seed Mix (applied at 40 PLS pounds per acre) may be a suitable option to replace common reed within those areas after treatment. Refer to the *Photographic Log* in **Appendix IV**. Monitoring this buffer for the presence of other invasive upland species (such as common buckthorn and exotic bush honeysuckle) is recommended because common buckthorn and exotic honeysuckle are likely to colonize Wetland E’s buffer due to its proximity to colonized areas.

The buffer surrounding Wetland F is of a satisfactory size that functions as an agent of water quality control. Buffer maintenance activities should largely be focused on eradicating or controlling the presence of common buckthorn, glossy buckthorn, and exotic bush honeysuckle

and replacing these invasive species with native alternatives indicated earlier in this Natural Areas Management Plan.

Buffer enhancement in Wetlands G and J may be limited in terms of size due to their location (e.g., adjacent to US-23 and roadways leading up to residences); therefore, activities should not initially focus in the existing narrow buffer, but in enhancing the wetland areas. These activities should focus in rigorous treatment of common reed, the dominant invasive species observed within both wetlands. Treatment and eradication of this species should be followed by plantings and or seeding of native alternatives indicated earlier in this Natural Areas Management Plan.

The size of the buffer surrounding Wetland H varies; it is narrow in proximity to residences to the north, northeast, south and southwest and widens to the west and northwest. This buffer appears to contain a great density of common buckthorn and exotic honeysuckle. Buffer maintenance activities should focus on eradicating or controlling those species and replacing them with native alternatives indicated earlier in this Natural Areas Management Plan.

An additional enhancement option that could be implemented for certain areas of Wetland's H buffer (east and south east) may be to plan for the establishment of a mesic-to-dry prairie grass and wildflower community. Professional installation of Nativescape's Mesic-to-Dry Prairie Seed Mix (applied at 30 pounds per acre) or the Economy Short Grass Seed Mix or Tall Grass Seed Mix (applied at 50 pounds per acre) would be a suitable option to enhance the habitat within those areas.

The buffer surrounding Wetland I can be considered narrow and limited due to the presence of residences which limit buffer width. Buffer maintenance activities should largely be focused on eradicating the presence of common buckthorn and replacing this species with native alternatives indicated earlier in this Natural Areas Management Plan. Additionally, the best approach for supplementing the natural barrier that this buffer provides to Wetland I in terms of water quality, would be to make reduction runoff from adjacent properties and Kilburn Park #2 a priority. This can be achieved by reducing or eliminating excess fertilizer use on residences' lawns as well as within the park, deterring large flocks of geese from roosting in the park, and promoting the idea of water/runoff capture among residents by means of gardens placed between their lawn and the park's boundaries.

Based on the October 2010 site visits, Atwell estimates that the placement of habitat structures for wildlife in buffer areas should not be considered a priority because appropriate cover appears to be available. Refer to the *Photographic Log* in **Appendix IV**.

6.0 CONCLUSIONS AND RECOMMENDATIONS

In January 2010 Atwell identified, classified, and assessed 10 wetland communities within the Arbor Hills Condominium development. Three existing wetlands are currently used as storm water retention basins; six existing wetlands are natural and not directly impacted by storm water; the remaining natural wetland is part of the mitigated (e.g. constructed) wetland system and therefore also used as a storm water retention basin.

In October 2010 Atwell conducted a site visit to confirm presence of invasive species located during the Ecological Assessment and to identify current locations where invasive species are present. Atwell formulated a Natural Areas Management Plan to address recommendations included in the Ecological Assessment dated February 3, 2010; evaluate additional management options regarding control of invasive species, and to discuss maintenance and/or enhancement of wetland buffer areas within the Arbor Hills Condominium development.

Atwell has provided a general inventory of invasive species within the 10 wetland communities and their associated buffer areas. In addition, a detailed review of invasive species treatment options (e.g., chemical, mechanical, and biological control) including timelines and recommended methods, were also provided.

Atwell recommends formulating goals, setting timetables, and establishing preferred management methods for each species indicated in this plan as well as for each area targeted for management. Based on those sets of goals, schedules and methods, Atwell recommends prioritizing targeted areas in terms of cost/benefits of management activities in the long-term.

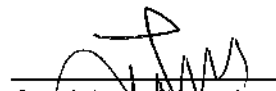
Based on the existing conditions, Atwell recommends focusing initial efforts on controlling purple loosestrife within Wetlands E, F, G, H, and I; controlling common buckthorn and glossy buckthorn within Wetlands A, B, F, H, I, and D; and controlling common reed within Wetlands G, I, J, and areas north of Wetland E. Next, Atwell recommends conducting plantings and/or seeding for these wetlands and their associated buffers as outlined in this Natural Areas Management Plan

Atwell estimates that eradication and control of invasive species within wetland and buffers within the Arbor Hills Condominium development would increase the ecological condition of each wetland. Many of these systems have great potential to provide functions and values that wetland habitats within urban settings are able to provide (e.g., flood and storm water storage, enhancing esthetic value of the community, habitat and/or protection for transient wildlife).

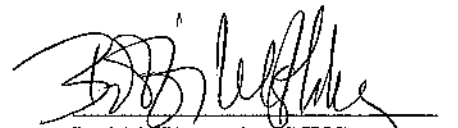
If you have any questions regarding this or any other matter, please feel free to contact our office at (248) 447-2000.

Atwell, LLC Project No. 08004831

This report submitted by:



Guadalupe Cummins
Ecological Specialist
Natural Resources Group



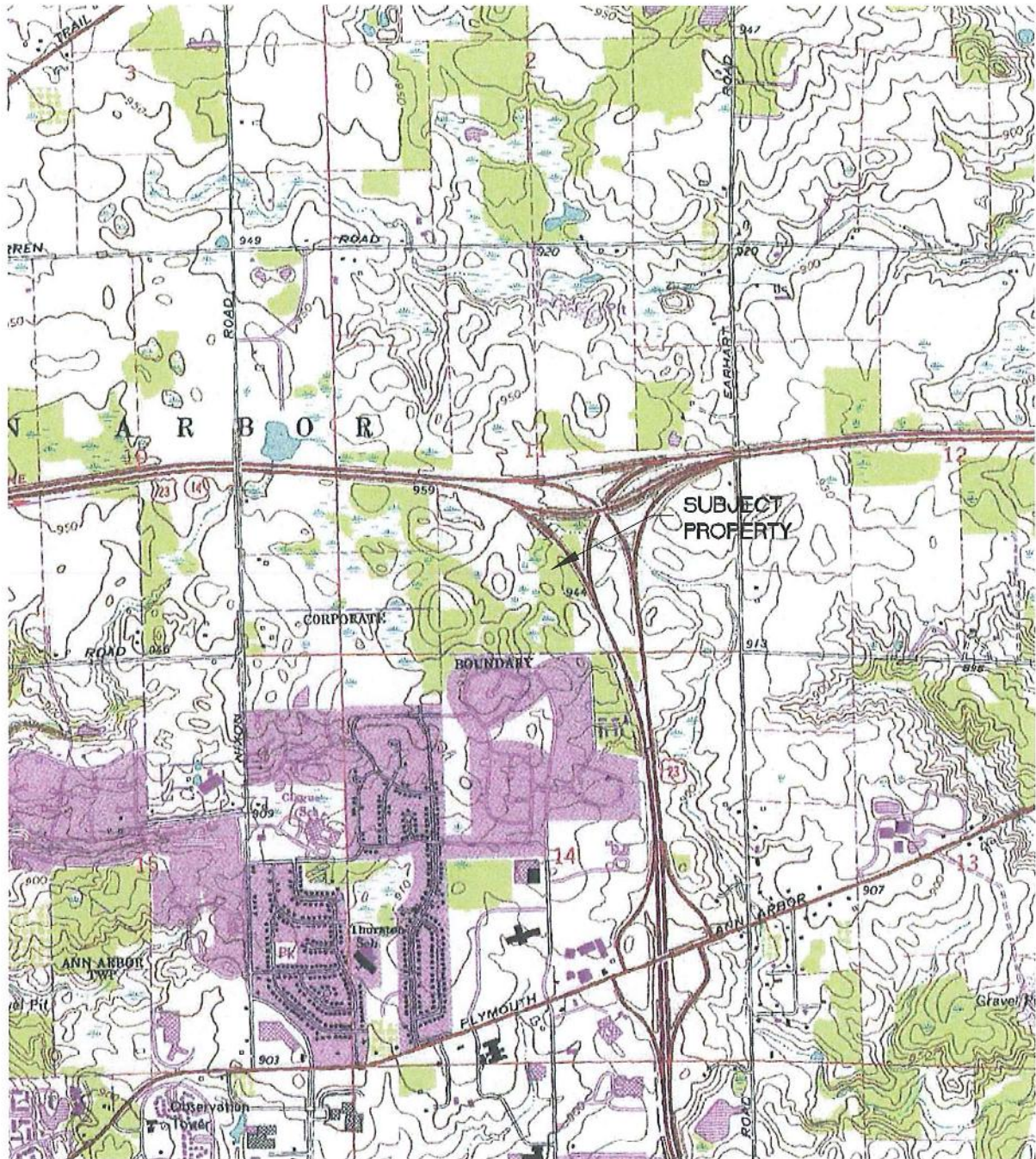
Bobbi Westerby, PWS
Team Leader
Natural Resources Group

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APPENDIX I

Site Location Map
Wetland and Invasive Species Location Map



SITE LOCATION MAP
CITY OF ANN ARBOR
WASHTENAW COUNTY, MICHIGAN

SCALE 0 1000 2000
1" = 2000 FEET

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REFERENCE

USGS 7.5 MIN TOPOGRAPHIC QUADRANGLE
ANN ARBOR EAST, MICHIGAN QUADRANGLE
DATED: 1965, PHOTOREVISED: 1983

T2S R6E SECTION 11

PROJECT: 08004831
DATE: JANUARY 13, 2010
DRAWN: BWT
CHECKED: GC
CAD FILE: 08004831EC-01



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