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CWA Section 404 Wetland Mitigation Plan
Armed Forces Reserve Center
Middletown, CT

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Contents

List of Appendices

List of Figures

A. General Information and Project Description

This Wetland Mitigation Plan (WMP) has been developed by AECOM Environment on behalf of the United States Army (U.S. Army) for the proposed construction of a new Armed Forces Reserve Center (AFRC) and accompanying support facilities as part of the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510) and the ("BRAC Commission") recommendations. To implement the BRAC Commission's recommendations, the U.S. Army proposes to provide necessary facilities to support the changes in force structure and the consolidation of reserve units. The U.S. Army proposes to construct the new facility on the 42-acre Cucia Park property located on Smith Street in Middletown, Connecticut (Figure 1). Middletown is located along I-91 in Middlesex County approximately 20 miles south of Hartford and 25 miles northeast of New Haven, Connecticut within the Lower Connecticut River Watershed. I-91 borders the east side of the site, while the western side of the site consists of Sawmill Brook and its bordering wetlands and floodplains.

The proposed AFRC will provide a five-story, approximately 164,000 square foot (sf) training facility. Associated support facilities include a 34,979 sf (approximate) Organizational Maintenance Shop (OMS) and a 3,886 sf (approximate) storage building. Together, these facilities will support approximately 900 personnel, both reservists and civilians. The relocation and realignment of reserve units to the proposed AFRC would bring approximately 219 unit vehicles, equipment, and materials to the facility. Within the new facility there will be approximately 8.76 acres of paved areas including approximately 3.80 acres of military equipment parking areas and approximately 4.96 acres of privately-owned vehicle parking areas, walkways, and access roads. Under the BRAC law, the U.S. Army must complete all realignments not later than September 15, 2011. Implementation of the Proposed Action would occur over a span of approximately two years with completion of construction occurring sometime in the latter half of 2011.

As a means of avoiding and minimizing the total amount of wetland impacts that would result from the development, numerous steps were taken. The proposed AFRC building was redesigned as a five-story structure instead of a single-story facility in order to reduce the buildings footprint while still providing the space required to meet the U.S. Army's needs. Additionally, the development footprint was pushed as far east towards the Interstate highway and away from Sawmill Brook and its abutting wetland areas as the required Anti-terrorism/Force Protection Requirements allow. The incorporation of retaining walls instead of sloped embankments along the western and southern margins of the Project allowed the development footprint much less encroachment into wetland areas. This alternative site design resulted in wetland impacts reduced from approximately 4 acres to approximately 1.5 acres.

As stated above, the proposed wetland impacts have been avoided to the greatest extent practicable and steps have been taken to ensure that the unavoidable impacts have been minimized. Based upon the site selection process, and the final efforts at wetland impact avoidance and minimization, the New England District Army Corps of Engineers Regulatory Division (Corps Regulatory), as well as the USEPA Region 1, have determined that the proposed development of the Project at the Cucia Park site represents the Least Environmentally Damaging Practicable Alternative (LEDPA). Project construction will result in the unavoidable loss of approximately 1.5 acres of wetlands and mitigation is required for this loss. A combination of measures, both occurring on-site and off-site, has been chosen to provide this mitigation.

The on-site mitigation will include native plantings in close proximity to the wetlands and invasive species management throughout the Project site (Figure 2) area as well as improvements to existing stormwater drainage features. While proposed off-site mitigation will include wetland habitat enhancement, endangered species management and invasive species control, as well as wetland and upland habitat preservation with the implementation of a conservation restriction on the off-site parcel (Figure 3). The off-site location (Boardman Lane Site) was selected based on a watershed approach as depicted in the April 10, 2008 ruling (EPA 40 CFR Part 230) and is located on Boardman Lane in Middletown, CT (latitude 41.578646 and longitude -72.726567), less than 1 mile from the Project site. This property is an 89-acre parcel that includes farm land, forested uplands and wetlands, perennial streams and associated riparian areas. The Army

proposes the acquisition of 40-acres of the Boardman Lane property; the remaining 49-acres will be retained by the current owner. This 40-acre parcel is located along Sawmill Brook just upstream of the Project site (Cucia Park), and is also within the Lower Connecticut River Watershed (USGS hydrologic unit code 01080205). The WMP contains figures showing the locations and design of the mitigation areas. Attached to this plan are 11 by 17" Project and mitigation plans (Appendix C).

A.1 On-site Stormwater Management System

In addition to on-site proposed enhancements plantings and invasive species management significant improvements are proposed to existing stormwater drainage management features at the Project site (Cucia Park) as well as the implementation of state-of-the-art stormwater management measures to control the rate and quality of stormwater runoff from the developed site. The proposed stormwater treatment system is designed to comply with the Energy Independence and Security Act (EISA) of 2007 which dictates the use of Low Impact Development (LID) practices. LID is a stormwater management strategy concerned with maintaining or restoring the natural hydrologic functions of a site. In addition, EPA issued guidance for Green Infrastructure/Low Impact Development (GI/LID) management approaches that should be used when feasible to meet the requirements of EISA. The proposed design incorporates best management practices (BMP's) which enable the project to comply with EISA and where feasible integrate the GI/LID approaches and include:

a. Surface stormwater management basins incorporate best management practices design features pursuant to the Connecticut Stormwater Quality Manual. The three basins include forebays and are sized to detain the 1-inch rainfall event and slowly discharge that volume via low-capacity bottom outlets;

b. The stormwater management system is designed so that the hydrologic characteristics of post-development run-off from the site will mimic pre-development patterns and intensities for a variety of storm events.

c. A de-centralized stormwater management system design concept with four discharge locations is designed to maintain flows to adjacent wetlands areas.

d. Oil-water separators for pavement areas draining to underground detention system.

e. The main parking area is designed to sheet flow to a water quality-type swale to increase flow times (to reduce detention sizing requirements). This also reduces catchbasin and pipeline installation, and promotes infiltration.

f. A new and relocated outlet for a State drainage system is provided to address a current and on-going erosion problem caused by that outlet.

g. The efficient design of the parking driveway near the building entrance provides for a convenient turn-around area without excessive addition of pavement surface.

h. A vegetated (green) roof on a portion of the Training Center will naturally reduce runoff and air conditioning loads.

i. A 40kW photovoltaic (PV) electric generation installation is provided in the Privately Owned Vehicle (POV) parking lot. In addition to providing on-site generation to satisfy a portion of the electric demand of the project, the PV panel array provides shade for the pavement and cars parked below it.

j. A domestic solar hot-water system is provided on the Training Center roof to provide a portion of the hot-water supplied for the building occupants.

k. Landscape material selection includes native species that do not require irrigation.

l. Floor trench drains at the overhead doors for the maintenance shop which discharge to the sanitary sewer.

m. A vehicle wash bay which discharges to the sanitary sewer

The GI/LID management approaches and design elements incorporated into the Project to increase the Project compliance with the spirit and intent of the EISA and include:

a. Rain gardens, bio-retention, and infiltration planters
b. Porous pavements
c. Vegetated swales and bio-swales
d. Green roofs
e. Trees and tree boxes
f. Pocket wetlands
g. Reforestation/revegetation using native plants
h. Protection and enhancement of riparian buffers and floodplains
i. Rainwater harvesting for use (e.g. irrigation, HVAC make-up, non-potable indoor uses)

Additional GI/LID management approaches and design elements were incorporated into the project, and those BMP's initially proposed were enhanced. This was done in order to increase project compliance with the spirit and intent of the EISA. The benefits of these design changes include:

- Cleaner stormwater run-off from the site
- Helping to maintain clean and adequate water supplies
- Source water protection
- Cleaner air
- Help to moderate the impacts of climate change
- Increases in energy efficiency
- General and overall community benefits

The recommended GI/LID management approaches mentioned above, and how they are incorporated into the project, or why they were not, are discussed in detail below:

a. *Rain gardens, bio-retention, and infiltration planters:*

The design criteria for the stormwater management system was increased and the surface basins will now be constructed as bio-retention basins. The surface systems will be constructed so that the post-development peak runoff rates do not differ significantly from pre-development conditions for the 2, 10, 25, and for the extent practical, for the 100-year storm events at the design points. Due to site constraints, the two underground detention systems were designed to attenuate the 2, 10 and 25-year storms, but not the 100-year storm. The stormwater management systems are designed to be in compliance with the intent of the recently authorized Executive Order No. 13514, the Energy Independence and Security Act, in that 95th percentile rainfall event are retained on-site and not directly discharged. This is accomplished by installing refills with controlled permeability under the three surface bio-basins and the two underground detention galleries, and discharging water percolating into these soils via underdrains to adjacent ground surfaces. It is expected that water will also infiltrate into underlying natural soils; however given the fine-grained and

relatively impermeably characteristics of these soils, they cannot be relied on to dewater the stormwater management systems in a timely period so that overall performance of the systems to attenuate peak flow rates from storm events can be expected, hence the addition of the underdrains to the design.

b. Porous pavements

Porous pavements were deemed infeasible because the under-lying site soils are fine-grained and generally impermeable.

c. Vegetated swales and bio-swales

In addition to the swale incorporated into the POV parking lot drainage system, the discharge from the main bio-retention basin from larger storm events flow from the basin over a concrete weir to a 'cascade channel' which runs parallel to a site sidewalk, then to a pipe system for discharge via a level spreader to an upland area adjacent to the northerly existing site pond. While the cascade channel cannot be grass-lined due to erosion concerns, it will promote infiltration and increase flow times for stormwater thereby reducing detention/retention basin sizing requirements. An additional grass swale was incorporated in lieu of a pipeline section to convey a portion of the roof run-off and western loading dock runoff overland thereby increasing flow times and promoting infiltration and recharge of groundwater.

d. Green roofs

The run-off from the Training Center roof, including that from the green roof, and the main bio-retention basin dewatering/underdrain system discharge to the wetland associated with the southerly existing site pond. This discharge scheme was added to help maintain the water balance to this wetland/pond area closer to existing conditions. It is specifically noted that only water from the roof and underdrain is discharged to this wetland area; no runoff that has flowed across pavement surfaces is discharged directly to any site wetland or watercourse.

e. Trees and tree boxes

The landscape plan includes a generous number of deciduous and coniferous trees, increasing the amount provided in the original design. It is also noted that trees were added along Smith Street to provide an enhanced general and overall community benefit.

f. Pocket wetlands

Pocket wetlands were deemed infeasible due to the site constraints of steep slopes, extensive adjacent wetlands and the irreducible project requirements.

g. Reforestation/revegetation using native plants

The landscape plant material list was developed to contain native plants and cultivars exclusively; no invasive species are included.

h. Protection and enhancement of riparian buffers and floodplains

The area along the east side of Sawmill Brook will be selectively cleared of invasive plants and select areas will be replanted with native wetland plants. In addition, a 40-arce parcel along the same brook south of the site will be purchased and permanently maintained as open space.

i. Rainwater harvesting

Water harvesting and use are not practical because the volume of water used for toilet flushing is not significant enough to warrant the design and use of water harvesting and use systems. High-efficiency sensor-operated urinals are provided in the project to reduce over-all water use. No landscape irrigation is proposed.

In summary, the designers are aware of the water and environmental quality issues and are implementing GI/LID strategies and practices in an effort to provide a more sustainable and responsible project.

B. Wetland Impact Area

The proposed Project is located on a 42-acre parcel known as Cucia Park and situated west of I-91 on Smith Street in Middletown, Connecticut. The Project site includes approximately 12 acres of federally jurisdictional wetlands within the area subject to construction, as identified in Table 1 below.

Table 1: Summary of Site Wetlands

Wetland Area	Approximate Wetland Size (within property boundary)	Wetland Type
Wetland System 1	7 Acres	Palustrine Forested
A	3 Acres	Palustrine Forested
E	2 Acres	Palustrine Forested/Palustrine Scrub-Shrub
G	0.16 Acres	Palustrine Forested

The site consists of two distinct landforms: a large floodplain wetland bordering a perennial watercourse (Sawmill Brook) in the western part, and a glacial till hillside in the eastern portion with I-91 bordering the eastern boundary of the site. The floodplain (Wetland System 1) borders Sawmill Brook which flows north through the western portion of the site. Wetland impacts are confined to the poorly drained hillside portions of the site that have been subjected to historical earthwork and other activities known to have occurred in the 1800's. The wetlands associated with these landforms include System 1, a 7 acre Palustrine Forested Wetland (PFO) located in the floodplain of Sawmill Brook, Wetland A, a 2.9-acre PFO located in the southern third of the site just north of the power line, Wetland E, a 2.0-acre PFO exhibiting some areas of open standing water located in the north and north central portions of the site, and Wetland G an isolated PFO centrally located on the site between the old trolley line berm and the sewer main that bisects the western portion of the site from north to south.

As previously described in Section A, measures have been taken to avoid and minimize the wetland impacts that will occur as a result of the Project. The proposed Project will permanently alter six separate areas of freshwater wetland (identified as areas A through H) and the total amount of alteration will be approximately 1.5-acres. In addition, the Project will temporarily impact one wetland area associated with the sewer connection within Wetland E that totals 270-sq. This temporary impact area is not identified with

an Impact Area Location label on the project plans. Table 2 below provides a summary of the impact areas and amounts. The two largest unavoidable wetland impact areas are to occur near the southern end of the Project footprint (impact areas D and G) where the OMS and MEP will be located. Together these two impact areas account for approximately 84 percent of the total amount of wetland impact. The nature of the wetland alteration will be the removal of vegetation and placement of fill in the wetlands in order to construct the proposed access roadways, retaining walls, certain structures, embankments, and utilities.

A summary of impact areas within the wetlands/waters of the United States for the Project is provided in Table 2 below.

Table 2: Summary of Wetland Impacts

Impact Area Location	Wetland ID	Impact quantity (sf)	Temporary Impact quantity (sf)	Wetland Type	Type of Impact	Project Element Resulting in Impact
A	E	2,607	200	Palustrine Forested	Permanent - clear and fill	Grading/roadway construction adjacent to infiltration basin; temporary impact for stormwater plunge pool
C	E	712		Palustrine Forested	Permanent - clear and fill	Retaining wall and roadway construction adjacent to personnel parking area
D	E	24,808		Palustrine Forested	Permanent - clear and fill	OMS and military equipment parking area
E	E	3,232	270	Palustrine Forested / Palustrine Scrub-Shrub	Permanent and temporary - clear and fill	Retaining wall at margin of OMS, military equipment parking area and sewer line connection
F	G	860		Palustrine Forested	Permanent - clear and fill	Retaining wall at margin of OMS and military equipment parking area
G	A	32,166		Palustrine Forested	Permanent - clear and fill	OMS and military equipment parking area
H	A	789		Palustrine Forested	Permanent - clear and fill	Retaining wall at margin of OMS and military equipment parking area
Total:		**65,174 sf (1.5 acres)**	**470 sf**			

As described above wetland impacts will be compensated for by a combination of on-site and off-site mitigation to include permanent preservation of wetlands and uplands via a Conservation Restriction, listed species habitat enhancement and maintenance, invasive vegetation management, riparian enhancement and wet meadow grassland management, as well as on-site wetland enhancement planting that will include the installation of native plantings and invasive species management.

In the spring of 2009, wetland functional assessments were performed on the Cucia Park site using the USACE "Highway Methodology" *(Wetland Functions and Values: A Descriptive Approach* – USACE, 1999), which is appropriate for projects such as this. During the assessments, wetlands were identified within the proposed construction area of the site and evaluated for specific functions and values that each wetland potentially provides. Most of the wetlands identified on the site have been historically affected (and in some cases, created) by previous earth work and soil compaction associated with sewer line installation, trolley line use and a utility line right-of-way. Generally, most of the wetlands surveyed appear to provide low to moderate functions and values while the primary floodplain wetland, Wetland System 1, provides moderate to high functions of the following:

- Groundwater recharge/discharge;
- Flood control;
- Groundwater;
- Water quality;
- Shoreline stabilization;
- Visual quality; and
- Wildlife habitat.

The three primary functions that the wetlands to be impacted are likely to provide include wildlife habitat, groundwater discharge, and water quality treatment. Generally, the functions and values of the wetland areas that are to be impacted are relatively minor in the context of the overall Sawmill Brook and Mattabesset River watersheds. Nevertheless, the localized functions and the cumulative role these play in the overall ecological integrity of these watersheds warrants the development of a mitigation plan with the goal of offsetting the functional impacts from the unavoidable wetland losses. The consideration of wetland mitigation options has followed the guidance provided in the Final Rule for Compensating Mitigation for Losses of Aquatic Resources (USACOE and USEPA, April 10, 2008) as wells as the New England District ACOE Guidance on Compensatory Mitigation (December 18, 2007).

Wetland functions and values reports in Appendix E provide additional information for each impact area.

C. Mitigation Areas

To fully mitigate for impacts to the watershed functionality caused by the wetland impacts associated with the AFRC Project, the U.S. Army proposes on-site vegetation restoration and invasive species control, however the primary mitigation is focused on the off-site land preservation and riparian enhancement. As shown in Section B above, the AFRC will result in 1.5 acres of permanent impacts to forested wetlands as a result of construction of the new facility in Middletown, CT.

C.1 Mitigation Site Selection and Alternatives

U. S. Army considered the development of compensatory mitigation located within Middletown, CT Project site; however, due to Project requirements and site limitations, a combination of on-site and off-site mitigation measures was determined to provide greater potential for successful mitigation. A systematic process has been followed in the assessment of potential alternative sites that could be considered to provide compensatory mitigation in addition to the measures incorporated into the on-site mitigation plans. Contacts were made with local and regional environmental agencies to obtain information on watershed conditions and potential compensatory mitigation opportunities. Included in these contacts were the following:

- City of Middletown Planning and Inland Wetlands Agency Staff
- Connecticut River Watershed Council
- Rivers Alliance of Connecticut
- The Nature Conservancy of Connecticut
- Mattabesset River Watershed Association

From a watershed perspective, emphasis was placed first on the direct watershed of Sawmill Brook which flows through the Project site. Secondarily, consideration was preferentially given to mitigation opportunities within the Mattabesset River watershed, which Sawmill Brook flows into north of the Project site. The Mattabesset River flows easterly along the Cromwell/Middletown corporate boundary to the Connecticut River; accordingly, consideration was also given to sites within the Connecticut River watershed within the Middletown area.

Figure 4 indicates the range of sites that have been considered for off-site mitigation that are situated within these watersheds; additional sites beyond those shown on this figure include those that were also considered and reviewed for the actual Project site. Roughly one-half of the sites are within the watershed of Sawmill Brook that flows northerly through the site, while the others are in the watershed of Swamp Brook which flows north to the Mattabesset River in the eastern portion of Middletown, or in more localized subwatersheds that drain to the Connecticut River. A summary of some of these sites and the potential they offer for mitigation is provided briefly below. It should be emphasized that this review has been conducted largely on the basis of technical considerations for wetland compensation, such as hydrologic setting, habitat conditions, and grading/soil conditions; the availability of any of these sites for such uses pertaining to mitigation were not necessarily fully ascertained, however some reference to such aspects have been provided for some sites.

- Lawrence School/Mile Lane/Kaplan Drive: west of Lawrence School is an open field area that borders shrub-dominated habitat along West Swamp Brook. The field area is currently used in part for model airplane activities and other activities. The site presents an opportunity for minor earth work to lower the grades of the field area to create or enhance wetland conditions. The City of Middletown expressed reservations on the use of the site for wetland mitigation due at least in part to current and potential future uses.

- Middletown High School/Route 3: the existing Middletown High School site is located along East Swamp Brook just west of Route 3. The site has addressed wetland mitigation needs under Section 404 permitting in the recent past, and continues to review mitigation areas under this permit. Consideration has been given to whether additional wetland mitigation areas are possible in this vicinity. Based upon preliminary review, there did not appear to be any viable sites for additional wetland, although some consideration of invasive species control may be warranted within existing wetlands along East Swamp Brook.

- Tuttle Place: this site abuts the south side of the Mattabesset River in northeast Middletown. A small pond occurs there surrounded by woods. The presence of forested cover and the floodplain of the river through this area likely precludes significant area of wetland creation at this site.

- Smith Park: this site is located along Fall Brook to the southeast of Cucia Park. Areas along the brook were reviewed for potential wetland mitigation, streambank restoration, and other aquatic habitat improvements. Much of the land area which is in a proper setting for wetland creation already provides good habitat of forest, shrub, and some scattered emergent cover, and is protected as public parkland. The stream course through the area appears in good condition, with only minor erosional areas along the streambank. Accordingly, on a preliminary basis it does not appear that any substantial area of wetland or water resource improvements is possible at this site.

- Soccer Fields south of Smith Park: these new soccer fields have resulted in some erosion issues toward Fall Brook to the west. However, the steep, wooded grades to the west of the fields and down to the brook are not conducive for wetland creation or enhancement.

- Bysiewicz Site: the western portion of this site along Richard's Brook (which flows south to Sawmill Brook) was reviewed for potential wetland mitigation options. The combination of forested cover and glacial till hillside conditions make this area generally unsuitable for creation of wetland mitigation areas.

- Boardman Lane Site: The southeast portion of this site consists of open fields in active agricultural use that border Sawmill Brook at its confluence with Richard's Brook and Manthay Brook. Much of the fields contain hydric soils, and most of it is within the floodplain of these brooks. Wetland enhancement, rehabilitation, or restoration in these open fields represents a viable wetland mitigation option that would directly contribute to the watershed functions of Sawmill Brook in proximity to the impacts proposed at Cucia Park. The site also provides known habitat for the Eastern Box Turtle (*Terrapene c. carolina*) and Squarose Sedge (*Carex squarrosa*), State Species of Special Concern, and contains potential vernal pools.

- Wilcox Site: this area to the west of Boardman Lane is a City-owned parcel with active recreational trails, apparently used commonly by ATV traffic. While much of this site is upland forest, a significant area is dominated by red pine which is typically considered undesirable wildlife habitat. Portions of the red pine forest are situated within the buffer of a flooded forested wetland. Consideration of habitat improvements within this buffer by removing the red pine may provide some watershed function improvements to mitigate on-site impacts. However, developing compensation on this site would require removal of existing mature trees which may not be considered beneficial or an improvement to the site's existing conditions.

- Manthay Site: this site is a 33-acre parcel on the west side of Middle Street and south of Boardman Lane. Manthay Brook flows north through the site as a headwater stream enroute to Sawmill Brook. An agricultural field occurs along the east side of Manthay Book, which could offer wetland enhancement or creation opportunities of less than one acre. Much of the remaining portions of the site are forested with steep slopes. The forested cover and glacial till hillside conditions make much of this site unsuitable for creation of wetland mitigation or enhancement areas.

Conclusion on Alternative Mitigation Sites

Based upon a review of the available information, including limited site reviews, the Boardman Lane site appears to offer the most preferred conditions for providing compensatory mitigation that would directly offset the unavoidable functional impacts to wetlands from development of the Project at the Cucia Park site. The site is located within the same watershed as the Project site, and directly borders Sawmill Brook just upstream of the Project site. The site includes degraded wet meadow areas that directly border the stream system of Richards Brook and Sawmill Brook, which would benefit from enhancement and permanent protection. Two State-Listed Species of Special Concern, the Eastern Box Turtle and Squarrose Sedge, are documented to occur on the site and would also benefit from such protection. Sufficient acreage occurs on the site to achieve mitigation ratios in accordance with Corps guidance. Slope wetland conditions occur along the western edge of the grazed wet meadow that would be included in the mitigation plan. Upland conditions occur along the west side of the site that drain easterly to the wetlands bordering Sawmill Brook and Richards Brook; permanent protection of these uplands will ensure long-term protection and enhancement of the drainage from these uplands, contributing to the ecological integrity of the wet meadow floodplain and the bordering brook system.

C.2 On-Site Mitigation Area

C.2.1 Existing Wildlife Use

The Project site, Cucia Park, provides woodland habitat used by typical wildlife species. The U.S. Fish and Wildlife Service (USFWS) reported in January, 2009, that no federally-listed or proposed endangered or threatened species were known to occur on or in the vicinity of the site. Construction and operation at Cucia Park would permanently alter approximately 28 acres of woodland habitat, which would be removed to accommodate the AFRC facilities. Wildlife species occurring on the site are those commonly found in forested tracks in suburban areas of Connecticut. Wildlife species expected to occur include grey squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*), eastern chipmunk (*Tamius striatus*), white-tailed deer (*Odocoileus virginianus*), eastern bluebird (*Sialia sialis*), and woodpeckers (*Picoides* spp).

C.2.2 Existing Soils

The United States Department of Agriculture (USDA) Natural Resources Conservation Services (NRCS, formerly the Soil Conservation Service) published the Soil Survey of Middlesex County as well as GIS soil data layers (NRCS, 2009). The soil survey, as well as digital data and site-specific investigations, identify the following three soil mapping units found in the vicinity of the site:

Table 3: Existing Soil Types

Wetland Soils	Upland Soils
6: Wilbraham and Menlo	40B: Ludlow
	87B, 87C, 88C: Wethersfield
	306: Udorthents-Urban land Complex

Wilbraham and Menlo: These series are nearly level to gently sloping soils in drainage ways or low-lying positions of till hills. They consist of poorly to very poorly drained loamy soils formed in subglacial till. This series is a hydric component of the other mapped units on the site.

Ludlow silt loam 3 to 8 percent slopes: This soil series can go from nearly level to strongly sloping soils on till plains, hills and drumlins. This is moderately well drained soils formed in loamy lodgment till. They are very deep to bedrock and moderately deep to densic contact.

Wethersfield 0 to 35 percent slopes: This series consists of very deep, well drained loamy soils formed in dense glacial till on uplands. The soils are moderately deep to dense basal till. They are nearly level to steep soils on till plains, low ridges, and drumlins. Permeability is moderately rapid or moderate in the solum and slow or very slow in the dense substratum.

Udorthents-Urban land complex (Ud): This complex consists of excessively drained to moderately well-drained soils that have been disturbed by cutting or filling, and areas that are covered by buildings or pavement. Slopes range from 0 to 15 percent. This is not a hydric or state inland wetland soil.

The soil series that describe each of the mapping units contain soil that formed from red parent material (RPM), thus the entire study area is considered a potential Problem Area for delineating federally-defined wetlands. Problem Areas are present when certain conditions exist that may make the application of wetland indicators of one or more of the parameters difficult to apply. RPM soils in the Central Lowlands formed from the Triassic-Jurassic sediments in the Connecticut River Valley. They are considered a potential Problem Area because the oxidized iron in RPM soils does not reduce in the same time frame as non-RPM soils under similar pH and Eh conditions, thus it takes longer for low chroma matrix colors (≤ 2) to form. To address this problem the National Technical Committee on Hydric Soils adopted the following guideline for determining if RPM soils are hydric: "In parent material with hue of 7.5YR or redder, a layer at least 10 cm (4 inches) thick with a matrix value and chroma of 4 or less and 2 percent or more redox depletions and/or redox concentrations occurring as soft masses and/or pore linings. The layer is entirely within 30 cm (12 inches) of the soil surface. The minimum thickness requirement is 5 cm (2 inches) if the layer is the mineral surface layer" (NRCS, 2006). This guideline was used in performing the investigation for wetlands within Cucia Park.

C.2.3 Existing Vegetation

Upland habitats consist largely of woodlands, characterized by mixed-age deciduous trees with a relatively sparse understory of shrubs. The upland plant community consists mainly of red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), red oak (*Quercus rubra*), sycamore (*Platanus occidentalis*), American beech (*Fagus grandifolia*), black oak (*Quercus velutina*), white oak (*Quercus alba*), black birch (*Betula lenta*), black cherry (*Prunus serotina*), musclelwood (*Carpinus caroliniana*), and red cedar (*Juniperus virginiana*) in the tree canopy. Witch hazel (*Hamamelis virginiana*), highbush blueberry (*Vaccinium corymbosum*) and hop hornbeam (*Ostrya virginiana*) are found in the shrub layer, and species including Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), goldenrod (*Solidago spp.*), and partridgeberry (*Mitchella repens*) were observed in the herbaceous layer.

C.2.4 Surrounding Land Use

The on-site mitigation area is located in mixed land use and includes commercial and industrial business, and agriculture farm land as well as residential properties. Cucia Park is a 42-acre park land situated next to Interstate 91 on Smith Street and is zoned as industrial property and bordered by commercial development

C.2.5 USFWS and/or NOAA Clearance Letter or Biological Opinion

Pursuant to U.S. Fish & Wildlife Coordination Act (16 U.S.C. §§ 661-667e, as amended) and Section 7 of the federal Endangered Species Act (ESA) (16 U.S.C §§ 1531-1544, as amended), the U.S. Fish and Wildlife Service (USFWS) reported in January, 2009, that no federally-listed or proposed endangered or threatened species were know to occur on or in the vicinity of the site.

C.2.6 SHPO Cultural Resource Clearance Letter

The Cucia Park site is formerly the site of the MacDonnell Brick Company, closed in the 1960's. In 2008 the site was surveyed for cultural resources that revealed no artifacts and only the dumping of modern

trash and debris associated with the recent use of the park or with MacDonnell Brick (Environmental Assessment, April 2009).

C.3 Off-Site Mitigation Area – Boardman Lane

C.3.1 Existing Wildlife Use

The Boardman Lane site is used by a diverse mix of wildlife typical to upland forest, forested wetlands and agricultural fields in Connecticut, and similar to those listed in section C.2.1. In addition, the site provides habitat for two species listed as Species of Special Concern by the Connecticut Department of Environmental Protection (CDEP). During a Special Species Survey conducted on the site the Eastern Box Turtle and Squarrose Sedge were found and documented. Upland habitats on the site are composed of mixed hardwood/coniferous forests, hardwood forests, scrub/shrub areas, old agriculture fields, pastureland, and barnyard area.

C.3.2 Existing Soils

Boardman Lane site includes Richards and Sawmill Brooks and their bordering floodplain wetlands; which contain soils generally identified as Wilbraham or Menlo silt loams and muck deposits. These floodplain wetlands extend over much of the eastern portion of the site, while an elevated landform rises over the western portion of the site, much of which is upland. The largest extent of the eastern portion of the property exhibited a soil profile consistent with the Wilbraham silt loam complex, a drainage or depression soil formed from basalt and/or sandstone and shale till:

- Stratum I: 0-5cm very dark gray (10YR 3/1) loamy humus (O Horizon)
- Stratum II: 5-25 cm dark grayish brown (10YR 4/2) silty loam (A Horizon)
- Strum III: 25+ cm reddish brown (5YR 5/4) silty loam with gravel (B Horizon)

Although this eastern half of the property is classified as wetlands, much of it (approximately 15 ac around the Noah Bacon Homestead) is only seasonally flooded and currently used as a horse pasture.

Soils to the west are more consistent with the Cheshire-Holyoke complex, 3 to 15 percent slopes, very rocky. Specifically, soils are closer in kind to Holyoke soils, loamy eolian ridge top deposits laid atop melt-out till derived from basalt and/or sandstone and shale (USDA 2008):

- Stratum I: -15 cm very dark gray (10YR 3/1) loamy humus (O Horizon).
- Stratum II: 15-25 cm light yellowish brown (10YR 6/4) silty loam (A Horizon) over sandstone bedrock.

Soils in the western half of the site were found to be excessively eroded and while bedrock was encountered at 30 cm below ground surface in some test borings on the gradual eastern ridge slope; it was often found exposed on the surface or directly under the humus throughout the ridge tops. Surfaces along these ridge tops were strewn with weathered sandstone cobbles as well as trap rock. In the course of the survey, two isolated finds (IF) were identified:

- Stratum I: 0-15 cm light yellowish brown (10YR 6/4) sandy loam and gravel (A Horizon)
- Stratum II: 15+ cm light brown (7.5YR 6/4) sandy loam with gravel and cobbles (B Horizon)

C.3.3 Existing Vegetation

The Boardman Lane site consists of forested, scrub/shrub, and emergent wetlands and upland areas of mixed hardwood/coniferous forests, hardwood forests, scrub/shrub areas, old fields, pasturelands, and barnyard areas. Forested areas contain species including American beech, white oak (*Quercus alba*), northern red oak (*Q. rubra*), tulip poplar (*Liriodendron tulipifera*), sugar maple (*Acer saccharum*), green ash *(Fraxinus pennsylvanica)*, American elm *(Ulmus americana)*, eastern hemlock (*Tsuga canadensis*), red maple *(Acer rubrum)*, swamp white oak (*Q. bicolor*), and pin oak (*Q. palustris*) in the canopy. Understory trees include hop hornbeam (*Ostrya virginiana*), red maple, and black birch (*Betula lenta*). Common shrubs are arrow-wood (*Viburnum dentatum*), speckled alder (*Alnus incana*), honeysuckle (*Lonicera* sp.), silky dogwood *(Cornus amomum)*, gray dogwood (*Cornus racemosa)*, spicebush (*Lindera benzoin*), and common winterberry (*Ilex verticillata*). The Squarrose Sedge is present in forested areas along the site's western border as well as in forested areas adjacent to Richards Brook to the east. Vegetation management has historically occurred in much of the low-lying floodplain area and pasture land centrally located on the site (e.g., tree and brush removal).

C.3.4 Surrounding Land Use

The proposed off-site mitigation area is located on a parcel of agricultural land within a continuum of open space and undevelopable land to the north. Forested uplands are located to the west while developed commercial property is located to the east. Residential property is located to the south bordering Boardman lane. Portions of this property, as well as properties to the north, are mapped in the Natural Diversity Data Base and provide essential habitat for the two Species of Special Concern. The proposed mitigation area will be protected from future development through a conservation easement or deed restriction, thereby protecting the habitats and supporting landscapes and providing for the long-term connectivity of the surrounding open space areas.

C.3.5 USFWS and/or NOAA Clearance Letter or Biological Opinion

As mentioned above the Boardman Lane site provides habitat for listed species of Special Concern and has been identified by CDEP and mapped as Natural Diversity Data Base habitat. A Special Species Survey conducted in October 2008 and confirmed the presence of the Eastern Box Turtle and the *Squarrose Sedge*. The proposed preservation and conservation restrictions for the site mitigation area will provide species protection. Therefore, no detrimental impact to this habitat is expected to result from the proposed wetland mitigation plan.

C.3.6 SHPO Cultural Resource Clearance Letter

A Cultural Resources Survey, conducted at the Boardman Lane site, found the site contains an architectural resource within its boundaries and also two resources within its viewshed. The Bacon Homestead (218 Boardman Lane) is a circa 1735-1770 Center-Chimney Colonial farmhouse. There are also two historic barns on the property, constructed at a later date. According to the associated Connecticut Historic Resources Inventory Form, the house has "retained its original usage and relationship to its property" for over two centuries. The two cultural resources within the immediate viewshed of the Boardman Lane site include a circa 1890 Gable-Front house located at 19 Bell Street, and the Old Westfield Cemetery. The Old Westfield Cemetery was not found to have any exceptional historical or architectural significance (Environmental Assessment, April 2009). Appendix G provides copies of letters from the Connecticut Commission on Culture and Tourism's SHPO. The proposed land preservation for compensatory mitigation will not include any historic features.

C.4 Proposed Mitigation

This WMP provides on-site and off-site mitigation measures as compensation for the 1.5 acres of wetland fill. These proposed mitigation measures have been designed and sited to replace the lost functions and values of the impacted wetlands. On-site mitigation will include buffer plantings between the Project and the adjacent wetlands to help screen wetlands areas from the proposed training facility, as well as control of invasive plants over the undeveloped portions of the site. Off-site mitigation will include the permanent protection of 40-acres of the Boardman Lane site, including enhancement of a 14-acre grazed wet meadow, invasive species control, and grassland management in a manner designed to protect the Eastern Box Turtle use of the site (Appendix C).

C.4.1 On-Site Mitigation

C.4.1.1 Size and Type of Mitigation

On-site mitigation will include 0.75 acres of wetland and upland buffer enhancement plantings adjacent to the proposed impact areas and 22 acres of invasive vegetation species control and management. In addition, stormwater from I-91 that currently is shed over the Cucia Park site in an erosive manner will be treated in a new conveyance system to minimize this erosion. Finally, stormwater management for the proposed development will include a number of best management practices and Low Impact Development measures to minimize the effects of the Project on the adjacent wetlands and watercourses.

C.4.1.2 Functions and Values Replaced

As previously described, a majority of the wetlands to be impacted on the site have been identified as historically affected (and in some cases, created) by previous earth work and soil compaction associated with the previous brick manufacturing company, sewer line construction and installation, trolley line use and a maintained utility line right-of-way. Wetland impacts on the site will primarily affect wildlife habitat, groundwater discharge, and water quality functions. Proposed on-site measures of buffer plantings and invasive species control are intended to mitigate for the habitat functional impacts. Stormwater management and project sitting and design measures are intended to mitigate the impacts to water quality treatment and groundwater discharge to the extent practicable.

C.4.2 Off-Site Mitigation – Boardman Lane

C.4.2.1 Size and Type of Mitigation

The compensatory mitigation measures at the Boardman Lane site include the permanent preservation of a 40-acre area consisting of approximately 17 acres of wetland and 23 acres of upland. The Army is purchasing this 40-acre area and will ensure it is permanently protected.

Within the 40-acre area, an existing 14-acre grazed wet meadow would be enhanced via grassland management (10 acres) and riparian zone plantings (4 acres) to improve the habitat value and maximize the capacity of this area to protect the adjacent Richards Brook and Sawmill Brook. Invasive species control will also be implemented for a five-year period over this area.

C.4.2.2 Functions and Values Replaced

These proposed off-site mitigation measures have been designed and located to replace the lost functions and values of the impacted wetlands by providing permanent preservation and enhancement of wetland and upland habitat, wet meadow enhancement and habitat management. The preservation of land at the Boardman site alone provides a compensation ratio of over 26:1. The location of the currently degraded wet meadow along Sawmill Brook provides a direct nexus to the functional impact at the Cucia Park site; enhancement, rehabilitation, and permanent protection of this area will directly off-set habitat and water quality impacts attributed to the Project development at Cucia Park.

C.4.3 Construction Oversight and Timing

A wetland scientist will be on-site to monitor construction, invasive species control, and planting activities of both the on-site and off-site wetland mitigation areas to ensure compliance with the mitigation plan and to make adjustments when appropriate to meet mitigation goals.

Compensatory mitigation will be initiated not later than 90 days after project initiation and completed no later than one year after the permitted wetland impacts occur unless the USACE-approved mitigation plan specifically states otherwise and compensation for the temporal impacts are appropriate. If the impact will occur before the mitigation is constructed, the mitigation plan will address temporal losses. In either of the above situations, the permittee will work with the USACE to develop financial assurances for the mitigation construction and monitoring, including remedial actions.

The necessary work would involve mowing, one-time light tilling and seeding with a native meadow seed mixture. Such activities would be similar to the regular tilling and planting of the field for agricultural cultivation, and are also similar to certain plantings of native species. Appropriate erosion and sedimentation control measures for the work in buffer areas will be included in the Project erosion control plan.

C.4.4 Responsible Parties

The U.S. Army will be designated as the official responsible party, and a party acceptable to the Corps Regulatory Division will be responsible for planning, accomplishing, and maintaining each aspect of the Project for both the on-site and off-site mitigation areas.

C.4.5 Appropriate Financial Assurances

The proposed Project and mitigation will be funded by the U.S. Government. Due to the nature of the Project, it is assumed that no specific financial assurance is required.

C.4.6 Potential to Attract Waterfowl and other Bird Species that Might Pose a Threat to Aircraft

All proposed mitigation is to occur in areas that are currently heavily vegetated. There is no potential to attract additional waterfowl and other bird species that might pose a threat to aircraft. The remediation area is not an airport or of concern to the Federal Aviation Administration.

D. Hydrology

Both the Cucia Park and Boardman lane sites border Sawmill Brook, a sub-watershed to the Mattabesset River. From a broader perspective, both sites are located within the Lower Connecticut River Watershed. This watershed is the largest watershed in Middlesex County, covering almost the entire county.

On-site Mitigation Area Hydrology

Cucia Park is bordered by Sawmill Brook on the western side. Sawmill Brook is three miles long and flows in a northerly direction. In 2008 the Brook was listed as impaired in the Connecticut Integrated Water Quality Report due to violations of Escherichia coli from an unknown source (CTDEP, 2008e). Sawmill Brook is a wooded lowland brook with deep pools and riffles with a considerable aesthetic quality. This waterway is tributary to the Mattabessett River. A shallow water-table is evident at mid-slope where groundwater seeps up to the soil surface along most of the site's central areas. These seeps provide hydrology to pools, wetlands, and a man-made pond found in this region.

Off-site Mitigation Area Hydrology

Boardman Lane site is bordered by Richards Brook, a perennial stream, along the eastern property boundary. Richards Brook flows north to south to the confluence of Sawmill Brook at the southeast corner of the site. Richards Brook is situated at the lowest elevation of the site, 92 feet. Base flood elevation is between 93 and 95 feet (NAVD88). Emergent wetlands, forested wetlands and scrub/shrub wetlands are hydrologically contiguous with Richards Brook and Sawmill Brook within the property boundary. In addition, a few seasonally flooded forested wetlands occur in depressional areas surrounded by upland forests along the site's western portions. These wetlands are influenced by a shallow seasonally perched water table.

E. Grading Plan

Grading of the undisturbed soils at the proposed on-site mitigation area is expected to be minimal. A majority of the plants to be installed will be planted within undisturbed wetland or upland areas adjacent to impact areas. Any areas that are disturbed will be graded to match the existing grades of the adjoining areas.

No grading will occur at the Boardman Lane site.

F. Topsoil

The off-site mitigation area will not require additional topsoil. It is not anticipated that on-site enhancement plantings will require additional topsoil and it is unlikely the plantings will generate an excessive amount of topsoil that will require storage. However; in the event that additional topsoil is required for either on-site or off-site mitigation areas these soils will be stockpiled separately and either used for final grading and planting or disposed within an upland outside of any wetland buffer zone. As suggested by the USACE's *Guidance of the New England District Mitigation Checklist*, the following measures will be implemented by the contractor when stockpiling topsoil:

- Prior to stockpiling topsoil material contractors will seek approval from property owners or site engineer for appropriate locations within uplands to store and stockpile materials;
- Avoid stockpiling compost organics in piles over 4 feet in height;
- Protect stockpiles from surface water flow and contain them with haybales and/or siltfence;
- Cover stockpiles with a material that prevents erosion (tarps, erosion control mat, or straw and temporary seed, depending on the size and duration of storage);
- Inspect and repair protection measures listed above regularly (weekly), as well as prior to (to the extent possible) and after storm events; and
- Maintain moisture in the soils during droughty periods.

The control of invasive species seeds and rootstock that may be present within topsoil is discussed in Section J of this report.

G. Planting Plan

On-site planting plan includes a variety of plantings and seed mixes to stabilize disturbed and/or exposed soil in a timely fashion and to direct and ensure the establishment a variety of wetland and upland plant communities within the buffer enhancement area described on Figure 3 in Appendix A and Mitigation Plans in Appendix C. It is the goal of this on-site mitigation effort to achieve at least 75 percent coverage of the surface of the disturbed area within two growing seasons. If at the time of final grading soil temperature and site conditions are not appropriate for transplantation and seed germination, the mitigation area will be stabilized with 2 to 4 inches of straw mulch and subsequently planted at an appropriate time.

At the off-site Boardman Lane location, the planting plan includes a variety of woody species plants over a 4-acre portion of the overgrazed agriculture fields. Trees and shrubs proposed for the area were selected based on current hydrologic regime and existing plant communities of the adjacent woodlands and meadows and are described in Section C.3.3. Similar to the on-site plan, it is the goal of this off-site mitigation effort to achieve at least 75 percent coverage of the surface of the planting area within two growing seasons. Plantings will occur when site conditions are appropriate for transplantation.

Plantings will be accomplished through the use of plant stocks chosen for their compatibility with the local environment as well as the various hydrologic regimes within each mitigation area. Commercially available plants and seeds will be utilized to accomplish this goal. The planting plans have been designed to provide a variety of wetland and upland plant species to promote species richness, enhance wildlife edge habitat, and improve the aesthetics of the on-site wetland system.

The table at the end of this section provides the composition of the proposed wetland seed mix that is to be applied within the proposed mitigation area at the on-site location, Cucia Park. Only plant materials native and indigenous to the region will be used. Species not specified in the mitigation plan will not be used without written approval from the Corps. No cultivars of native species shall be used. The following notes further clarify the proposed planting programs:

On-site Mitigation Area (Cucia Park Site)

1. A wetland seed mix will be hand broadcast or hydro-seeded at appropriate rates throughout appropriate areas of the wetland and upland buffer enhancement areas to create an herbaceous groundcover. A conservation grass seed mix will be distributed along the upland areas of the mitigation area, where the slopes grade into the natural surroundings. Acceptable wetland seed mixes include New England Wet Mix as shown in following Table 3, and an upland seed mix, New England Conservation Wildlife Mix as shown in following Table 4, can be provided by New England Wetland Plants, Amherst, MA. Comparable alternative sources may be approved by the wetland scientist. Following seeding, mulch will be evenly dispersed over the graded areas as a loose layer of straw approximately 2 inches in thickness.

2. In addition to herbaceous seeding referenced above, woody plantings are proposed within the wetland and upland buffer enhancement areas. Mulch will be used around woody plantings in an 18" diameter

circle approximately 2" deep. These plantings are shown on the attached tables and planting plans in Appendix C.

3. The contractor will be required to maintain adequate moisture in the wetland mitigation area for the first two growing seasons following planting to support the plantings (>75% survival is required).

Off-site Mitigation Area (Boardman Site)

1. Only woody plantings are proposed within the mitigation areas (riparian enhancement). Mulch will be used around woody plantings in an 18" diameter circle approximately 2" deep. These plantings are shown on the attached tables and planting plans.

2. The contractor will be required to maintain adequate moisture in the wetland mitigation area for the first two growing seasons following planting to support the plantings (>75% survival is required).

To ensure the success of the proposed enhancement and mitigation plan, a qualified wetland scientist would make certain that the necessary hydrologic regimes are achieved, and that the benefits of the proposed plan are maximized. During planting, a qualified professional may relocate up to 50 percent of the plantings if as-built conditions would pose an unreasonable threat to the survival of plantings installed according to the mitigation plan. The plantings will be relocated to locations with suitable hydrology and soils and where appropriate structural context with other planting cells can be maintained.

To reduce the immediate threat and minimize the long-term potential of degradation, the species included on the "Invasive and Other Unacceptable Plant Species" list in Table 4 of the New England District Mitigation Plan Guidance shall not be included as planting stock in the overall Project (United States Army Corps of Engineers – New England District, January 2007). Only plant materials native and indigenous to the region shall be used. Species not specified in the mitigation plan shall not be used without prior written approval from the Corps.

Table 3.
2009 New England Wetmix (wetland seed mix)

Botanical Name	Common Name	Ind.
Alisma plantago-aquatica	Mud Plantain	OBL
Asclepias incarnata	Swamp Milkweed	OBL
Aster novi-belgii	New York Aster	FACW+
Bidens cernua	Nodding Bur Marigold	OBL
Carex comosa	Bristly/Cosmos Sedge	OBL
Carex crinita	Fringed Sedge (Nodding)	OBL
Carex lupulina	Hop Sedge	OBL
Carex lurida	Lurid Sedge (Shallow)	OBL
Carex scoparia	Blunt Broom Sedge	FACW
Carex vulpinoidea	Fox Sedge	OBL
Eupatorium maculatum	Spotted Joe Pye Weed	FACW
Eupatorium perfoliatum	Boneset	FACW
Glyceria Canadensis	Rattlesnake Grass	OBL
Glyceria striata	Fowl Mannagrass	OBL
Juncus effuses	Soft Rush	FACW+
Mimulus ringens	Square Stemmed Monkey Flower	OBL
Onoclea sensibilis	Sensitive Fern	FACW
Scirpus atrovirens	Green Bulrush	OBL
Scirpus cyperinus	Wool Grass	FACW
Scirpus validus	Soft Stem Bulrush	OBL
Verbena hastate	Blue Vervain	FACW

Table 4.
2009- New England Conservation/Wildlife Mix

Botanical Name	Common Name	Ind.
Andropogon gerardii	Big Bluestem	FAC
Asclepias syriaca	Common Milkweed	FACU-
Aster novae-angliae	New England Aster	FACW-
Chamaecrista fasciculata (Cassia f.)	Partridge Pea	FACU
Desmodium canadense	Showy Tick Trefoil	FAC
Elymus virginicus	Virginia Wild Rye	FACW-
Eupatorium maculatum	Spotted Joe Pye Weed	FACW
Euthamia graminifolia (Solidago g.)	Grass Leaved Goldenrod	FAC
Festuca rubra	Creeping Red Fescue	FACU
Heliopsis helianthoides	Ox Eye Sunflower	UPL
Panicum clandestinum	Deer Tongue	FAC+
Panicum virgatum	Switch Grass	FAC
Rudbeckia laciniata	Tall/Green Headed Coneflower	FACW
Schizachyrium scoparium	Little Bluestem	FACU
Solidago juncea	Early Goldenrod	
Sorghastrum nutans	Indian Grass	UPL

H. Coarse Woody Debris and Other Features

If directed by the Corps Regulatory Division, a supply of dead and dying woody debris shall cover at least 4% of the ground throughout the mitigation sites and along the banks of the existing Brooks. The intended habitat of the Boardman Lane wet meadow as grassland that will be periodically mowed may preclude the use of coarse woody debris. These materials shall not include any invasive species as listed by the Corps. The proposed development will require the clearing and cutting of mature trees, logs and stumps, and other woody debris at different stages of decomposition throughout the development area.

I. Erosion Control

Implementation of erosion control measures will be initiated in compliance with the construction mitigation measures. During the construction process the erosion control barriers will be maintained on a regular basis and remain in place until the disturbed area is stabilized. Erosion control barriers will also be installed along wetland enhancement boundaries until the grading and plantings within the areas are complete. Extra erosion control materials will be kept on-site to be used for any maintenance of the installed erosion control barriers.

Temporary devices and structures to control erosion and sedimentation in and around enhancement sites will be properly maintained at all times. These devices and structures will be disassembled and properly disposed of as soon as the site is stable but no later than November 1 three full growing seasons after the planting. Sediment collected by these devices will be removed and placed upland in a manner that prevents its erosion and transport to a waterway or wetland.

J. Invasive and Noxious Species

J.1 Management of Potential Invasive Species

It is acknowledged that soils and sediments disturbed by projects are very susceptible to infiltration by undesirable species. Because of the nature of the Project, there is a higher risk of invasive and noxious species infiltration. Invasive species such as phragmites already inhabit the areas at the Cucia Park site, and was noted growing along the sewer main that traverses the site. In addition to those species located at Cucia Park, other invasive species included on the "Invasive and Other Unacceptable Plant Species" list in Table 4 of the New England District Mitigation Plan Guidance have been detected along Richards Brook, located in the eastern portion of the Boardman Lane site, and the adjoining wetlands include, but are not limited to:

- Common reed (*Phragmites australis*)
- Purple Loosestrife (*Lythrum salicaria*)
- Autumn olive (*Elaeagnus* spp.)
- Oriental Bittersweet (*Celastrus orbiculatus*)
- Honeysuckle (*Lonicera tataria* and *L. morrowii*),
- Multiflora Rose (*Rosa multiflora*),

To manage the threat of these species, and potentially other invasive plants, establishing themselves within the restored/enhanced wetlands, an invasive species monitoring and control plan will be implemented. There are no known constraints that influence the control plan. The monitoring and control program will incorporate, as necessary, both manual and chemical means to control and eradicate any species found within the restored/enhanced wetlands or areas immediately adjacent to them.

A qualified wetland scientist will inspect the mitigation area for invasive species for at least five years. If invasive species are found, the necessary control measures will be developed and implemented. For instance, a treatment of Rodeo (or similar product) would likely be used to eradicate any communities of phragmites, which may spread to the disturbed and/or enhancement areas. Purple loosestrife could be removed by physical means. Regardless, an effective treatment plan will be tailored to address problems identified during the inspections and implemented.

J.2 Long Term Management of Existing Invasive Species

Removal of invasive species in the wetland areas and habitat enhancement areas shall be performed to address potential problems with invasive species. Native plant communities with wildlife habitat benefits shall be maintained in the wetlands and enhancement areas. Invasive species were identified based on information prepared by the CT DEP and the Massachusetts Invasive Plant Advisory Group (MIPAG 2005). Control methods will involve the use of physical and mechanical control methods and chemical or biological controls where appropriate. Chemical control methods will be used to deal with heavy infestations of invasive species. Herbicide applications shall be used according to state and federal guidelines. All herbicide treatments shall be applied by a licensed applicator.

a. Shrubs

Removal of non-native shrubs, including exotic bush honeysuckles, multiflora rose, and autumn olive from the wetlands and habitat enhancement areas shall be performed by a licensed landscape professional in agreement with accepted vegetation control practices. Stands of glossy buckthorn (*Frangula alnus* = *Rhamnus frangula*) will also be treated should this non-native, invasive shrub to small tree be found on the sites.

Dense thickets of multiflora rose shade out more desirable native species in the ground layer and reduce species diversity. Infestation of the non-native bush honeysuckles reduce species diversity due to shading influences and the release of allelopathic root toxins which inhibit the growth of other more desirable species. The control of non-native shrubs in the wetlands and habitat enhancement areas will use physical and mechanical cutting measures and/or hand pulling to remove seedlings and small plants with shallow root systems. An effective method for controlling exotic honeysuckles, multiflora rose, autumn olive, and possibly glossy buckthorn is hand pulling young plants (TNC 2005a, TNC 2005b, and IPSAWG 2006a). These treatments are most effective in the spring when the soil is loose and moist and the infestation is light.

The long-term control of invasive shrubs may require repeated cuttings to control new stem growth if the control methods are limited to physical and mechanical measures. Herbicide applications are proposed to treat heavy infestations. The application of a systemic herbicide to the cut stumps is recommended in conjunction with the cutting treatment for optimum results. Glyphosate solutions applied directly to the leaves or freshly cut stumps and stems are effective in controlling the spread of the non-native shrubs (TNC 2005a, PAC 2005a). Herbicide treatments shall be applied by a state licensed applicator.

Informational fact sheets for the control of non-native, invasive shrubs (multiflora rose, exotic bush honeysuckles, Russian and Autumn olive, and glossy buckthorn) are included in the Appendix D

b. Vines

Infestations of Oriental bittersweet (*Celastrus orbiculatus)* degrade natural plant communities and reduce species diversity. If Oriental bittersweet vines are found in the habitat enhancement areas or invasive species control areas removal methods includes a combination of cutting the stems at ground level and hand pulling. Young vines may be hand pulled and the collected material placed in plastic bags for removal to a landfill for disposed. All root material must be removed for this method to be effective. Cutting treatments for controlling the spread of Oriental bittersweet vines are most effective in the spring and late summer and/or the early fall, but repeated cuttings are necessary because the plants will sprout back from the base. Physical controls in combination with herbicide applications are required for the eradication of this invasive vine.

The application of a systemic herbicide directly to the cut stem is an effective treatment in the control of Oriental bittersweet vines (PAC 2005c, IPSAWG 2006). A 25% glyphosate solution mixed with water is generally effective when the application is done when the temperature is above 50° F for numerous days. The application treatment will be performed under the direction of a licensed applicator. Controlling the spread of Oriental bittersweet vines is proposed to promote the development of native species in the open field and meadow habitats. Informational fact sheets with recommended methods for the control of Oriental bittersweet are included in the Appendix D.

c. Invasive Herbaceous Species

The control of non-native, invasive herbaceous species will be implemented under the Plan to foster the development of native species. Target species currently include purple loosestrife and common reed. Light infestations of purple loosestrife may be removed by hand pulling or grubbing early in the season. This treatment should be done before the plants flower and set seeds. Heavy infestations of purple loosestrife may be controlled by chemical methods using a glyphosate herbicide application applied late in the season when the plants are preparing for dormancy. Rodeo® is an approved herbicide recommended for use in wetland habitats and in areas near to open water. Biological controls using the imported beetles (*Galerucella* sp) have been effective as a control agent for purple loosestrife and may be appropriate for use at the site.

Control methods for common reed will include physical controls and chemical controls where such treatments would be effective. Annual cuttings before the plants flower in the end of July are reportedly effective in controlling the spread of common reed (IPSAWG 2007). Cutting operations may be required over an extended period of years for this practice to be effective if herbicide applications are not used. A glyphosate herbicide treatment in conjunction with numerous years of mowing was found to be effective in controlling the spread of common reed (CT DEP 2007).

The enhancement areas will be monitored for "Invasive and Other Unacceptable Plant Species as referenced in the USCOE (2007a) guidance document for mitigation plans in New England. Invasive species in the compensatory wetland mitigation area will be addressed under an invasive species management plan. Native trees, shrubs, and herbaceous species selected for the riparian enhancement area shall be selected from a list of species found commonly in vegetated wetlands in the region. Control methods for removing invasive herbaceous species will use accepted treatments.

K. Off-Road Vehicle Use

It is not anticipated that the mitigation and enhancement sites will be subjected to incidences of off-road vehicle use. The sites will maintain operation/maintenance plans to ensure such activities do not occur.

L. Preservation

The proposed mitigation plan includes the implementation of a 40-acre conservation restriction to permanently protect from future development areas of forested wetlands, emergent marsh, stream banks and forested uplands found on the property. In addition, the mitigation plan includes a management plan for mowing in a manner compatible with box turtle use. Within 90 days of the issuance of the Corps' authorization of the proposed Project activities, the permittee shall submit to the Corps a draft of the conservation restriction or deed restriction. Within 30 days of the date the Corps approves this draft document in writing, the permittee shall execute and record the aforementioned document with the Registry of Deeds for the City of Middletown and the State of Connecticut. A copy of the executed and recorded document will be sent to the Corps within 90 days of the date it is recorded. The conservation restriction or deed restriction shall enable the area to be protected in perpetuity from any future development.

M. Monitoring Plan

On-site Monitoring (Cucia Park)

The applicant will monitor the on-site enhancement area for a period of five years. For each of the first five full growing seasons following establishment of the on-site enhancement area the site will be monitored and annual monitoring reports submitted. Observations will occur at least two times during the growing season - in late spring/early summer and again in late summer/early fall. Annual reports will be completed and shall be submitted to the New England District Regulatory Division Policy Analysis and Technical Support Branch no later than December 15 of the year being monitored. Failure to perform the monitoring and submit the monitoring reports constitutes permit non-compliance. A self-certification form will be completed, and signed as the transmittal coversheet for each annual monitoring report and it will indicate the permit number and the report number (transmittal forms are provided in Appendix H).

The yearly reports will follow the same protocol as described in Off-site Monitoring (Boardman Site) below.

Off-site Monitoring (Boardman Site)

The applicant will monitor the off-site forested/shrub riparian enhancement area for a period of five to ten years. For the growing season of years 1, 2, 3, 5, 7, and 10 following plantings of the enhancement area, the site shall be monitored. Observations will occur at least two times during the growing season – in late spring/early summer and again in late summer/early fall. Annual monitoring reports will be completed and shall be submitted electronically New England District Regulatory Division Policy Analysis and Technical Support Branch no later than December 15 of the year being monitored. Each report coversheet shall indicate the permit number and the report number. Observations will occur at least two times during the growing season in late spring/early summer and again in late summer/early fall.

The reports will answer the following success-standard questions and shall address in narrative format the items listed after the questions. The reports shall also include the monitoring-report appendices listed below. The first year of monitoring shall be the first year that the site has been through a full growing season after completion of construction and planting. For these special conditions, a growing season starts no later than May 31.

The reports shall be submitted in Portable Document Format (e.g. Adobe PDF) and will be concise and effectively provide the information necessary to assess the status of the compensatory mitigation Project. The report will follow a 10-page maximum report format per site, with a self-certification form transmittal provided in Appendix H. The report will provide information framed within the following format.

1. Project Overview (1 page).
2. Requirements (1 page): a list of monitoring requirements and performance and/or success standards, as specified in the approved mitigation plan and special conditions of the permit, and evaluated whether the compensatory mitigation project site is successfully achieving the approved performance and/or success standards or trending toward success.
3. Summary Data (maximum of 4 pages): summary data will be provided to substantiate the success and/or potential challenges associated with the compensatory mitigation project. Photo documentation will be provided to support the findings and recommendations, and placed in Appendix.
4. Maps: maps will be provided and show the location of the compensatory mitigation site relative to other landscape features, habitat types, locations of photographic reference points, transect, sampling data points, and/or other features pertinent to the mitigation plan. In addition, the submitted maps will clearly delineate the mitigation site boundaries to assist in proper locations for subsequent site visits. Each map or diagram will fit on a standard 81/2 x 11 sheet of paper and include a legend and the location of any photos submitted for review.
5. Conclusion (1 page): a general statement describing the conditions of the compensatory mitigation project will be included. If performance or success standards are not being met, a brief discussion of the difficulties and potential remedial actions proposed, including a timetable will be provided.

The following language will be included in the narrative portion of the mitigation plan:

Notification of Construction Completion

Within 60 days of completing the mitigation project (riparian enhancement) the applicant will submit a signed letter to the Corps, Policy Analysis and Technical Support Branch, specifying the date of completion of the enhancement work. If the mitigation work is initiated in, or continues throughout the year, but is not completed by December 31 of any given year, the permittee will provide the Corps, Policy Analysis and Technical Support Branch, a letter providing the date mitigation work began and the work completed as of December 31. The letter will be sent no later than January 31 of the next year. The letter will include the Corps permit number.

Monitoring Report Guidance

For each of the first full growing seasons following construction of the mitigation site, the site will be monitored and annual reports submitted. Observations will occur at least two times during the growing season in late spring/early summer and again in late summer/early fall. Each annual monitoring report will be submitted to the Corps, Regulatory Division, Policy Analysis and Technical Support Branch, no later than December 15 of the year being monitored. Failure to perform the monitoring and submit monitoring reports constitutes permit non-compliance. A self-certification from will be completed and signed as the transmittal coversheet for each annual monitoring report and will indicate the permit number and the report number (Monitoring Report 1 of 5 for example). The reports will address the following success standards in the summary data section and will address the additional items noted in the monitoring report requirements, in the appropriate section. The reports will also include the monitoring-report appendices listed below.

The first year of monitoring will be the first year that the site has been through a full growing season after completion of planting. A growing season starts no later than May 31. However, if there are problems that need to be addressed and if the measures to correct them require prior approval from the Corps, the permittee will contact the Corps by phone (1-800-343-4789 in CT) or letter as soon as the need for corrective action is discovered.

Remedial measures will be implemented – at least two years prior to the completion of the monitoring period – to attain the success standards described below within two growing seasons after completions of construction of the mitigation site. Should measures be required within two years of the end of the monitoring period, the monitoring period will be extended to ensure two years of monitoring after the remedial work is completed without written approval from the Corps.

At least one reference site adjacent to or near each enhancement area will be described and shown on the locus map.

Success Standards

Success shall be measured as follows:

1. Does the site have the hydrology to support the enhancement plantings and design? What percentage of the site is meeting project hydrology levels? Areas that are too wet or too dry will be identified along with suggested corrective measures.
2. Are the proposed vegetation diversity and/or density goals for woody plants from the plan are met?
3. a) Do the enhancement areas have at least 80% areal cover by noninvasive species (See Table 4 in Appendix H)?
   b) Planned scrub-shrub and forested cover types have at least 60% cover by noninvasive hydrophytes, of which at least 15% are woody species?

For the purpose of this success standard, invasive species of hydrophytes are:

Cattails -- *Typha latifolia, Typha angustifolia, Typha glauca*;
Common Reed -- *Phragmites australis*;
Purple Loosestrife -- *Lythrum salicaria*;
Reed Canary Grass -- *Phalaris arundinacea*; and
Buckthorn – *Rhamnus frangula*.

4. Common reed, purple loosestrife, Russian and Autumn olive, buckthorn, Japanese knotweed and multiflora rose plants at the mitigation/enhancement sites are being controlled.
5. Area soils, substrate and enhancement features within and adjacent to the mitigation/enhancement sites are stable?

Monitoring Report Narrative Requirements

The following Items shall be addressed in narrative discussion:

- Highlighted summary of problems which need immediate attention (e.g., severe invasive species problem, serious erosion, major losses from herbivory, etc.). This should be at the beginning of the report and highlighted in the project overview and in the self-certification form provided in Appendix H.

- A copy of the permit mitigation special conditions and summary of the mitigation goals.

- Address success standards achievement and/or measure to attain the standards.

- Dates work began and ended.

- Describe the monitoring inspections that occurred since the last report.

- Soils data, commensurate with the requirements of the soils portion of the 1987 Corps Delineation Manual (Technical Report Y-87-1) New England District data form, should be collected after construction and every alternate year throughout the monitoring period. If monitoring wells or gauges were installed as part of the project, this hydrology data should be submitted annually.

- Concisely describe remedial actions done during the monitoring year to meet the five success standards – actions such as removing debris, replanting, controlling invasive plant species (with biological, herbicidal, or mechanical methods), applying additional topsoil or soil amendments, adjusting site hydrology, etc. Also describe any other remedial actions done at each site.

- Report the status of all erosion control measures on the compensation site(s). Are they in place and functioning? If temporary measures are no longer needed, have they been removed?

- Give visual estimates of (1) percent vegetative cover for each site and (2) percent cover of the invasive species listed under Success Standard No. 2, above, at each site.

- What fish and wildlife use the site(s) and what do they use it for (nesting, feeding, shelter, etc.)?

- By species planted, describe the general health and vigor of the surviving plants, the prognosis for their future survival and a diagnosis of the cause(s) of morbidity or mortality.

- What remedial measures are recommended to achieve or maintain achievement of the four success standards and otherwise improve the extent to which the enhancement site(s) replace the functions and values lost because of project impacts?

Monitoring Report Appendices

Appendix A - An as-built plan showing topography to 1-foot contours, inlet/outlet structures and the locations and extent of the design plant community types (e.g. forested/shrub-scrub). Within each community type the plan shall show the species planted, but not necessary to illustrate the precise location of each individual plant. There should be a soil profile description and the actual measure organic content of the topsoil to be included in the first monitoring report.

Appendix B - A vegetation species list of volunteers in each plant community type. The volunteer species list will include those that cover at least 5% of their vegetation layer.

Appendix C - Representative photos of each mitigation/enhancement site take from the same locations for each monitoring event. Photos will be dated and clearly labeled with the direction from which the photo was taken. The photo sites will be indentified on the appropriate maps.

M.1 Wet Meadow Grassland and Eastern Box Turtle Management

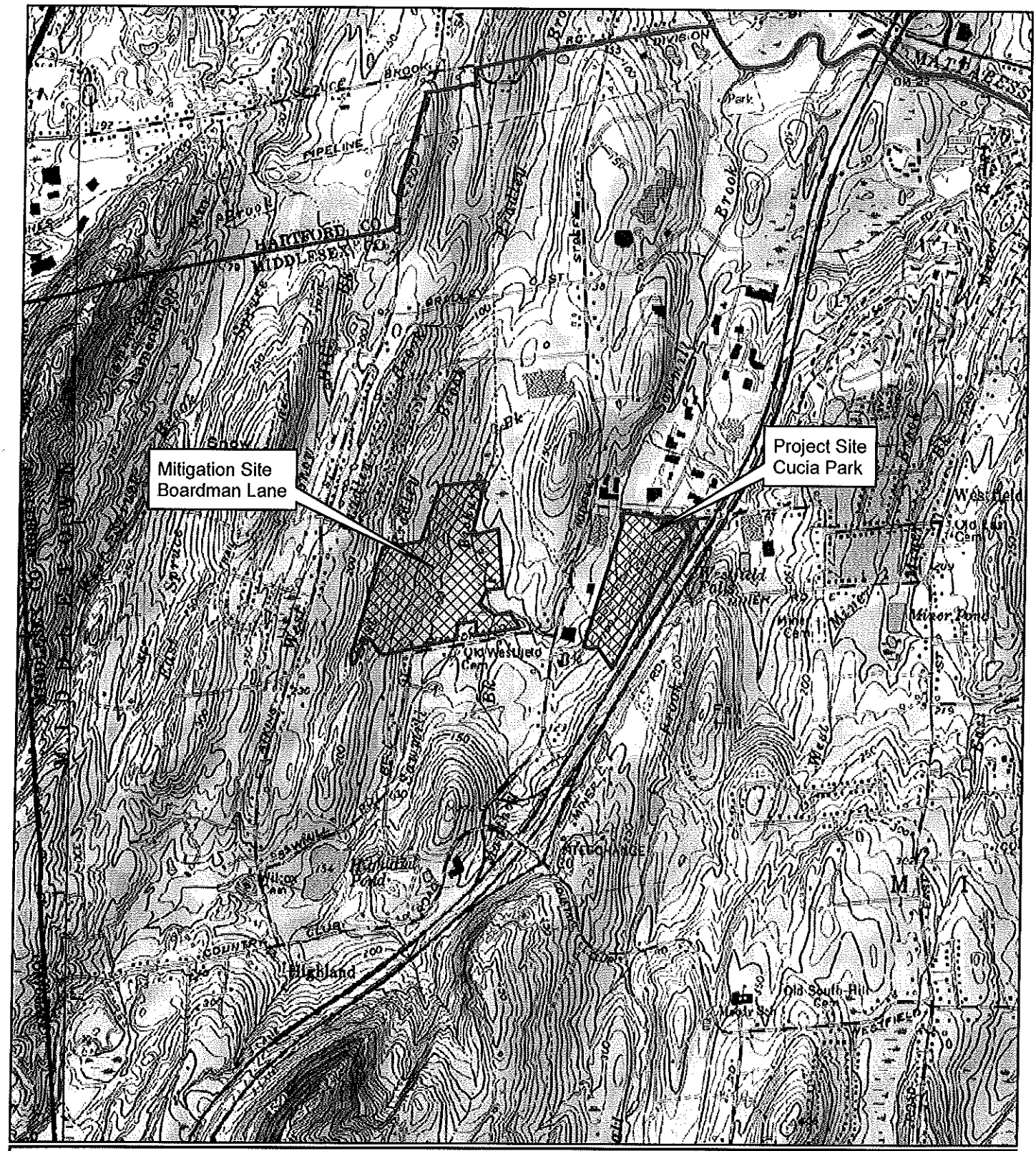
The Boardman Lane site is documented to support the Eastern Box Turtle and the Squarrose Sedge, two Connecticut Listed Species of Special Concern. In addition, the open wet meadow in the lower portion of the site offers the potential for enhanced grassland habitat that could aid in the support of these two state-listed species as well as offer ideal grassland habitat for other species.

Eastern Box Turtles inhabit a variety of habitats including old fields, wet and dry meadows, deciduous woodlands and forest edges with dappled sunlight, thickets, marshes, and bogs (CT DEP 2008, Ernst et al. 1994, Klemens 1993). Power line corridors, logged-over woodlands, and well-drained forest bottomlands also offer highly favorable habitat for this state-listed reptile. Although generally terrestrial, Eastern Box Turtles are often found near vegetated wetlands and buffer zones to freshwater habitats including small streams and ponds (CT DEP 2008, Klemens 1993). The species is easily identified by the domed carapace (top shell) and hinged plastron (under shell). The carapace shows yellow or orange markings on a dark brown to black background. The intensity and pattern of the colors is highly variable within the species. Surveys of Boardman Lane conducted in 2008 identified three (3) individual box turtles on the site adjacent to and within forested and floodplain wetlands associated with Richards Brook. An informational fact sheet is included in the Appendix D.

Squarrose Sedge is a perennial species reported from wet meadows, swamps, emergent wetlands, and banks of streams in Connecticut. Site surveys conducted in 2008 identified two areas of the Squarrose Sedge within the Boardman Lane site, a depressional forested wetland area just northwest of the southwestern farm field and northeast of the lower eastern fields. An informational fact sheet is included in the Appendix D.

Efforts to enhance habitat conditions on the Boardman Lane site for these species will focus on three areas: a grassland management plan involving a mowing program to improve habitat conditions for the box turtle and to minimize impacts to this species and others from the actual physical mowing program; invasive species control to minimize the potential for native plants to be dominated by undesirable species that reduce habitat value; and a riparian-zone planting plant that will improve conditions along the watercourses in the eastern portion of the wet meadow for habitat as well as water quality treatment.

Open areas in the upland field and meadow habitats created under the mitigation plan will be maintained according to mowing practices outlined in *Mowing Advisory Guidelines in Rare Turtle Habitat: Pastures, Successional Fields, and Hayfields* (NHESP 2009b). Clearing and mowing operations in the open fields and meadows created in the mitigation areas shall occur prior to April 1st or after October 31st to avoid accidental injury to rare turtles that may use the fields and meadows. The mowing bar shall be held at 8" to 10" above the ground surface. Directional mowing is recommended in the grass dominated fields and meadows outside the active use areas. During the months when turtles are active, mowing shall start from the center of the field or meadow habitats with the mower working back and forth across the area in a linear manner. The mowing shall then expand out from the center of the field or meadow habitat in agreement with recommended conservation mowing practices (NHESP 2009b, Sample 1997). When the field or meadow habitats border upland forest or a freshwater stream, the mowing will start as far from the woodland or stream as possible and mow slowly toward the woodland or stream. The mower speed shall be held in low gear or at the slowest speed possible to prevent the accidental injury to rare turtles. Removal of invasive species in the wet meadow area shall be performed for a three-year period to address potential problems with invasive species. Native plant communities with wildlife habitat benefits shall be maintained in the enhancement areas. Invasive species recorded in the field surveys include exotic bush honeysuckles (*Lonicera* spp.), multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus* spp.), Oriental bittersweet (*Celastrus orbiculatus*), purple loosestrife (*Lythrum salicaria*), and common reed (*Phragmites australis*) (Fact Sheets are provided in Appendix D). Invasive species will be removed using accepted vegetation management practices. Control methods will involve the use of physical and mechanical control methods and chemical or biological controls where appropriate.



Source: USGS Quadrangle Middletown CT

Coordinate System: NAD 1983,
State Plane Connecticut
FIPS 0600 Feet

N

1 inch = 2,000 feet

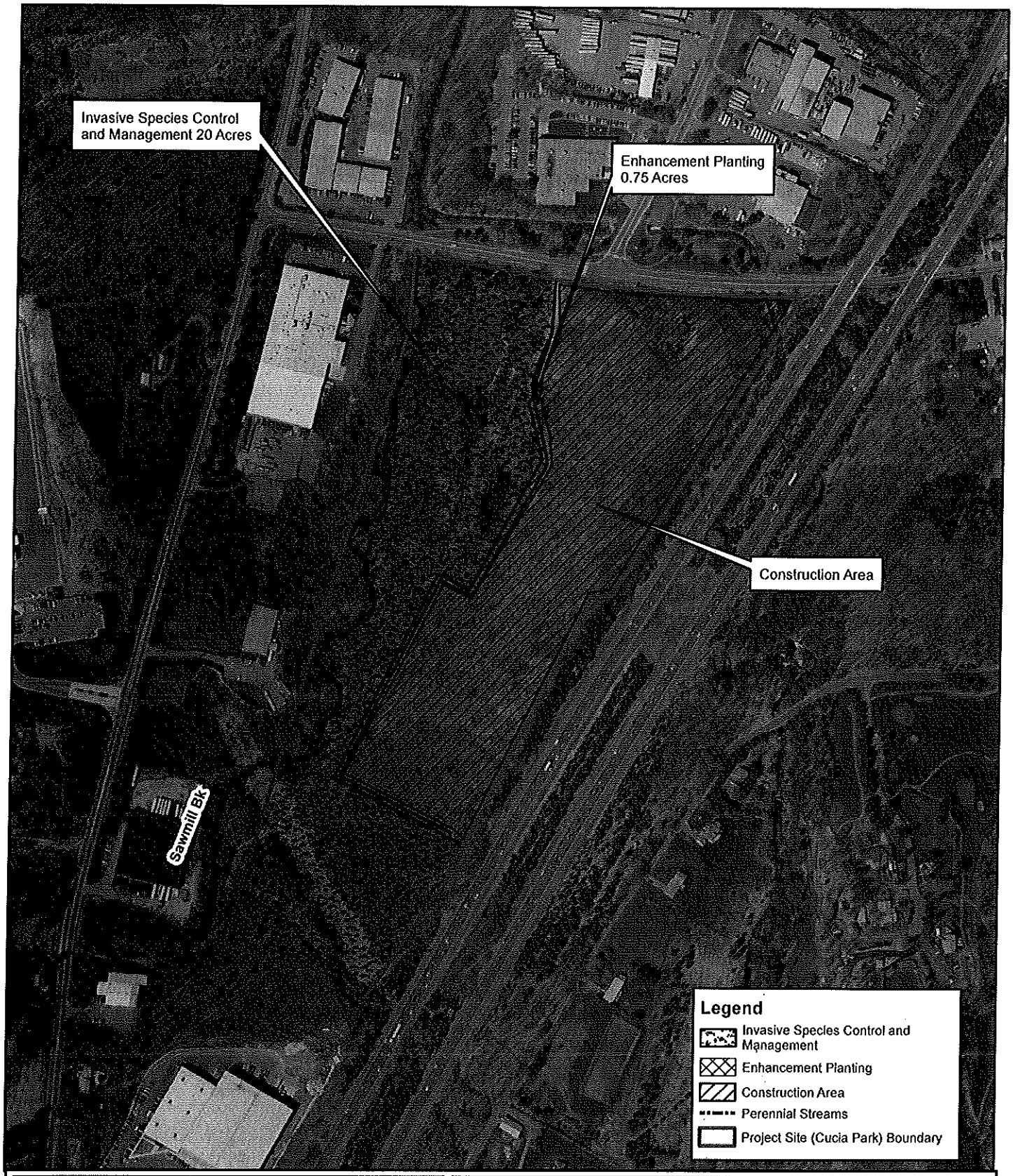
Site Locus
BRAC Realignment
Middletown, CT

SCALE	DATE	PROJECT NO.
1:3,600	12/09	60140125

AECOM

Figure Number

1



Source: CT Ortho Photograhp

Coordinate System: NAD 1927, State Plane Connecticut FIPS 0600 Feet

N

1 inch = 400 feet

BRAC Realignment
Project Site Cucia Park On-Site
Mitigation Plan
Middletown, CT

SCALE	DATE	PROJECT NO.
1:4,800	12/09	60140125

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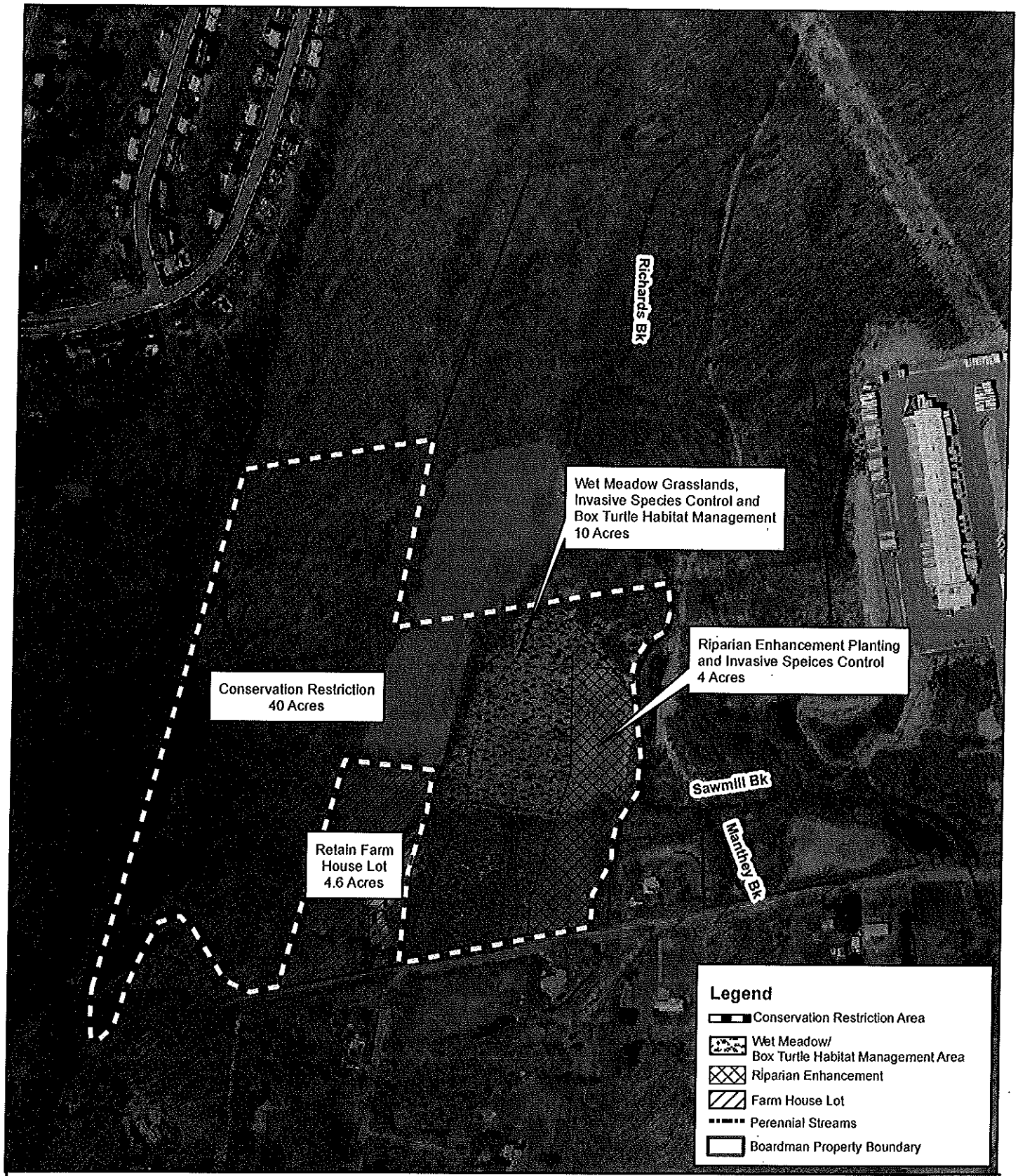
Figure Number

2



Source: CT Ortho Photograhp

Coordinate System: NAD 1927, State Plane Connecticut FIPS 0600 Feet

N

1 inch = 400 feet

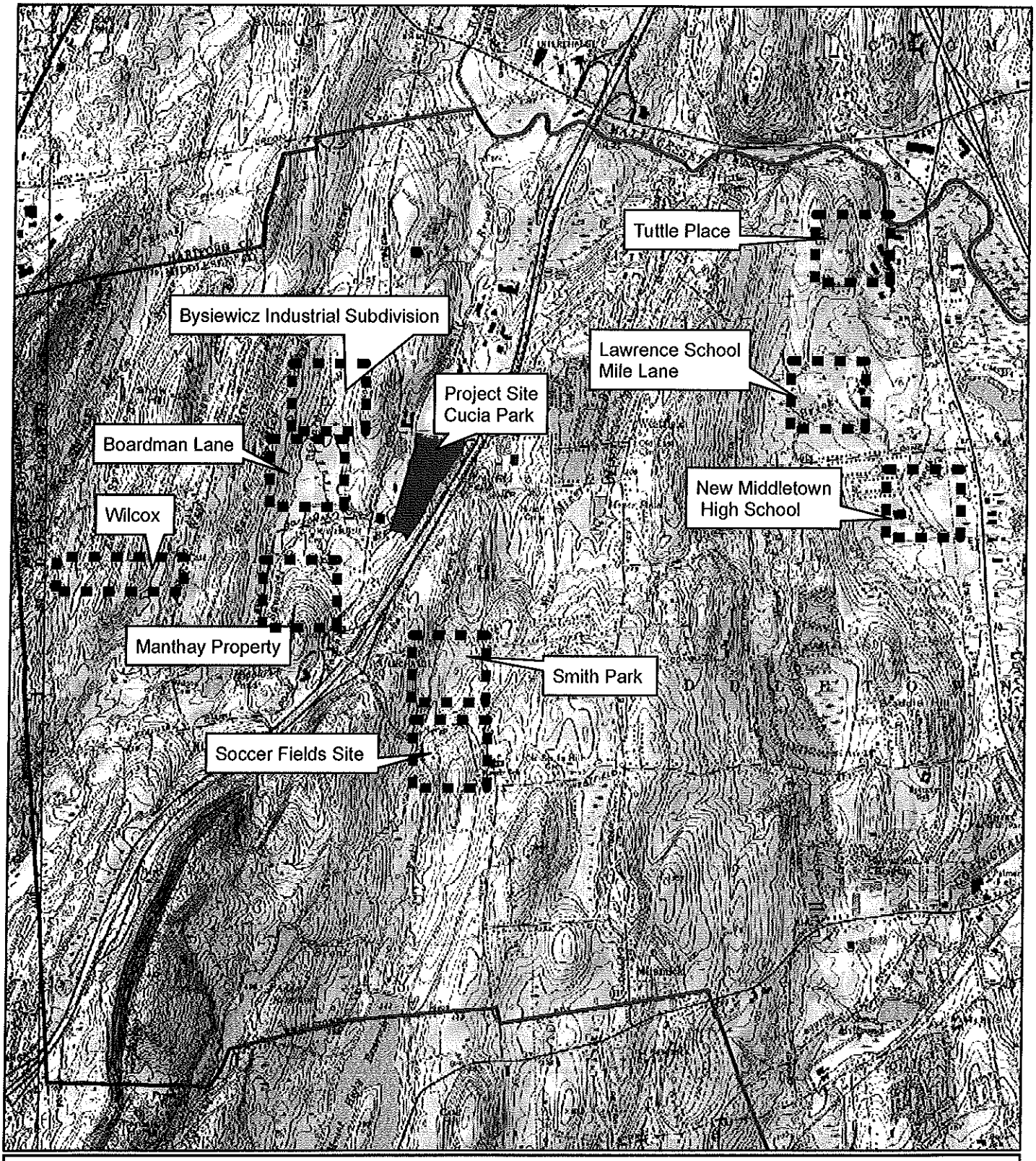
BRAC Realignment
Boardman Lane Off-Site
Mitigation Plan
Middletown, CT

SCALE	DATE	PROJECT NO.
1:4,800	12/09	60140125

AECOM

Figure Number

3



Source: USGS Quadrangle Middletown CT

Coordinate System: NAD 1983,
State Plane Connecticut
FIPS 0600 Feet

N

1 inch = 3,000 feet

BRAC Realignment Project
Alternative Mitigation Sites
Middletown, CT

SCALE	DATE	PROJECT NO.
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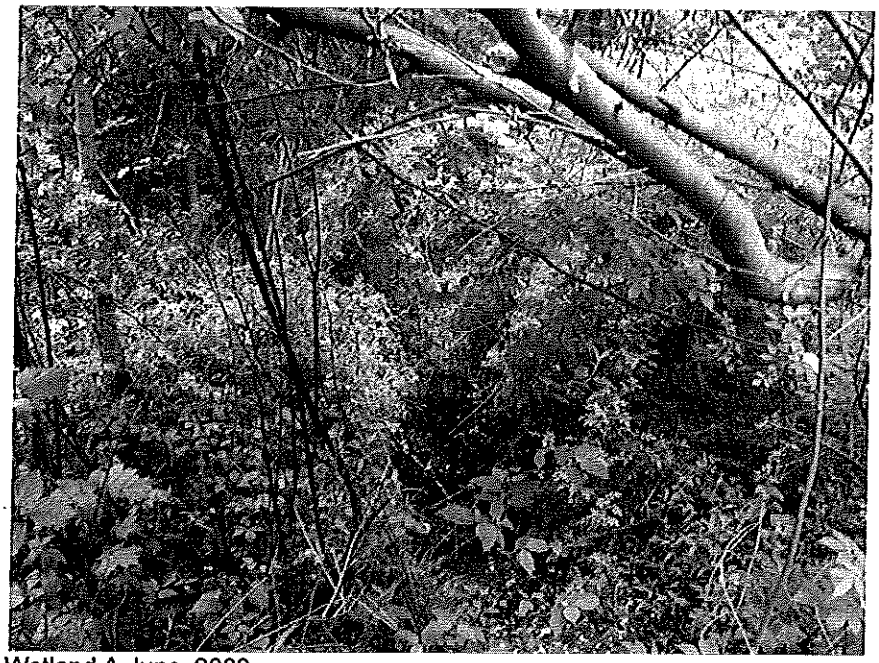
Figure Number

4

Appendix B

Photographs

Cucia Park On-Site Wetlands



Wetland A June, 2009.

Wetland A/F June, 2009.

Wetland A, Invasive species (*Phragmites australis*) in foreground June, 2009.

Wetland A June, 2009.

Wetland A June, 2009.

Wetland A June, 2009.

Wetland E, proposed construction area, June, 2009.

Wetland E - proposed construction area, June, 2009.

Wetland E - proposed construction area, June, 2009.

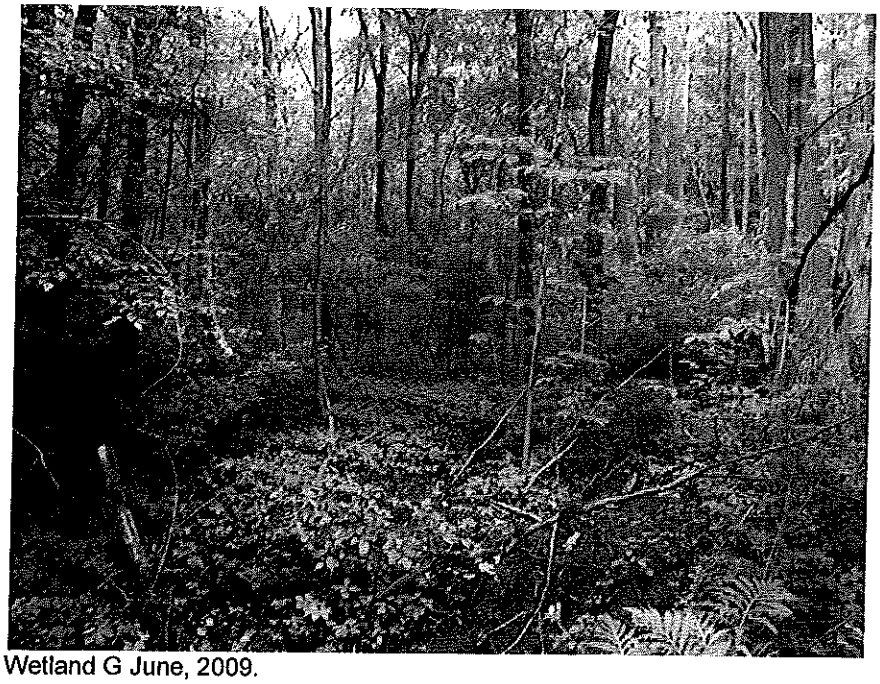
Wetland E - proposed construction area, June, 2009.

Wetland E June, 2009.

Wetland E June, 2009.

Wetland E June, 21009.

Wetland E June, 2009.



Wetland G June, 2009.

Wetland G June, 2009.

Wetland G June, 2009.

Boardman Lane Off-Site Mitigation Parcel

Lower First Field, Proposed Mitigation – Riparian Enhancement, Box Turtle Habitat and Invasive Species Management.

Lower First Field, Proposed Riparian Enhancement, Box Turtle Habitat and Invasive Species Management.

Lower Second Field, Proposed Wet Meadow Grasslands, Invasive Species and Box Turtle Habitat Management.

Lower Second Field, Proposed Wet Meadow Grasslands, Invasive Species and Box Turtle Habitat Management in background.

Lower Second Field, Proposed Riparian Enhancement, Invasive Species Management and Box Turtle Habitat Management.

Boardman northern marsh, not part of Mitigation Plan, December, 2009.

Lower Second Field, Proposed Riparian Enhancement, Invasive Species Management and Box Turtle Habitat Management, December, 2009.

Lower Second Field, Proposed Wet Meadow Grasslands, Invasive Species and Box Turtle Habitat Management, December, 2009. Purple loosestrife (*Lythrum salicaria*) along field edge.

Lower Second Field, Proposed Wet Meadow Grasslands, Invasive Species and Box Turtle Habitat Management, December, 2009.

Boardman Site, north of mitigation parcel Richards Brook culvert December, 2009.

Boardman Site, northern emergent marsh north of migration parcel, December, 2009.

Lower Second Field, Proposed Riparian Enhancement, Invasive Species Management and Box Turtle Habitat Management, December, 2009.

Lower Second Field, Proposed Riparian Enhancement, Invasive Species Management and Box Turtle Habitat Management, December, 2009.

Confluence of Richards Brook and Sawmill Brook, located east of Boardman Site, December, 2009.

Confluence of Richards Brook and Sawmill Brook, located east of Boardman Site, December, 2009.

Lower Second Field, Proposed Riparian Enhancement, Invasive Species Management and Box Turtle Habitat Management in foreground, Wet Meadow Grasslands, Invasive Species Management in center, and Conservation Restriction in upper field in background.

Lower Second Field, Proposed Invasive Species and Box Turtle Habitat Management, Purple loosestrife (*Lythrum salicaria*) in foreground and upper field Conservation Restriction.

Lower First Field, Proposed Riparian Enhancement, Invasive Species Management and Box Turtle Habitat Management in foreground and Wet Meadow Grasslands, Turtle Habitat and Invasive Species Management in background.

Lower First Field, Proposed Riparian Enhancement, Invasive Species and Box Turtle Habitat Management to the right, Wet Meadow Grasslands, Turtle Habitat and Invasive Species Management to the left.

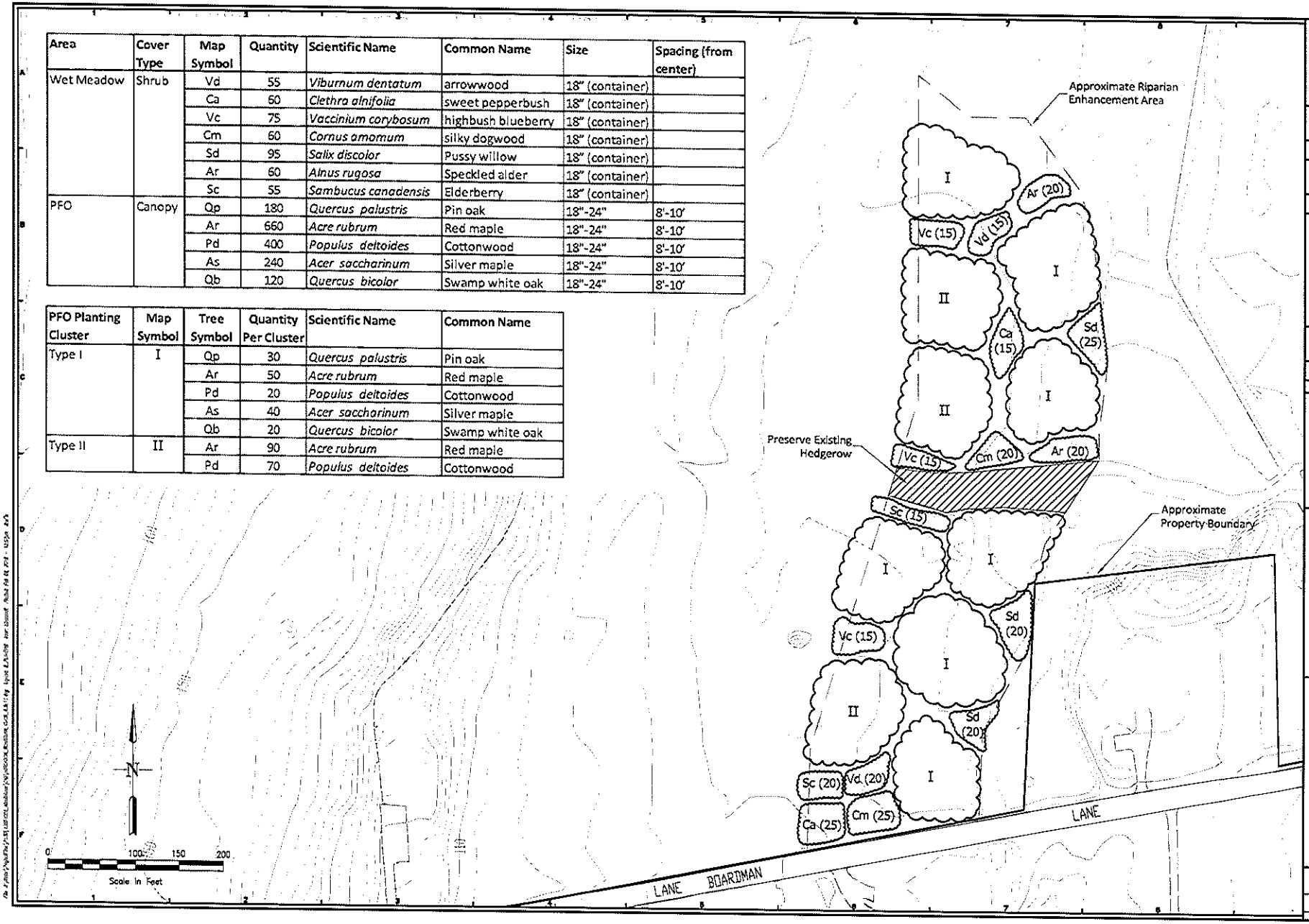
Appendix C

Mitigation Area Plans

Overview
Off-Site Mitigation
Boardman Lane
BRAC Realignment
Mitigation Plan
Boardman Lane
Middletown, CT
PROJ. NO: 60140125
DATE: 12/2009
AECOM
DRAWING NUMBER
1
SHEET NUMBER
1 of 6
REVISION
0
NO. DRN. DATE REVISION CHK. DATE APP'D. DATE
Approximate Property Boundary
Wet Meadow Grasslands Invasive Species Control And Box Turtle Habitat Management (10 Acres)
See Sheet 2 For Planting Plan
Riparian Enhancement Planting Woody Species And Invasive Species Control (4 Acres)
Conservation Restriction Boundary (Typ.)
Conservation Restriction (40 Acres)
Scale In Feet
0
300
450
600

Area	Cover Type	Map Symbol	Quantity	Scientific Name	Common Name	Size	Spacing (from center)
Wet Meadow	Shrub	Vd	55	*Viburnum dentatum*	arrowwood	18" (container)	
		Ca	60	*Clethra alnifolia*	sweet pepperbush	18" (container)	
		Vc	75	*Vaccinium corybosum*	highbush blueberry	18" (container)	
		Cm	60	*Cornus amomum*	silky dogwood	18" (container)	
		Sd	95	*Salix discolor*	Pussy willow	18" (container)	
		Ar	60	*Alnus rugosa*	Speckled alder	18" (container)	
		Sc	55	*Sambucus canadensis*	Elderberry	18" (container)	
PFO	Canopy	Qp	180	*Quercus palustris*	Pin oak	18"-24"	8'-10'
		Ar	660	*Acre rubrum*	Red maple	18"-24"	8'-10'
		Pd	400	*Populus deltoides*	Cottonwood	18"-24"	8'-10'
		As	240	*Acer saccharinum*	Silver maple	18"-24"	8'-10'
		Qb	120	*Quercus bicolor*	Swamp white oak	18"-24"	8'-10'

PFO Planting Cluster	Map Symbol	Tree Symbol	Quantity Per Cluster	Scientific Name	Common Name
Type I	I	Qp	30	*Quercus palustris*	Pin oak
		Ar	50	*Acre rubrum*	Red maple
		Pd	20	*Populus deltoides*	Cottonwood
		As	40	*Acer saccharinum*	Silver maple
		Qb	20	*Quercus bicolor*	Swamp white oak
Type II	II	Ar	90	*Acre rubrum*	Red maple
		Pd	70	*Populus deltoides*	Cottonwood



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Boardman Lane
Middletown, CT

DATE: 12/2009

PROJ. NO.: 60140125

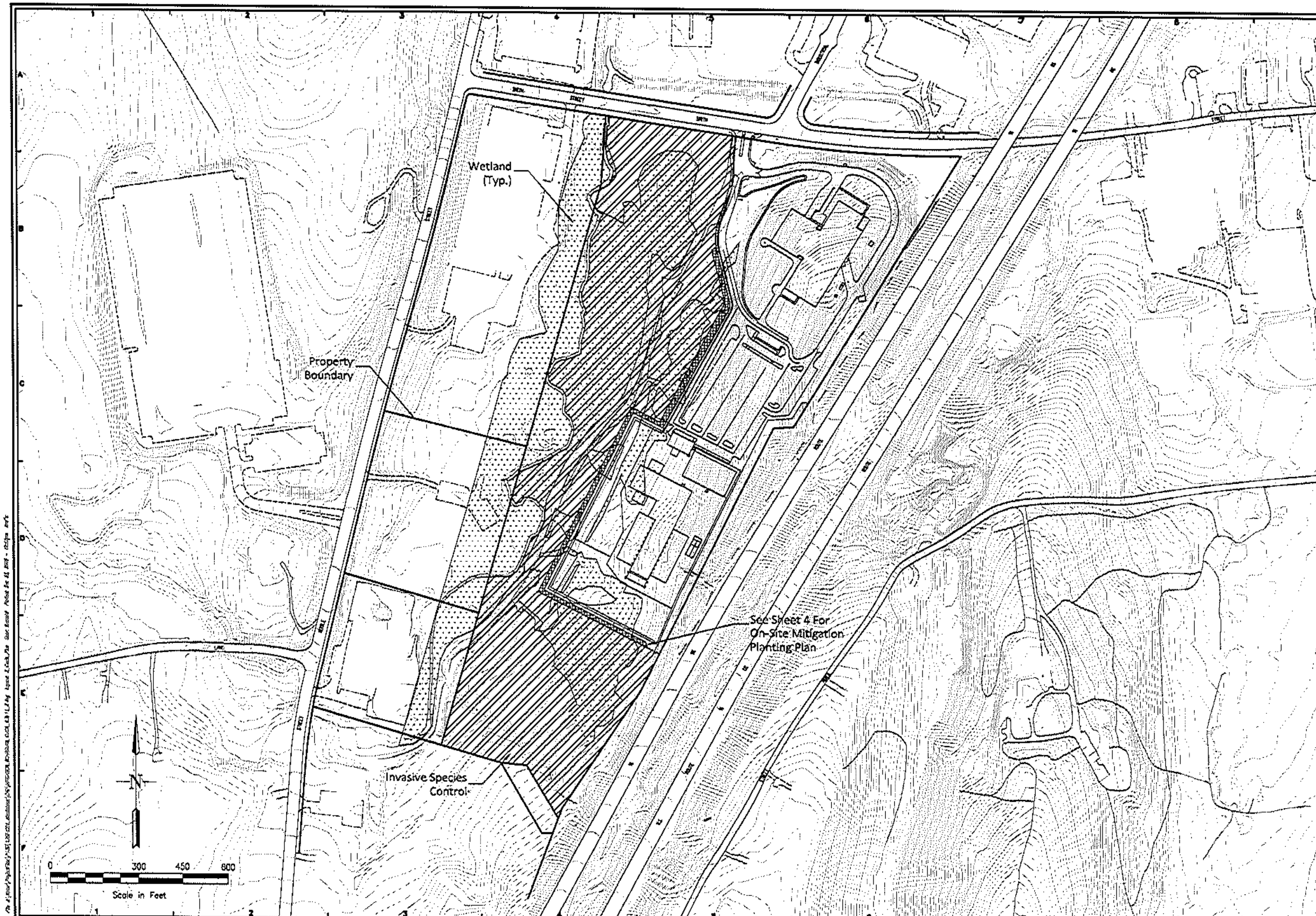
Planting Plan
Off-Site Mitigation
Boardman Lane

BRAC Realignment
Mitigation Plan

DRAWING NUMBER
2

SHEET NUMBER
2 of 6

REVISION 0



Overview
On-Site Mitigation
Cucla Park

BRAC Realignment
Mitigation Plan

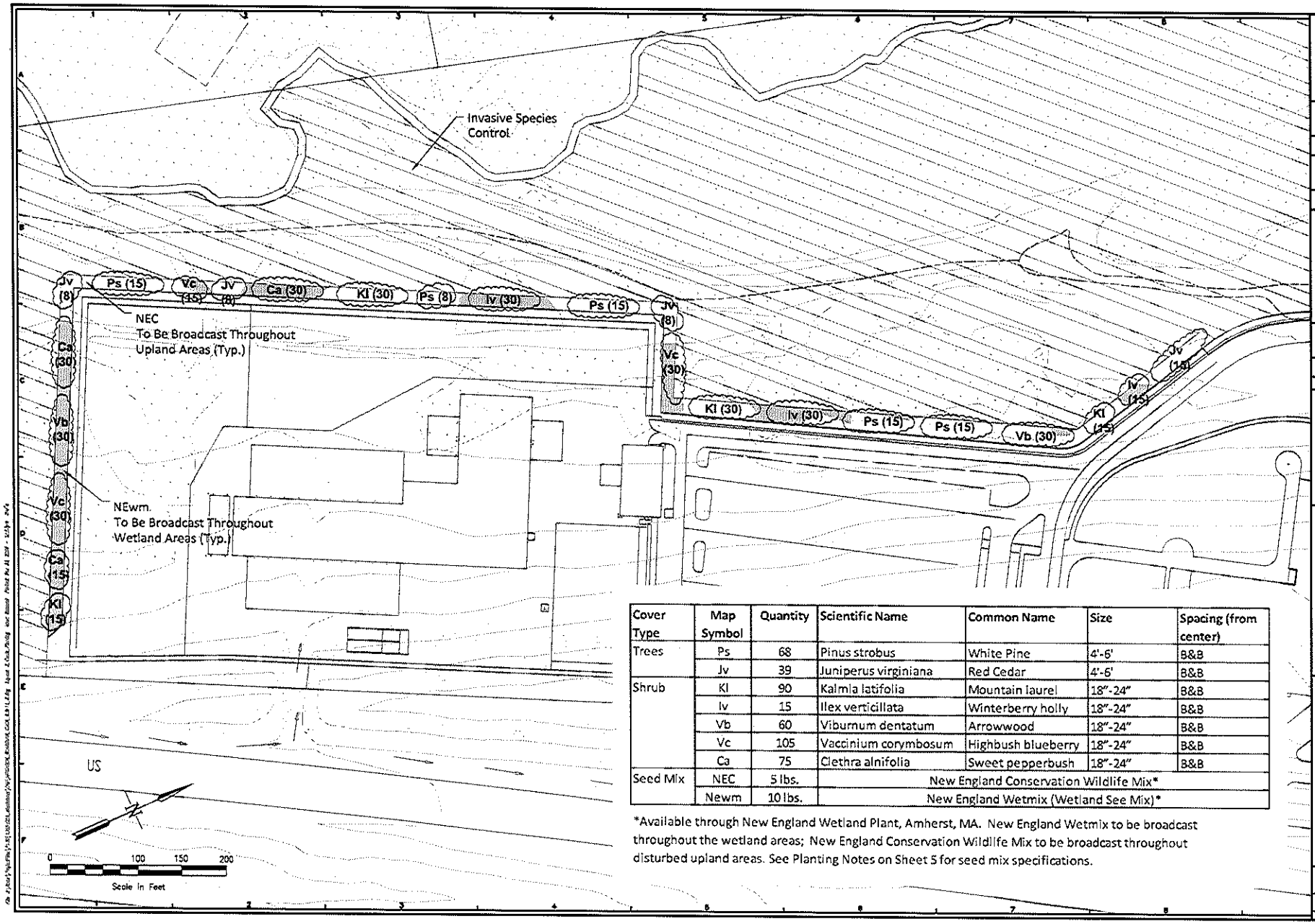
Smith Street
Middletown, CT

PROJ. NO: 60140125 | DATE: 12/2009

AECOM

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE

DRAWING NUMBER 3
SHEET NUMBER 3 of 8
REVISION 0



Cover Type	Map Symbol	Quantity	Scientific Name	Common Name	Size	Spacing (from center)
Trees	Ps	68	Pinus strobus	White Pine	4'-6'	B&B
	Jv	39	Juniperus virginiana	Red Cedar	4'-6'	B&B
Shrub	Kl	90	Kalmia latifolia	Mountain laurel	18"-24"	B&B
	Iv	15	Ilex verticillata	Winterberry holly	18"-24"	B&B
	Vb	60	Viburnum dentatum	Arrowwood	18"-24"	B&B
	Vc	105	Vaccinium corymbosum	Highbush blueberry	18"-24"	B&B
	Ca	75	Clethra alnifolia	Sweet pepperbush	18"-24"	B&B
Seed Mix	NEC	5 lbs.	New England Conservation Wildlife Mix*			
	Newm	10 lbs.	New England Wetmix (Wetland See Mix)*			

*Available through New England Wetland Plant, Amherst, MA. New England Wetmix to be broadcast throughout the wetland areas; New England Conservation Wildlife Mix to be broadcast throughout disturbed upland areas. See Planting Notes on Sheet 5 for seed mix specifications.

NO. | DRWN | DATE | REVISION | CHKD | DATE | APPD | DATE

AECOM

Smith Street
Middletown, CT

PROJ. NO: 60140105 | DATE: 12/2009

Overview
On-Site Mitigation
Cucia Park

BRAC Realignment
Mitigation Plan

DRAWING NUMBER
4

SHEET NUMBER
4 of 6

REVISION 0

Tree and Shrub Planting Notes

Site Preparation
The planting hole must be dug no deeper than the rootball as measured from the trunk flare to the bottom of the ball. Planting holes dug deeper than the rootball often result in the settling of the plant above the trunk flare and structural roots which can result in the rootball being planted too deep. Research shows that the fibrous or absorbing roots of most woody plants are usually found within the top 6 to 12 inches of soil, and since root development often extends beyond the canopy or dripline, it is now recommended that the planting area be loosened and aerated at least 3 to 5 times the diameter of the rootball.

Planting Hole Preparation
One of the most common errors in tree planting is that the rootball is either planted too deep or too high, both of which can cause serious problems.

To properly plant balled and burlapped (B&B) plant material, start by locating the point at which the trunk flare begins. In some cases, the trunk flare junction may be buried in the top of the rootball and it may be necessary to loosen the burlap at the top of the ball to properly locate the junction. Measuring from the trunk flare to the bottom of the ball will give the correct planting hole depth. (Alternatively, if the trunk flare is not well developed, the root ball can be probed for structural roots using a surveyor's chaining pin or similar tool. Generally the uppermost structural roots in the rootball should be planted within 1 - 3 inches of the soil surface, measured 2 - 5 inches from the trunk.

The integrity of the rootball should be maintained until it is secure in the hole. In the event that some of the soil falls away from the roots, proceed with the planting, taking care to ensure that the roots do not dry out from sun or wind. The planting hole size should be approximately 3 to 5 times the width of the ball and have sloping sides.

Setting the Plant
Carefully set the plant in the hole so that the trunk flare is at, or 1 to 2 inches above, the existing grade. Once the plant is properly placed, cut away and remove all visible rope and burlap. If the rootball appears in danger of completely collapsing, remove the rope and burlap from only the top one-third of the ball. Although still subject to debate, it is recommended that as much of the wire basket as possible, or at least the top 8 to 16 inches of the wire basket, be removed once the root ball is stable in the planting hole. Do not leave any protruding points of wire, which could cause injury.

Backfilling the Planting Hole
According to research, backfilling with soil dug from the planting hole is preferable to mixing the soil with large amounts of organic soil amendments such as peat moss, compost, etc. The addition of an organic soil amendment may be called for if the existing soil is of poor quality, such as excessively sandy or heavy clay soils or those consisting of undesirable fill material. Alternatively, quality topsoil, similar in texture to the existing soil, may be brought in and used for backfill.

While backfilling the hole, it has been customary to tamp the soil to avoid leaving large air pockets. However, this practice often results in the soil being packed so firmly as to drive out all the fine air spaces needed for a well-aerated soil. An alternative to tamping the soil would be to water the soil halfway through the backfill process and allow it to drain. When the water has drained away, resume backfilling and water again thoroughly. If the practice of tamping the soil is chosen, it should be done lightly so as to not compact the soil in the planting hole.

To complete the backfilling, smooth the surface soil and check to ensure that the trunk flare is completely exposed. (The structural roots should be within the top 3 inches of soil as measured 4 inches from the trunk.) Water the rootball and planting area immediately after backfilling.

Watering
Water is a critical factor to the successful establishment of landscape plants. Excessive or insufficient water will impede the formation and/or elongation of new roots. Immediately after planting, water the root ball and the planting area deeply. The root ball of newly planted trees must receive adequate water weekly during the entire first growing season, right up until dormancy in the fall, to become established. More frequent irrigation may be needed during the summer season or in times of extended drought. Rainfall alone may not provide the adequate, consistent moisture necessary for establishment. On larger caliper trees, weekly watering is necessary through the next several growing seasons. According to research, in the Northern part of the US, the establishment period, for recently transplanted trees, is approximately one year for each one inch of trunk caliper.

Fertilizing
Fertilization is not likely to be effective during the first growing season, as long as there is no nutrient deficiency. The addition of fertilizer and limestone should be made according to recommendations based on a soil test. Avoid placing water-soluble (quick-release) nitrogen fertilizer directly in the planting hole as this may cause injury to roots. If needed, a slow release or organic form of nitrogen could be mixed into the planting area or be applied on the soil surface around the tree basin.

Staking
While there are many opinions on the method and value of staking trees at planting time, most experts agree that staking is not necessary for all trees. Trunk strength, size of the canopy, wind direction and site traffic problems should all be considered before staking a tree. Research has shown that staked trees may develop a smaller root system and decreased trunk taper. If the rootball is stable in the soil, then it may not need to be staked. However, if the root ball is unstable and staking is required, try to attach stakes low on the trunk and allow some sway. In most instances, stakes should be removed after one growing season.

Mulching
Mulching is a cultural practice that can be of benefit in the landscape when done correctly. Mulching will reduce weeds, moderate soil temperatures, conserve soil moisture in the root zone, and add an aesthetic quality to the landscape. However, improper mulching can impair plant health and may lead to the decline of the plant material.

Organic mulch should be placed in a wide band around the plant, approximately 3 times the diameter of the rootball, over the root zone and no more than 2 to 4 inches deep, tapering to, but not touching, the trunk. Mulch piled up against the trunk may cause rotting of the bark and can create entry points for insects or disease organisms. Field mice may also inhabit deep mulch and feed on the bark. AVOID "VOLCANO MULCHING".

Pruning
After transplanting, prune only broken or damaged branches. Top pruning to compensate for root loss is no longer recommended. It is important to leave as much foliage on the tree as possible because carbohydrates and other products produced by photosynthesis in the leaves are necessary for root system regeneration and development.

(Planting Notes Continued on Sheet 6)

NO. | DRAWN DATE | REVISION | CHKD DATE | APPV'D DATE
AECOM
Boardman Lane & Cuda Park
Middletown, CT
PROJ. NO.: 60149125 | DATE: 12/2009
Planting Notes
Mitigation Plan
BRAC Realignment
Mitigation Plan
DRAWING NUMBER
5
SHEET NUMBER
5 of 6
REVISION 0

Tree and Shrub Planting Notes (Cont.)

Tree Wrapping

The bark on a tree or shrub is as important as skin to an animal. It acts as a barrier to exclude insects and disease organisms from the vascular system, which lies directly under the bark. Some bark injuries may occur because of damage from the sun (sunscald) or temperature extremes (frost cracks). For many years, it has been a common practice to use tree wrap on newly planted or thin-barked trees in an effort to reduce sun or temperature damage to the bark.

Research has found that some tree wraps may not provide the protection that was originally intended. In experiments using plastic tree guards on dogwoods, large numbers of dogwood borers were found under the guards while few were found in trees without guards. In addition, some tree wraps were found to retain excess moisture beneath the wrap. This may encourage fungal or bacterial growth, especially if there were pre-existing wounds in the trunk.

If tree wrap is to be used, it is recommended that appropriate material be selected, checked frequently, and the wrap be removed during periods of active growth.

It is hoped that these guidelines, together with the selection of appropriate and healthy plant material, will be of help in promoting improved plant health in the landscape.

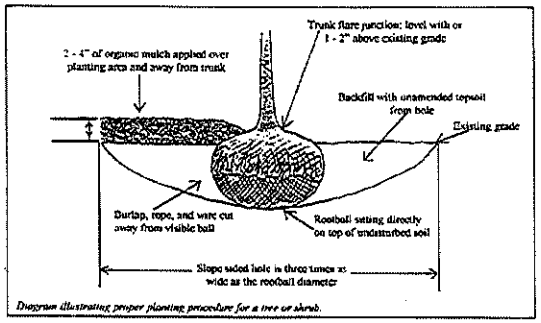


Diagram illustrating proper planting procedure for a tree or shrub.

2009 New England Conservation/Wildlife Mix*

Botanical Name	Common Name	Ind.
Andropogon gerardii	Big Bluestem	FAC
Asclepias syriaca	Common Milkweed	FACU-
Aster novae-angliae	New England Aster	FACW-
Chamaecrista fasciculata (Cassia f.)	Partridge Pea	FACU
Desmodium canadense	Showy Tick Trefoil	FAC
Elymus virginicus	Virginia Wild Rye	FACW-
Eupatorium maculatum	Spotted Joe Pye Weed	FACW
Euthamia graminifolia (Solidago g.)	Grass Leaved Goldenrod	FAC
Festuca rubra	Creeping Red Fescue	FACU
Heliopsis helianthoides	Ox Eye Sunflower	UPL
Panicum clandestinum	Deer Tongue	FAC+
Panicum virgatum	Switch Grass	FAC
Rudbeckia laciniata	Tall/Green Headed Coneflower	FACW
Schizachyrium scoparium	Little Bluestem	FACU
Solidago juncea	Early Goldenrod	
Sorghastrum nutans	Indian Grass	UPL

New England Conservation/Wildlife Mix provides a permanent cover of native grasses, wildflowers and legumes to provide both erosion control and wildlife habitat. This mix is designed to be a no maintenance seeding, and it is appropriate to cut and fill slopes, detention basin slopes, and disturbed areas adjacent to commercial and residential projects. Always apply on clean bare soil. The mix may be applied by hydro-seeding, by mechanical spreader, or on small sites it can be spread by hand. Lightly rake, or roll to ensure proper soil-seed contact. Best results are obtained with a spring seeding. Late spring and summer seeding will benefit with a light mulching of weed-free straw to conserve moisture. If conditions are drier than usual, watering may be required. Late fall and winter dormant seeding require an increase in the seeding rate. Fertilization is not required unless the soils are particularly infertile. Preparation of a clean weed free soil surface is necessary for optimal results.

2009 New England Wetmix*

Botanical Name	Common Name	Ind.
Alisma plantago-aquatica	Mud Plantain	OBL
Asclepias incarnata	Swamp Milkweed	OBL
Aster novi-belgii	New York Aster	FACW+
Bidens cernua	Nodding Bur Marigold	OBL
Carex comosa	Bristly/Cosmos Sedge	OBL
Carex crinita	Fringed Sedge (Nodding)	OBL
Carex lupulina	Hop Sedge	OBL
Carex lurida	Lurid Sedge (Shallow)	OBL
Carex scoparia	Blunt Broom Sedge	FACW
Carex vulpinoidea	Fox Sedge	OBL
Eupatorium maculatum	Spotted Joe Pye Weed	FACW
Eupatorium perfoliatum	Boneset	FACW
Glyceria canadensis	Rattlesnake Grass	OBL
Glyceria striata	Fowl Mannagrass	OBL
Juncus effusus	Soft Rush	FACW+
Mimulus ringens	Square Stemmed Monkey Flower	OBL
Onoclea sensibilis	Sensitive Fern	FACW
Scirpus atrovirens	Green Bulrush	OBL
Scirpus cyperinus	Wool Grass	FACW
Scirpus validus	Soft Stem Bulrush	OBL
Verbena hastata	Blue Vervain	FACW

New England Wetmix (wetland seed mix) contains a wide variety of native seeds which are suitable for most wetland restoration sites that are not permanently inundated. All species are best suited to moist disturbed ground as found in most wet meadows, scrub shrub, or forested wetland restoration areas. This mix is well suited for detention basin borders, and the bottom of detention basins not generally under standing water. The seeds will not germinate under inundated conditions. If planted during the fall months, the seed mix will germinate the following spring. During the first season of growth, several species will produce seeds, while other species will produce seeds after the second growing season. Not all species will grow in all wetland situations. This mix is composed of the wetland species most likely to grow in created/restored wetlands and should produce more than 75% ground cover in two full growing seasons.

* From New England Wetland Plants, Amherst, MA 2009 Catalog.

	DRAWN	DATE	REVISION	CHKD	DATE	APPD	DATE

AECOM

Boardman Lane & Cuda Park
Middletown, CT

DATE: 12/2009

PROJ. NO.: 60140125

Planting Notes (Cont.)
Mitigation Plan

BRAC Realignment
Mitigation Plan

DRAWING NUMBER
6

SHEET NUMBER
5 of 6

REVISION 0

Appendix D

Species Fact Sheets

Connecticut Department of Environmental Protection

Eastern Box Turtle

Terrapene carolina carolina

State Species of Special Concern

Description
The eastern box turtle is probably the most familiar of the 8 species of turtles found in Connecticut's landscape. It is known for its high-domed carapace (top shell). The carapace has irregular yellow or orange blotches on a brown to black background that mimic sunlight dappling on the forest floor. The plastron (under shell) may be brown or black and may have an irregular pattern of cream or yellow. The length of the carapace usually ranges from 4.5 to 6.5 inches, but can measure up to 8 inches long. The shell is made up of a combination of scales and bones, and it includes the ribs and much of the backbone.

Each individual turtle has distinctive head markings. Males usually have red eyes and a concave plastron, while females have brown eyes and a flat plastron. Box turtles also have a horny beak, stout limbs, and feet that are webbed at the base. This turtle gets its name from its ability to completely withdraw into its shell, closing itself in with a hinged plastron. Box turtles are the only Connecticut turtle with this ability.

Range
Eastern box turtles are found throughout Connecticut, except at the highest elevations. They range from southeastern Maine to southeastern New York, west to central Illinois, and south to northern Florida.

Habitat and Diet
In Connecticut, this terrestrial turtle inhabits a variety of habitats, including woodlands, field edges, thickets, marshes, bogs, and stream banks. Typically, however, box turtles are found in well-drained forest bottomlands and open deciduous forests. They will use wetland areas at various times during the season. During the hottest part of a summer day, they will wander to find springs and seepages where they can burrow into the moist soil. Activity is restricted to mornings and evenings during summer, with little to no nighttime activity, except for egg-laying females. Box turtles have a limited home range where they spend their entire life, ranging from 0.5 to 10 acres (usually less than 2 acres).

Box turtles are omnivorous and will feed on a variety of food items, including earthworms, slugs, snails, insects, frogs, toads, small snakes, carrion, leaves, grass, berries, fruits, and fungi.

Life History
From October to April, box turtles hibernate by burrowing into loose soil, decaying vegetation, and mud. They tend to hibernate in woodlands, on the edge of woodlands, and sometimes near closed canopy wetlands in the forest. Box turtles may return to the same place to hibernate year after year. As soon as they come out of hibernation, box turtles begin feeding and searching for mates.

The breeding season begins in April and may continue through fall. Box turtles usually do not breed until they are about 10 years old. This late maturity is a result of their long lifespan, which can range up to 50 to even over 100 years of age. The females do not have to mate every year to lay eggs as they can store sperm for up to 4 years. In mid-May to late June, the females will travel from a few feet to more than a mile within their home range to find a location to dig a nest and lay their eggs. The 3 to 8 eggs are covered with dirt and left to be warmed by the sun. During this vulnerable time, skunks, foxes, snakes, crows, and raccoons often raid nests. Sometimes, entire nests are destroyed. If the eggs survive, they will hatch in late summer to early fall (about 2 months after being laid). If they hatch in the fall, the young turtles may spend the winter in the nest and come out the following spring.

As soon as the young turtles hatch, they are on their own and receive no care from the adults. This is a dangerous time for young box turtles because they do not develop the hinge for closing into their shell until they are about 4 to 5 years old. Until then, they cannot entirely retreat into their shells. Raccoons, skunks, foxes, dogs, and some birds will prey on young turtles.

Conservation Concerns
The eastern box turtle was once common throughout the state, mostly in the central Connecticut lowlands. However, its distribution is now spotty, although where found, turtles may be locally abundant. Because of the population decline in Connecticut, the box turtle was added to the state's List of Endangered, Threatened, and Special Concern Species when it was revised in 1998. It is currently listed as a species of special concern. The box turtle also is protected from international trade by the 1994 CITES treaty. It is of conservation concern in all the states where it occurs at its northeastern range limit, which includes southern New England and southeastern New York.

Many states have laws that protect box turtles and prohibit their collection. In Connecticut, eastern box turtles cannot be collected from the wild (DEP regulations 26-66-14A). Another regulation (DEP regulations 26-55-3D) "grandfathers" those who have a box turtle collected before 1998. This regulation limits possession to a single turtle collected before 1998. These regulations provide some protection for the turtles, but not enough to combat some of the even bigger threats these animals face. The main threats in Connecticut (and other states) are loss and fragmentation of habitat due to deforestation and spreading suburban development; vehicle strikes on the busy roads that bisect the landscape; and indiscriminate (and now illegal) collection of individuals for pets.

Loss of habitat is probably the greatest threat to turtles. Some turtles may be killed directly by construction activities, but many more are lost when important habitat areas for shelter, feeding, hibernation, or nesting are destroyed. As remaining habitat is fragmented into smaller pieces, turtle populations can become small and isolated.

Adult box turtles are relatively free from predators due to their unique shells. The shell of a box turtle is extremely hard. However, the shell is not hard enough to survive being run over by a vehicle. Roads bisecting turtle habitat can seriously deplete the local population. Most vehicle fatalities are pregnant females searching for a nest site.

How You Can Help

- Leave turtles in the wild. They should never be kept as pets. Whether collected singly or for the pet trade, turtles that are removed from the wild are no longer able to be a reproducing member of a population. Every turtle removed reduces the ability of the population to maintain itself.
- Never release a captive turtle into the wild. It probably would not survive, may not be native to the area, and could introduce diseases to wild populations.
- Do not disturb turtles nesting in yards or gardens.
- As you drive, watch out for turtles crossing the road. Turtles found crossing roads in June and July are often pregnant females and they should be helped on their way and not collected. Without creating a traffic hazard or compromising safety, drivers are encouraged to avoid running over turtles that are crossing roads. Also, still keeping safety precautions in mind, you may elect to pick up turtles from the road and move them onto the side they are headed. Never relocate a turtle to another area that is far from where you found it.
- Learn more about turtles and their conservation concerns. Spread the word to others on how they can help Connecticut's box turtle population.

The production of this Endangered and Threatened Species Fact Sheet Series is made possible by donations to the Endangered Species-Wildlife Income Tax Checkoff Fund.
(5/08)

FACT SHEET
Carex squarrosa L.
Squarrose Sedge

Description

Fruiting period	May to August.
Culm height	30 - 80 cm.
Leaf	3 - 6 mm wide.
Terminal spike	gynecandrous.
Lateral spike	N/A
Perigynium	planoconvex to biconvex in cross section.
Achene	trigonous in cross section.
Style	persistent.

Habitat
Wet meadows, old fields, woodland edges.

Quick description
Unispicate culm; yellow/green in coloration.

Similar species
Carex frankii

Author and publication information for name
Carex squarrosa Linnaeus, Sp. Pl. 2: 973. 1753.

Conservation and Wetland Status

State	Status
Connecticut	Special concern

Wetland Status: Facultative Wetland

Vernacular name: Squarrose Sedge

Section
Carex sect. *Squarrosae*

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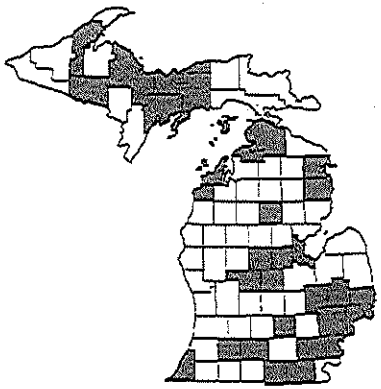
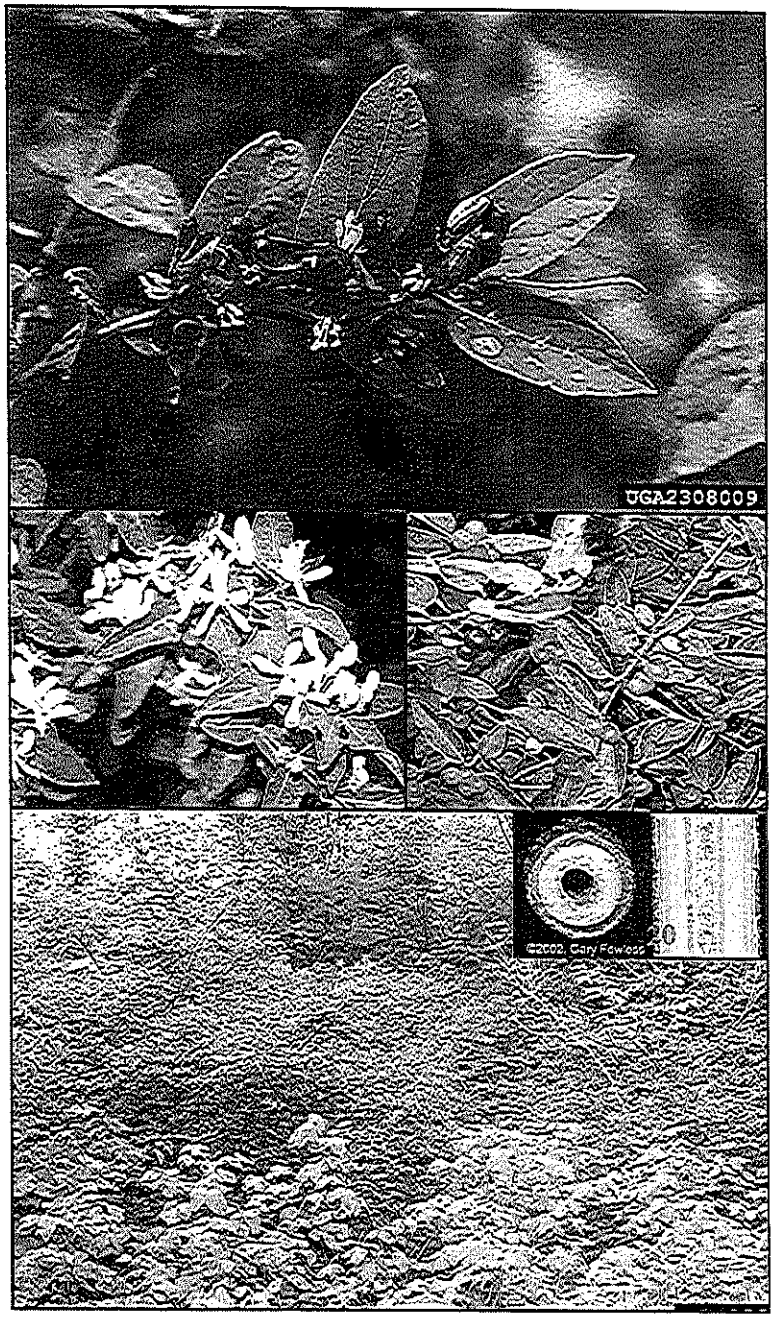
Tartarian Honeysuckle

Lonicera tatarica

Habit: Deciduous upright to spreading shrub growing to 3 m (9 ft) tall; shallow roots.
Leaves: Simple, opposite, oval to oblong, short, hairless, leaves with pointed tips; 3-6 cm long and 2-4 cm wide with smooth margins; dark green above and paler beneath; early leaf out, long growing season.
Stems/Bark: Twigs are slender, brown to reddish with brown pith; multiple stems; numerous arching branches; older branches often hollow; bark is light gray, somewhat exfoliating.
Flowers: Small, pink to white, tubular, fragrant, paired flowers on long (1.5-2.5 cm) stalks arising from the leaf axils; bloom May-June.
Fruits/Seeds: Abundant, red or orange paired berries.
Habitat: Sun and shade tolerant; occurs in a variety of soil and moisture conditions; commonly found along roadsides and on disturbed sites; invades forest, savannas and prairies.
Reproduction: By seeds; dispersed by birds.
Similar Species: Canada honeysuckle *(L. canadensis)*, American fly honeysuckle *(L. involucrata)*, fly honeysuckle *(L. oblongifolia)* and swamp fly honeysuckle *(L. villosa)*. Native honeysuckles are relatively short, sparse shrubs as compared to non-native species.
Comments: Invades woodlands and disturbed habitats; found near large urban areas and in rural areas where it was planted for wildlife food and cover; forms dense thickets in a forest under-story, shading out herbaceous plants, reducing tree and shrub regeneration and decreasing overall plant diversity.
Monitoring & Rapid Response: Monitor sunny, upland sites and open forests in spring as honeysuckle leafs out well before native species; begin control efforts in highest quality areas; target large, fruit-bearing plants; hand pull or dig seedlings or small plants in spring; foliar spraying may be effective for large populations where few natives are present; treat cut stumps with herbicide; basal bark treatment is also effective - spray bottom 18 inches of all stems.

Current Known Distribution:





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20. Gary Fewless, University of Wisconsin, Green Bay
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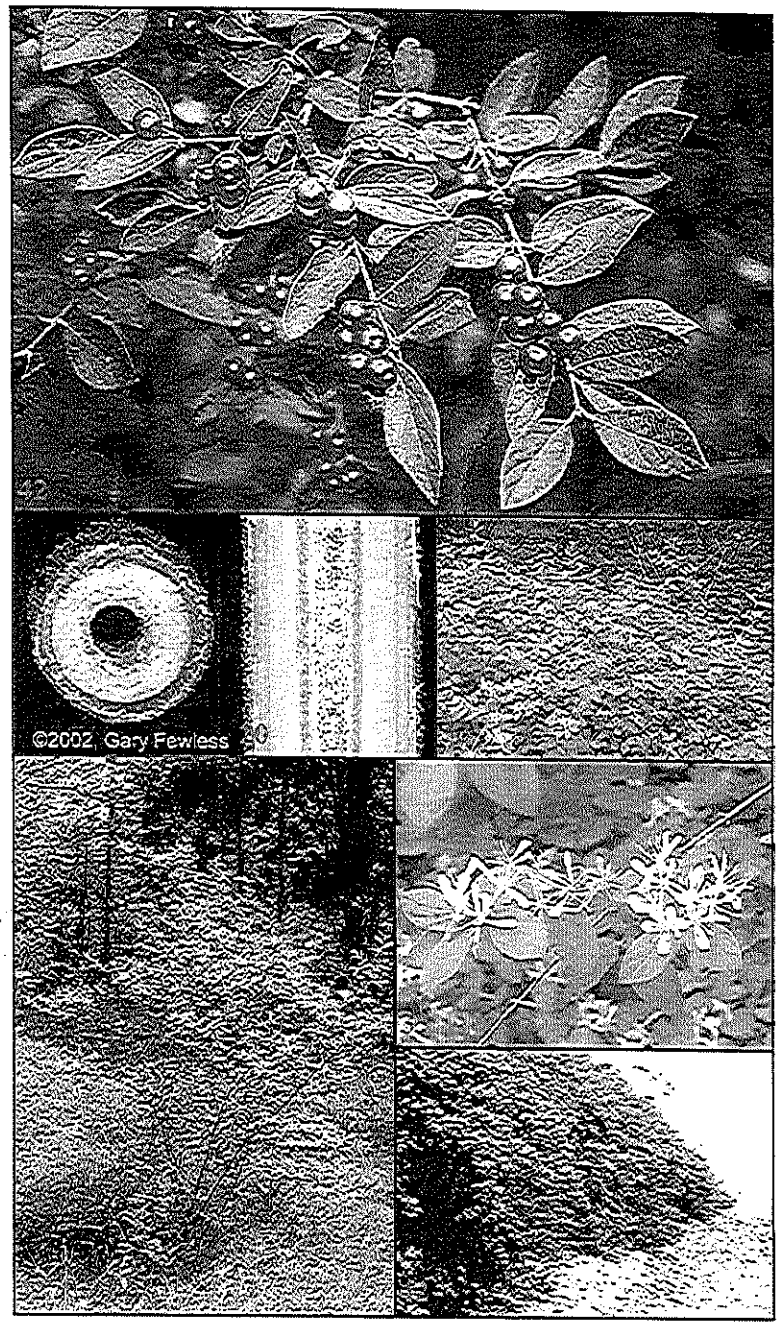
Morrow's Honeysuckle

Lonicera morrowii

Habit: Deciduous upright to spreading shrub growing up to 1.8 m (6 ft) tall.: shallow roots.
Leaves: Simple. opposite. elliptical to oblong: short: gray-green. softly hairy beneath: 3-6 cm long: early leaf out. long growing season.
Stems/Bark: Multiple stems: numerous arching branches: older branches often hollow: bark is gray or tan. shaggy.
Flowers: Small. white. tubular. paired. hairy and fragrant: borne on hairy stalks (0.5-1.5 cm long) arising from the leaf axils: blooms May-June.
Fruits/Seeds: Berries are red and paired: dispersed by birds.
Habitat: Sun and shade tolerant: occurs in a variety of soil and moisture conditions: commonly found along roadsides and on disturbed sites: invades forest. savannas. and prairies.
Reproduction: By seed: dispersed by birds.
Similar Species: Canada honeysuckle *(L. canadensis)*. American fly honeysuckle *(L. involucrata)*. fly honeysuckle *(L. oblongifolia)* and swamp fly honeysuckle *(L. villosa)*. Native honeysuckles are relatively short. sparse shrubs as compared to non-native species.
Comments: Especially affects woodlands and disturbed habitats: usually distributed near large urban areas. but also occurs in rural areas where it was planted for wildlife food and cover: can form dense thickets in a forest under-story. shading out herbaceous plants. reducing tree and shrub regeneration. and decreasing overall plant diversity.
Monitoring & Rapid Response: Monitor sunny. upland sites and open forests in spring as honeysuckle leafs out well before native species: begin control efforts in highest quality areas: target large. fruit-bearing plants: hand pull or dig seedlings or small plants in spring: foliar spraying may be effective for large populations where few natives are present: treat cut stumps with herbicide: basal bark treatment is also effective - spray bottom 18 inches of all stems.
Current Known Distribution:



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20. Gary Fewless. University of Wisconsin. Green Bay
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42. © John M. Randall/The Nature Conservancy. http://tncweeds.ucdavis.edu/photos.html

Bulletin #2532

MAINE INVASIVE PLANTS

Common Reed (Phragmites)

Phragmites australis
(Grass Family)

Threats to Native Habitats

Common reed is a very aggressive, robust, densely growing member of the grass family. Its height and density allow it to form monocultures or near monocultures that outcompete and overrun most nonwoody native wetland plants. The buildup of litter from previous years of growth prevents other species from germinating or establishing. It is capable of occupying and degrading vast areas of important wetland habitat. It is tolerant of a wide variety of environmental conditions. Wetlands composed of mixes of native plants provide habitat for more wildlife species than do wetlands overrun by common reed. Common reed is problematic in both coastal and inland wetland types. In coastal situations, debris trapped within stands of common reed can increase the elevation of marsh surfaces, which can reduce the frequency of tidal inundation and ultimately alter the natural ecosystems.

Common reed (photo by Don Cameron, Maine Natural Areas Program)

Description

Common reed is an upright perennial that ranges in height from five to 13 feet. Long, narrow leaves alternate on its tall stalks. Culms (flower-bearing stems) have smooth nodes and hollow internodes. Leaf blades are approximately one inch wide and are flat or rolled. Plants grow in dense, single-species or monocultural stands. Plume-like flower spikes six to 12 inches long form at the tops of the plants. Flowers are tiny with lots of silky hairs. Large purple flower heads turn gray and fluffy in late summer as they go to seed. They remain on the plant throughout the winter. The plant spreads through the growth of rhizomes or by seed. Aerial stems rise from joints in the rhizomes and aerial shoots that are knocked over can take root and produce new shoots at the nodes. The prostrate stalk sends out runners that generate new plants. Stout rootstalks, often exceeding 20 feet in length, interlock to form a dense network that can withstand fires, mowing and other forces that damage stalks and leaves. The underground network of rhizomes has an expansion rate of about three feet per year, but in nutrient-rich areas can spread up to 30 feet. Plants can spread by wind-blown or bird-deposited seeds, by movement of the rhizomes, by maintenance equipment in highway ditches, or by the action of tidal ice.

Habitat

Common reed grows on wetland fringes, where salt marsh and freshwater wetlands meet. It is found at the upper edges of wetlands, commonly in brackish or fresh water and at the edges of saltwater marshes, or where there are lower marsh water levels and less salty conditions. It is also occurs in both acidic and alkaline freshwater marshes, where it may occupy the entire wetland. It is more common near cities than in rural areas. Use of road salt may be promoting common reed along roadsides in New England. It is common in marshes that are in poor health and thrives in environments that kill most marsh grasses. Opportunity for invasion is often linked to human-caused disturbance.

Distribution

Common reed is a cosmopolitan species occurring throughout the world. It is thought to be the most widely distributed flowering plant. It lives in temperate zones, from the Sahara to the Arctic, as well as in tropical wetlands, with the exception of the Amazon Basin and central Africa. Common reed is a native of the Americas and Eurasia but the highly invasive form that is taking over U.S. wetlands originated in Europe. The invasive form is found in every state of the U.S. Examples of the native form are reputed to be less dense and generally smaller than the invasive European form.

Control

Phragmites plants are susceptible to extended periods of flooding, wave action and changes in salinity. Strong wave or current action will break the stalks. Long term tidal flushing is beneficial in all these cases, minimizing the influence of fresh water and higher nitrate levels, both of which aid the plant. Herbicides are effective in the short term of four to five years; glyphosate, formulated for use in wetlands, should be applied after the plants form their fluffy flower clusters, when the plants are sending carbohydrates to the rhizomes. Combined cutting, burning, herbicide application and water management plans can help control the plant by removing old canes and allowing other vegetation to grow. Plant stands can actually increase when cut early in the season. For effective management, cut plants in late summer, in several successive years. Monitoring the spread of this plant is crucial because of its tendency to reinvade. Control techniques may need to be repeated indefinitely. Anyone planning a control project at a site infested with common reed should research the options carefully, paying particular attention to the unique conditions of the site. Use herbicides responsibly and follow manufacturer's directions. Contact the Maine Department of Agriculture for information on restrictions that apply to the use of herbicides. Consult a licensed herbicide applicator before applying herbicides over large areas.

SOUTHERN MAINE COMMUNITY COLLEGE

This fact sheet was researched and written by Virginia Howe-Theisin, a student in the Plant and Soil Technology Program at Southern Maine Community College. Additional editing by Don Cameron, Maine Natural Areas Program.

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"Scarborough Marsh's restoration potential assessed." *Habitat* (Autumn 1999) 9-10.

For more information or for a more extensive list of references on invasive species contact:

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1865 THE UNIVERSITY OF MAINE Cooperative Extension

DEPARTMENT OF CONSERVATION MAINE

A Member of the University of Maine System

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Autumn olive

Elaeagnus umbellata **Thunberg**

and

Russian olive

Elaeagnus angustifolia **L.**

Oleaster Family (Elaeagnaceae)

Russian olive in flower

DESCRIPTION

Autumn olive and Russian olive are deciduous, somewhat thorny shrubs or small trees, with smooth gray bark. Their most distinctive characteristic is the silvery scales that cover the young stems, leaves, flowers, and fruit. The two species are very similar in appearance; both are invasive, however autumn olive is more common in Pennsylvania.

Height - These plants are large, twiggy, multi-stemmed shrubs that may grow to a height of 20 feet. They occasionally occur in a single-stemmed, more tree-like form.

Leaves - Leaves are alternate, oval to lanceolate, with a smooth margin; they are 2–4 inches long and ¾–1½ inches wide. The leaves of autumn olive are dull green above and covered with silvery-white scales beneath. Russian olive leaves are grayish-green above and silvery-scaly beneath. Like many other non-native, invasive plants, these shrubs leaf out very early in the spring, before most native species.

autumn olive in fruit

Flowers - The small, fragrant, light-yellow flowers are borne along the twigs after the leaves have appeared in May.

Fruit - The juicy, round, edible fruits are about ⅓–½ inch in diameter; those of Autumn olive are deep red to pink. Russian olive fruits are yellow or orange. Both are dotted with silvery scales and produced in great quantity August–October. The fruits are a rich source of lycopene. Birds and other wildlife eat them and distribute the seeds widely.

Roots - The roots of Russian olive and autumn olive contain nitrogen-fixing symbionts, which enhance their ability to colonize dry, infertile soils.

DISTRIBUTION AND HABITAT

Autumn olive was introduced to the United States from East Asia in the1830s. It was extensively planted in Pennsylvania and other states for revegetation of severely disturbed areas such as strip mines. The Pennsylvania Game Commission has also planted it for wildlife food and cover. Russian olive, native to Eurasia, was planted as an ornamental and for wildlife value. Both species have naturalized extensively in Pennsylvania, and in states from Maine south to Virginia, and west to Wisconsin. Russian olive is also a problem further west.

EFFECTS OF INVASION

Both autumn olive and Russian olive are very troublesome invasive species; their nitrogen-fixing root nodules allow them to thrive in poor soils. Typical habitats are disturbed areas, roadsides, pastures, and successional fields in a wide range of soils. They are drought tolerant and often invade grasslands and sparse woodlands. Neither species does well in densely forested areas, but Russian olive can be found in moist soils, and does particularly well in sandy floodplains. Both species create heavy shade that suppresses shorter plants requiring direct sunlight.

REPRODUCTION AND METHODS OF DISPERSAL

Autumn olive and Russian olive spread by seeds disseminated throughout the landscape by birds and other wildlife that consume the fruits. These shrubs grow rapidly, begin to produce fruit as early as 3 years of age, and have the ability to thrive in poor soil. They also resprout vigorously after cutting or burning.

CONTROL

Mechanical - Seedlings and sprouts can be pulled by hand when the soil is moist enough to insure removal of the root system. On larger plants, cutting alone results in thicker, denser growth upon resprouting. Burning during the dormant season also results in vigorous production of new shoots.

Chemical - Glyphosate can be used to control larger plants. Foliar application has proven effective in controlling these species. Since glyphosate is nonselective and will affect all green vegetation, care should be taken to avoid impacting native plants. At sites where this is a concern, application of the herbicide to the freshly cut stumps of the invasive shrubs should achieve the desired results. This method minimizes damage to other plants.

Biological - No biological control options are currently known.

LANDSCAPE ALTERNATIVES

The following native plants are suggested as alternatives to autumn olive or Russian olive in revegetation and wildlife habitat plantings: sweet-fern (*Comptonia peregrina*),

bayberry (*Myrica pensylvanica*), shining sumac (*Rhus copallina*), fragrant sumac (Rhus aromatica), staghorn sumac (*Rhus typhina*), black-haw (*Viburnum prunifolium*), shadbush (*Amelanchier arborea, A. laevis*), clammy locust (Robinia viscosa), redbud (*Cercis canadensis*), New Jersey tea (*Ceanothus americanus*).

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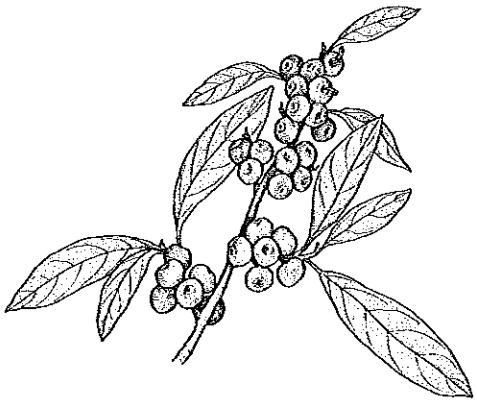
Internet resources - http://www.upenn.edu/paflora, http://www.invasivespecies.gov, http://tncweeds.ucdavis.edu



autumn olive in fruit

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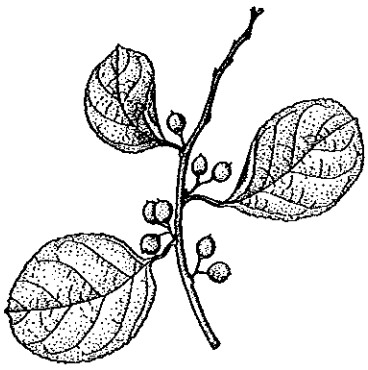
April 2002

Oriental bittersweet

Celastrus orbiculatus Thunb.

Staff-tree Family (Celastraceae)



Oriental bittersweet

DESCRIPTION

Oriental bittersweet is a woody, deciduous vine that twines around and drapes itself over other trees and shrubs in successional fields and along forest edges, often completely covering the supporting vegetation. In the shade it grows less vigorously, sometimes forming small trailing shrubs.

Oriental bittersweet is very similar to the native American bittersweet (*C. scandens*). The female flowers and fruits of oriental bittersweet are located in the leaf axils along the stem; American bittersweet, in contrast, blooms at the tips of the stems. The two species cannot reliably be distinguished in the absence of female flowers or fruits. Although American bittersweet has generally narrower leaves, this difference is not reliable.

Height - Bittersweet climbs to heights of 50 feet or more when large trees are available to provide support.

Stem - The twining stems may reach a diameter of 4 inches, they often deform and eventually girdle the trunks or branches of trees around which they have grown.

Leaves - Mature leaves of oriental bittersweet are usually broadly rounded to nearly orbicular; however on young shoots they can be much more narrow, leading to confusion with the native species. The leaves are arranged alternately on the stem, and are deciduous; they turn yellow in the fall.

American bittersweet

Flowers - Bittersweet flowers, which appear in May or June, are small and greenish. In general male and female flowers are produced on separate plants, however sometimes a few perfect flowers are also present.

Fruit and seed - The fruits are yellow or orange capsules that open to reveal 3 or 4 bright red seeds with their fleshy arils. The seeds are bird-dispersed. The fruiting branches are frequently used in the florist trade for autumn decorations, resulting in human dispersal of seeds. Pollen viability and seed germination are much higher in Oriental bittersweet than in the native species.

DISTRIBUTION AND HABITAT

Oriental bittersweet is native to China, Korea, and Japan; it was introduced for ornamental use about 1870, and has become naturalized from Maine to Louisiana and west to the Great Plains. In Pennsylvania it occurs mainly in the southern half of the state. It festoons itself on trees and shrubs on roadsides, along forest edges, fencerows, and old fields.

EFFECTS OF INVASION

Oriental bittersweet grows extremely vigorously in open and edge habitats; it covers and kills other vegetation and inhibits old-field succession. It also appears to be replacing the less vigorous native species, *Celastrus scandens*, which grows in similar habitats. American bittersweet is classified as a threatened species in Connecticut.

REPRODUCTION AND METHODS OF DISPERSAL

Bittersweet reproduces prolifically by seed, which is dispersed by birds. It also spreads by stolons and rhizomes, modified horizontal stems that grow at (stolons) or below (rhizomes) the soil surface. Shoots may also develop from the roots.

CONTROL

Mechanical - High growing vines can be cut; or small plants can be pulled out by hand. Fruiting stems should be bagged and removed from the site. Frequent monitoring is suggested for areas not yet infested, so that invading plants can be removed while they are still small.

Chemical - Cutting large stems and immediately treating the cut surface with glyphosate or triclopyr has been a successful control strategy.

Biological - No biological control options are currently known.

NATIVE ALTERNATIVES FOR LANDSCAPE USE

American bittersweet (*Celastrus scandens*) should be planted instead of the invasive, non-native species. Other native vines that might be considered include trumpet-creeper (*Campsis radicans*), virgin's-bower (*Clematis virginiana*), and Dutchmen's-pipe (*Aristolochia macrophylla*).

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Internet resources - http://www.upenn.edu/paflora, http://www.invasivespecies.gov, http://tncweeds.ucdavis.edu

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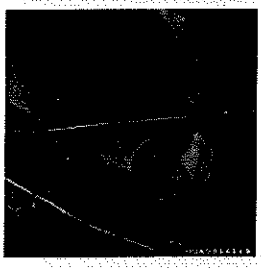
April 2002

INVASIVE PLANT SPECIES FACT SHEET

IPSAWG
Invasive Plant Species Assessment Working Group

Japanese Honeysuckle

Lonicera japonica



Pictures By (From Top to Bottom): C. Bargeron, T. Bodner and J. H. Miller @ www.invasive.org.

Invasive Plants are a Threat to:

- **Forests and wetlands**
- **Native plants**
- **Perennial gardens**
- **Wildlife**
- **Lakes and rivers**
- **Human Health**
- **Farmland**

Description:

Japanese honeysuckle is a perennial woody vine of the honeysuckle family that spreads by seeds, underground rhizomes, and above ground runners. It has opposite oval leaves, 4-8 cm. long, that are semi-evergreen to evergreen. Older stems are hollow with brownish bark that peels in long strips. The flowers are fragrant, two-lipped, and are borne in pairs. The berries are black. It creates dense tangled thickets by a combination of stem branching, nodal rooting, and vegetative spread from rhizomes.

Distribution:

The species was introduced into the United States in 1806 on Long Island, NY. It now occurs throughout the eastern half of the United States, an area encompassing 26 states. Japanese honeysuckle's range is limited to the north by severe winter temperatures and to the west by insufficient precipitation and prolonged droughts. It is in all 92 Indiana counties, but is much more aggressive in Southern Indiana.

Problem:

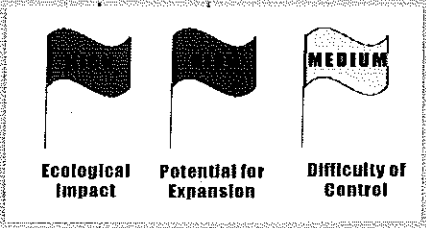
Japanese honeysuckle damages forest communities by out competing native vegetation for light, below-ground resources, and by changing forest structure. The vines overtop adjacent vegetation by twining about, and completely covering, small trees and shrubs. As it becomes established it forms a dense blanket that endangers most shrubs, herbs, and trees.

Origin:

Japanese honeysuckle is native to East Asia, including Japan and Korea. It was introduced to the United States as an ornamental plant, for erosion control, and for wildlife forage and cover. However, there are many better plant choices for those uses (see back for good alternatives).

Picture By: The Nature Conservancy.

IPSAWG Ranking:



IPSAWG Recommendation:

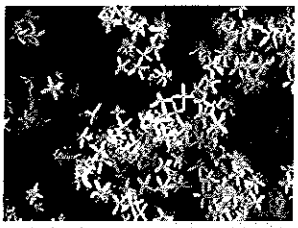
- Do not buy, sell or plant Japanese honeysuckle in Indiana.
- Help by eradicating Japanese honeysuckle on your property.

This ranking illustrates the results of an assessment conducted by the **Invasive Plant Species Assessment Working Group** (IPSAWG), which is made up of many organizations and agencies concerned about invasive plant species. IPSAWG's goal is to assess which plant species may threaten natural areas in Indiana and develop recommendations to reduce their use in the state.

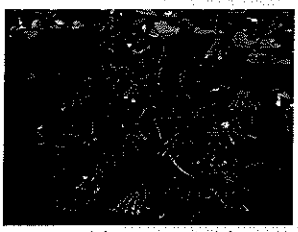
For more information about IPSAWG and the assessment tool used to rank invasive species, visit their website:
www.invasivespecies.IN.gov

Date Updated: 10/06

ALTERNATIVES to Japanese Honeysuckle:



Virgin's bower
(*Clematis virginiana*)



Trumpet Honeysuckle
(*Lonicera sempervirens*)

Woolly Dutchman's Pipe
(*Aristolochia tomentosa*)

Pictures By (Top to Bottom): D. Liebman, J. Lepore and S. Baskauf.

Other Alternatives:

Virgina Creeper
(*Parthenocissus quinquefolia*)
Crossvine
(*Bignonia capreolata*)

Not Recommended:

American bittersweet
(*Celastrus scandens*)
While American bittersweet is native and non-invasive, unfortunately, nurseries often mislabel Oriental bittersweet as American bittersweet. It is very difficult to find true American bittersweet for sale.

Control Methods:

Small populations of Japanese honeysuckle can be controlled by careful hand-pulling and removal of vines. Mowing twice a year along fields and roadsides can slow the vegetative spread but stem density may increase. Prescribed burning can greatly decrease the abundance within a habitat and limit its spread for one to two growing seasons. Where other options are difficult, Japanese honeysuckle may be treated with a glyphosate herbicide. This is best applied at 5-8% with a spray applicator in late autumn when other vegetation is dormant but Japanese honeysuckle is still physiologically active. Be careful to follow label guidelines when using herbicide. Reapplication may be necessary to treat plants missed during the initial treatment. **Always read and follow pesticide label directions.**

Japanese honeysuckle completely covering adjacent vegetation. (Picture By: J. M. Swearingen @ www.invasive.org)

Eight Easy Ways to Combat Invasive Plants

You can **help stop** the spread of **invasive plants** by following these **8 easy guidelines**:

1. Ask for only non-invasive species when you acquire plants. Request that nurseries and garden centers sell only non-invasive plants.
2. Seek information on invasive plants. Sources include botanical gardens, horticulturists, conservationists, and government agencies.
3. Scout your property for invasive species, and remove invasives before they become a problem. If plants can't be removed, at least prevent them from going to seed.
4. Clean your boots before and after visiting a natural area to prevent the spread of invasive plant seeds.
5. Don't release aquarium plants into the wild.
6. Volunteer at local parks and natural areas to assist ongoing efforts to diminish the threat of invasive plants.
7. Help educate your community through personal contacts and in such settings as garden clubs and civic groups.
8. Support public policies and programs to control invasive plants.

For More Information:

On this assessment and IPSAWG:

IPSAWG
www.invasivespecies.IN.gov

On identification and control techniques:

The Nature Conservancy's Wildland Weeds
www.tncweeds.ucdavis.edu

On native plant alternatives and sources:

Indiana Native Plant and Wildflower Society
www.inpaws.org

This grant project made possible with United States Forest Service funds administered by the IDNR, Division of Forestry.

Multiflora rose

***Rosa multiflora* Thunb.**

Rose Family (Rosaceae)

multiflora rose in flower

DESCRIPTION

Multiflora rose is a vigorous, prickly shrub with green or reddish, arching branches. In late May–June it is covered with clusters of small white (or slightly pinkish) flowers. The fringed stipules at the base of the leaf stalk are the best characteristic to use to distinguish multiflora rose from other species. No other species that occur in our region have both an upright-arching growth form and fringed stipules.

Height - Vigorous plants can grow to 8–9 feet high and up to twice as wide.

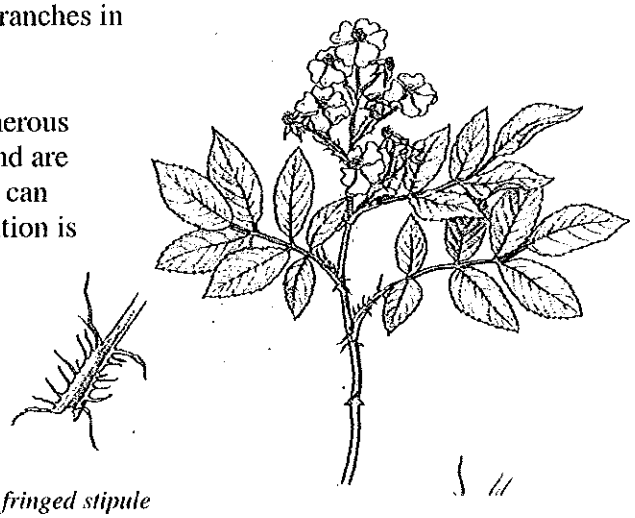
Stem - The stems are green or reddish and bear stout prickles that curve downward. In the open, stems often arch down to touch the ground, or they can extend even higher than 9 feet when supported by the branches of adjacent trees or shrubs.

Leaves - Leaves are pinnately compound with 5–11 toothed leaflets; they are alternate on the stem. The stipules, leaf-like strips along both sides of the leaf stalk near the base, are prominently fringed. The leaves begin to emerge very early in the spring, well before any native woody plants.

Flowers - Flowers are white, or slightly pinkish, individually they are ½–¾ inch wide. They appear in large, showy clusters at the ends of the branches in late May or early June.

Fruit and seed - The flowers are followed by numerous small red fruits (hips) that persist into the winter and are eaten by birds and small mammals. A single plant can produce as many as a million seeds. Seed germination is high; seeds can also remain viable in the soil for as long as 20 years.

Roots - Roots are wide-ranging and capable of resprouting. In addition, stem tips that contact the soil surface are capable of rooting, through a process known as layering, to form new plants.



fringed stipule

Extensive thickets are formed in this way.

DISTRIBUTION AND HABITAT

Multiflora rose is native to Asia, it was brought to the United States originally in the 1800s for use as rootstock for grafted ornamental roses. In the 1930s through the 1950s it was promoted by the United States Department of Agriculture as a "living fence". Millions of seedlings were distributed to farmers and planted throughout the East and Midwest. Natural resource agencies such as the Pennsylvania Game Commission and the Pennsylvania Bureau of Forestry also included the plant in their revegetation and wildlife enhancement programs until the 1960s.

Multiflora quickly established itself as part of the naturalized flora. Today it is estimated to infest 45 million acres nationally, and is classified as a noxious weed by many states including Pennsylvania. It is found throughout the state in old fields, roadsides, pastures, open woods, forest edges, and riparian areas. While it grows most vigorously in full sun, it can grow in the shade too, and will persist for many years under a tree canopy although it may not flower or fruit very heavily.

EFFECTS OF INVASION

Multiflora rose forms such dense stands that it can interfere with establishment of other woody species in old-field succession. It also replaces native vegetation in forest edges and riparian areas. However, once trees break through the dense thickets of rose and begin to shade it, the multiflora loses vigor.

REPRODUCTION AND METHODS OF DISPERSAL

Most spread of multiflora rose is by seed, but there is also some vegetative spread through layering, to form large clumps or thickets. Multiflora rose is so common in many areas of Pennsylvania that any open habitat such as lawn, meadow, pasture, or prairie is vulnerable to infestation due to the constant "seed rain" from birds. Regular monitoring of such areas is recommended so invading plants can be pulled while they are still in the seedling stage.

CONTROL

Mechanical - Seedlings can be pulled by hand. Small plants can be dug out or larger ones can be pulled using a chain or cable and a tractor, but care needs to be taken to remove roots also. Dense thickets may need to be attacked using a bulldozer. Repeated mowing for 2–4 years can be effective.

Chemical - Perhaps the most effective strategy is to cut the stems and immediately treat them with an herbicide such as glyphosate or triclopyr. The same chemicals can be employed as a foliar spray.

Biological - Rose rosette disease has been found in several areas of Pennsylvania, however it is not yet clear how much impact this virus disease, that was first reported in 1941, will have. The virus is spread naturally by a tiny mite. Plants affected by rose rosette disease develop witches'-brooms and small reddish leaves and shoots. The disease can kill plants in two years.

NATIVE ALTERNATIVES FOR LANDSCAPE USE

The native rose species, pasture rose (*Rosa carolina*), wild rose (*R. virginiana*), and swamp rose (*R. palustris*) are preferred landscape alternatives.

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Internet resources - http://www.upenn.edu/paflora, http://www.invasivespecies.gov, http://tncweeds.ucdavis.edu

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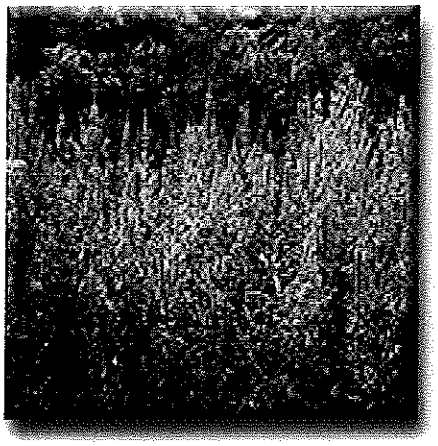
Invasive Plants Fact Sheet



Purple Loosestrife Lythrum salicaria L. Loosestrife Family (Lythraceae)

Status: Common and invasive in Connecticut

Description: Purple loosestrife is a non-native herbaceous perennial with a stiff, four-sided stem and showy spikes of numerous magenta flowers. Individual flowers have five to seven petals, and are attached close to the stem. This attractive plant is usually under four feet in height, but can grow to 10 feet in nutrient-rich habitats. Mature plants can have from 30 to 50 stems rising from a common rootstock, forming a large bushy cluster. Preferred habitat: Purple loosestrife can be found in a variety of wetland habitats including freshwater tidal and non-tidal marshes, river banks, ditches, wet meadows, and edges of ponds and reservoirs. It prefers moist, highly organic soils in open areas, but can tolerate a wide range of substrate material, flooding depths, and partial shade.

Seasonal Cycle: This aggressive weed not only re-seeds prolifically, but also can spread vegetatively through fallen lateral stems that root. Purple loosestrife flowers in July and August in most of Connecticut. The seeds mature in August and September, and germinate the following season as long as the soil is not too wet, and soil surface temperatures are optimum. Dead stalks remain standing through winter.

Distribution: Originally a native of Europe, loosestrife was introduced to the northeastern United States and Canada in the 1800's and has since spread westward to Minnesota and southward to Virginia. Although not native, it can occur "naturally" in any freshwater wetland area, particularly in an area that has been disturbed. It is also sold commercially for perennial gardens. Two cultivated species widely available are Lythrum salicaria and Lythrum virgatum. Cultivars of these species are supposedly self-infertile, but can become quite fertile and widespread when crossed with wild purple loosestrife and should not be used for home gardens. Other points of interest: Purple loosestrife has a long history of use in herbal medicine. It has been used to stop both internal and external bleeding, and sap extracted from the leaves can be taken to control dysentery. Although it is now seldom used, L. salicaria was highly recommended in early herbals.

Control: In spite of its spectacular beauty, often covering acres of wetland areas, purple loosestrife is a particularly troublesome invasive species with low wildlife value. It can grow as dense monocultures, crowding out sedges, grasses, rushes, and other aquatic plants more valuable to wildlife. In Minnesota, where purple loosestrife has spread at an alarming rate, it is illegal to plant or sell either L. salicaria or L. virgatum. Purple loosestrife is listed as a noxious weed in 12 other states, where its importation and distribution is prohibited. Control techniques include early detection of purple loosestrife, hand-pulling of small infestations of one- to two-year-old plants before they set seed, and spot treatment of older plants with non-selective herbicides such as Rodeo¨ for aquatic communities or Roundup¨ on terrestrial sites. A DEP

permit is required for the use of Rodeo¨ in aquatic communities, however. If herbicides are used, they are most effective when sprayed in the late summer or early fall, but repeated use is costly, and the long-term effects on natural systems are not fully understood. Due to a strongly-developed tap root, removal by digging is not recommended since the disturbance may encourage proliferation. Biological control, in this case using insects from the plant's natural environment, is being studied by the U.S. Department of Agriculture. The species include a root-mining weevil, Hylobius transversovittatus, and two leaf-eating beetles, Galerucella calmariensis and Galerucella pusilla. Release of these insects occurred in 1992 in New York, Pennsylvania, Maryland, Virginia, Minnesota, Oregon and Washington state. Their impact should be noticeable by 1997. Additional information sources: A Field Guide to Coastal Wetland Plants of the Northeastern United States. Ralph W. Tiner, Jr. The University of Massachusetts Press, Amherst 1987. Wetlands -- Audubon Society Nature Guide. William A. Niering. Chanticleer Press, New York 1985. Diagnostic information: Flowers: July to September; small, purplish-pink with five to seven petals, clustered in the axils of reduced leaves, forming long dense terminal spikes (4-16 inches long). Leaves: sessile (without stalks), up to four inches long, lance-shaped, with heart-shaped bases, somewhat clasping stem, oppositely arranged, sometimes in whorls of three, turn red at the end of the growing season. Stems: four-angled, almost woody, glabrous to pubescent. Fruits: small capsule. This fact sheet has been prepared by The Nature Conservancy Connecticut Chapter in cooperation with The Natural Diversity Data Base of the Connecticut Department of Environmental Protection.

The Nature Conservancy, Connecticut Chapter
55 High Street Middletown, CT 06457
Department of Environmental Protection Geological and Natural History Survey Natural Diversity Data Base
79 Elm Street Hartford, CT 06106

Appendix E

Wetland Functional Assessment

Wetland Functional Assessment Cucia Park Site

As noted in the Connecticut "Method for the Evaluation of Inland Wetlands" (DEP Bulletin No. 9), "it is generally accepted that all wetlands possess some value and that the value of a particular wetland can be assessed in relation to other wetlands in a given area." The basic concept behind most wetland evaluation or assessment methods is that wetland characteristics contribute to give rise to wetland functions that have certain value to natural systems, including man. By assessing the relative importance of certain characteristics indicated by research or experience to contribute toward particular functions (e.g., the dominant vegetative class affects wildlife habitat value), and then weighting the various conditions which that characteristic may occur in wetlands (e.g., shallow marsh, wooded swamp, etc.), some picture of the relative significance a particular wetland may play in providing certain functions can be developed. This concept is fundamental to the wetland evaluation procedures that were drawn from to assess the functional values of the wetland areas on the site. These methods include:

- New England Division Corps of Engineers Highway Methodology. 1995. Wetland Functions and Values: A Descriptive Approach. NEDEP-360-1-30a (see Appendix C for forms).
- Golet, F.C. 1976. Wildlife Wetland Evaluation Model. pp. 13-34 in: J.S. Larson (ed), Models for Assessment of Freshwater Wetlands. Univ. of Mass. Water Resources Research Center Publ. No. 32.
- Ammann, A.P., R.W. Franzen, and J.L. Johnson. 1986. Method for the Evaluation of Inland Wetlands in Connecticut.CTDEP Bulletin 9.
- Hollands, G.G. and D.W. Magee. 1986. A Method for Assessing the Functions of Wetlands. pp. 108-118 in: J.A. Kusler and P. Riexinger (eds). National Wetland Assessment Symposium Proceedings.

In recent years there has been a general tendency to move away from numerical or quantitative evaluation procedures. However, the basic understanding of how physical characteristics, setting, and other factors affect functional significance has not changed appreciably. As stated in the Corps of Engineers' Descriptive Approach, "...we advocate an approach that includes a qualitative description of the physical characteristics of the wetlands, identifies the functions and values exhibited, and most importantly, the bases for the conclusions using 'best professional judgment'." Accordingly, rather than focus on model output results, the rationale encompassed in the evaluation procedures for determining functions and values are utilized in rating the relative significance of each wetland area for a range of functions.

The objective of the assessment process was to develop an understanding of the probable significance of these wetlands on a site-specific and watershed basis. The evaluation methods were used to provide the rationale for assessing how the site-specific characteristics of wetlands on the site affect the capacity of these wetlands to contribute to selected functional values. As recommended by the EPA (1989), an assessment was desired that would provide guidance on wetland functions that could be impacted under prospective development scenarios, the reliability with which the functional impacts can be mitigated, and the risks if they cannot be adequately replaced.

The following discussion attempts to summarize this qualitative assessment for several of the more important natural resource functions. For the purposes of this discussion, the focus of the evaluation is on the wetland conditions within the area comprising the proposed development area and immediately surrounding areas, although some specific references are made to other wetlands in the project vicinity.

Groundwater Recharge / Discharge

The Connecticut method assesses the "groundwater use potential" of a wetland by considering wetland juxtaposition with existing or potential public water supplies, quality of associated ground and surface waters, and the shape of the associated water course. The Hollands and Magee method rates seven characteristics considered to influence groundwater functions, with the underlying surficial geology, hydrologic position (e.g., perched vs. water table condition), transmissivity of the associated aquifer, and wetland size the most important factors. The ACOE Descriptive Approach uses similar criteria.

Wetlands in the glaciated northeast occur in a wide variety of hydrogeological settings. The ground and surface water interactions within a wetland are strongly related to the properties of the soil and surficial geologic deposits underlying the wetland. In general, wetlands set in stratified sands and gravels are most likely to be associated with the regional groundwater system, and are most often areas of groundwater discharge although some recharge may occur at certain times of the year. Wetlands set in less permeable till or glaciolacustrine deposits typically have reduced ground and surface water interactions, and may be perched above the regional water table.

Wetlands on the site are set on poorly drained soils formed in dense glacial till deposits that limit vertical hydraulic conductivities and therefore are therefore not conducive to groundwater flow. Groundwater flow tends to be predominantly lateral, and accordingly the wetlands function primarily as groundwater discharge or seepage zones. While there may be some interflow (water moving laterally in the unsaturated zone) or shallow groundwater seepage into the wetlands on a seasonal basis, the potential for significant ground and surface water interactions is low for the site's wetlands.

Flood Control (Floodflow Alteration)

The ACOE Descriptive Method cites eighteen (18) factors to consider in assessing the flood control function of a wetland area, including: the size of the wetland relative to its watershed; location of the wetland in its watershed; watershed characteristics; wetland association with watercourses; and outlet conditions. The Connecticut wetland evaluation method assesses three basic factors to evaluate wetland flood storage capacity and reduction of downstream peak flows and flooding. These are: (1) the estimated volume of storage during the 1% chance (100-year) flood; (2) the effectiveness of that storage in relation to the total runoff and other storage in the watershed; and (3) the existing flooding concerns downstream. The Hollands and Magee Assessment Method rates fourteen (14) characteristics considered to influence flood storage capacity, with size, vegetative density, hydrologic connection, and the rate of water movement through the wetland most important.

In general, wetlands within 100-year floodplains and having some form of a constricted outlet to enhance water impoundment, a low gradient and dense vegetation (preferably woody) to slow water velocity, and sizable enough to contain a significant volume of water (although cumulative volumes from several smaller units need to be considered) are most important in decreasing peak flood flows and lessening flooding downstream.

Considering these factors, the wetland resources on the site offer varying opportunity to store appreciable flood waters to affect flood flows and flood elevations in downstream watercourses. Wetland System 1 offers the greatest capacity to retain high volumes of water, receive and detain excessive flood water as well as provide depressional storage. In addition, the floodplain and pond in Wetland System 1 have the potential to provide peak rate control function which serves to attenuate flood peaks downstream. The topographic conditions of Wetland System 1, which are relatively flat wooded lowlands, contribute to flood storage. Wetland E provides a minor capacity to retain water, receive and detain flood water and provides depressional storage within its man-made 0.35-acre pond as well as borrow pits; however, the total volume of water stored in these small depressions is negligible relative to the flood flows in Sawmill Brook . When

Wetland E reaches capacity it flows to Wetland System 1 via constricted channels and culverts. Wetlands A and G provide little flood control. Neither provides depressional areas for potential flood storage and both are situated on hillside slopes that drain toward the western portion of the site that provides no capacity to retain flood storage.

Wildlife Habitat / Fish and Shellfish Habitat

Most of the evaluation methods employ similar criteria for assessing overall wildlife habitat or biological functions; the Golet wetland wildlife evaluation provides the standard which most of the subsequent methods were developed from, and uses ten criteria in determining wildlife habitat value. Wetland size, variety and interspersion of vegetative cover types, availability of open water, juxtaposition to other wetlands, and surrounding habitat are important variables.

By contrast, wetland areas of less value generally contain a lack of plant community diversity and/or a typically disturbed plant community, are often isolated hydrologically or functionally from other wetlands, are smaller sized, and have an unproductive water regime. Accordingly, they are considered of low habitat quality, whereas the wooded wetland areas offer moderate quality habitat.

The most significant wetland within the site in terms of overall diversity of wildlife habitat is clearly Wetland System 1. Wetland System 1 (Sawmill Brook Wetland System) is considered by the City of Middletown as one of its outstanding wetlands and it is ranked 19th of the top 25 wetlands in Middletown. It is a wooded lowland brook with deep pools and very high aesthetic quality which flows into the Mattabessett River. In addition, the small pond located in northern portion of the site is contiguous with the Brook and provides additional open water habitat for fish and shellfish. Species most commonly found within these types of habitat include waterfowl and other aquatic/riparian species such as fish, aquatic invertebrates, amphibians, and certain mammals such as raccoons, muskrats, otters, and mink. The most significant wildlife component of the site is related to the contiguous riparian corridor along Sawmill Brook in the western portion of the site (i.e., Wetland 1)

Wetland E includes a small area of (man-made) open water habitat for warm water fish and other aquatic species, as well as potential vernal pool habitat in a depression also created by historic earth removal on the site. Evidence of minor breeding activity by obligate vernal pool species (spotted salamander) has been observed in the flooded depressions located in the northern most portion of Wetland E. Based on the observed conditions, however, it is not anticipated that significant levels of such breeding vernal pool activity occur within these pools.

The wooded hillside wetland areas (Wetland A, Wetland E and G) and adjacent forested uplands in the eastern portion of the site provide habitat for nesting and foraging passerine birds, small mammals and some herpetofauna species.

Sediment / Toxicant Retention

This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland to trap sediments, toxicants, or pathogens in runoff water from surrounding uplands or upstream eroding wetland areas. Wetland System 1 provides the most significant sediment and toxicant retention function on the site. As a floodplain wetland, Wetland 1 is associated with a perennial brook and provides floodwater storage. Its dense vegetation cover contributes to diffuse water flow and sediment trapping capability. Wetland E also provides a capacity to trap sediment, particularly within the pond where water is detained and settled. A drainage ditch, centrally located on the site, carries stormwater flow and sediments from Interstate 91 to the southern portion of Wetland E where it accumulates and flows north within the channelized portion of the wetland, adjacent to the old trolley line berm. Wetland A and G are primarily hillside seeps that provide little sediment or toxicant trapping qualities.

Nutrient Removal / Water Quality

The Connecticut method assesses the value of a wetland at reducing levels of nutrients by examining characteristics of the upstream watershed (potential sources of contaminants), the size of the wetland relative to that watershed, the type of vegetation in the wetland, the presence of impoundments in the wetland, and flood storage capacity of the wetland. The Hollands and Magee method rates 11 characteristics as influencing water quality maintenance, the most important being the dominant wetland class, vegetative density, topographic configuration, wetland size, and the rate of water movement through the wetland. The Corps' Descriptive Approach considers similar characteristics in assessing the "sediment/toxicant/pathogen retention" and the "nutrient removal/retention/transformation" functions.

In general, wetlands most likely to appreciably reduce levels of contaminants in waters moving through them are those having low (flat) gradients, long detention times, and diffuse surface water flow through dense vegetation and organic soils. The conditions within Wetland System 1 are the most conducive on the site for promoting water quality functions, and the location of the wetland in the watershed of Sawmill Brook conveys an opportunity for this capacity to have significance for affecting surface water quality in the downstream watercourse. Wetland E has similar opportunity for buffering associated intermittent watercourses from water quality changes; however internal characteristics are not as optimal as those within Wetland System 1. Wetlands A and G are considered the least significant wetland for maintaining water quality due to the gradient, low vegetative density, and lack of hydric soils.

Production Export

This function evaluates the effectiveness of wetlands to produce food or usable products for humans or other living organisms. Wetlands G and A provide little production export while Wetland System 1 and Wetland E provide evidence that some production export is available for wildlife use including aquatic food sources for wildlife development within their pools and ponds.

Sediment / Shoreline Stabilization

This function considers the effectiveness of a wetland to stabilize stream banks and shorelines against erosion. Wetland System 1 is a broad densely vegetated system that moderates high velocity flood flows, and therefore provides bank stabilization and erosion control along Sawmill Brook. Portions of Wetland E, adjacent to the pond, may provide minimal bank stabilization functions. Wetlands A and G afford little opportunity to provide stabilization functions as they are not associated with water bodies on the project site.

Recreation

Recreation value considers the suitability of the wetland and associated watercourses to provide recreational opportunities. Currently Cucia Park is an underutilized and outdated passive recreation area with overgrown ponds. The pond located in the northern portion of Wetland System I provides some recreational fishing, however the area is underutilized. The other wetlands provide no recreational potential and are difficult to access.

Educational / Scientific Value

This value considers the suitability of wetlands as sites for outdoor classrooms or as a location for scientific study or research. With the exception of the northern portion of the site around Sawmill Brook and the man-made pond, the wetland systems on the site do not posses characteristics that would be considered useful for wetland/water-based educational or scientific purposes.

Uniqueness / Heritage

This value pertains to the effectiveness of the wetlands or its associated water bodies to provide certain special values such as archaeological sites, critical habitat for endangered species, health, and

appearance of the ecological system, or relative importance as wetlands for the geographic location. As mentioned above, Wetland System 1 is considered by the City of Middletown as one of its outstanding wetlands with very high aesthetic qualities. The remaining wetlands do not possess distinct qualities relative to this value.

Visual Quality / Aesthetics

This value considers the visual and aesthetic quality or usefulness of the wetland. As mentioned above Wetland System 1 is considered as an outstanding wetland with high aesthetic quality. Wetland E also provides some aesthetic qualities around where the small pond is located, although this area is obscured and overgrown.

Threatened and Endangered Species Habitat

This value considers the suitability of the wetland to support threatened or endangered species. This site has been identified as potential habitat for the eastern box turtle, a State Species of Special Concern, although reviews for this species have not encountered an eastern box turtle specimen at Cucia Park.

Other Functions

There are a number of other functions and values that may be provided by wetlands and can be assessed using accepted criteria. In general, it is AECOM's experience that wetlands which are determined to be significant for functions such as wildlife habitat and water quality improvement are also likely to contribute to other functions such as recreation, educational/scientific, heritage, and visual/aesthetic. Conversely, wetlands that do not possess the characteristics that promote wildlife habitat and water quality improvement typically are also not likely to provide these other functions to a significant degree.

Table 3 provides a summary of the anticipated functional significance of the site's wetlands as discussed above. In summary, the floodplain wetland along the western border of the site has the greatest significance for flood storage, wildlife habitat, nutrient removal, and water quality functions. In general, wetland areas which are identified as having low value have the following characteristics:

- A low diversity of vegetative cover types with low habitat value or which are subject to disturbance (e.g., recent or past cutting).
- Limited flood storage capacity due to topographic setting or a lack of natural or man made control features to detain surface waters.
- Minimal surface water detention time or a lack of surface water during all portions of the year, as well as minimal input of surface water from upstream areas. These conditions infer a low potential for significant portions of the delineated wetland areas to interact with surface waters to positively influence the quality of the water and downstream resources.

The following table summarizes the functional assessment of the onsite wetlands.

Table 3: Summary of Wetland Functional Assessment

Functions/Values	Wetland System 1	Wetland A	Wetland E	Wetland G
Flood Control	High	Low	Moderate	Low
Groundwater	Moderate	Low	Low	Low
Water Quality	High	Low	Moderate	Low
Shoreline Stabilization	High	Low	Moderate	Low
Wildlife Habitat	High	Moderate	Moderate	Low

Recreation	Moderate	Low	Low	Low
Education	Moderate	Low	Low	Low
Uniqueness/Heritage	Moderate	Low	Low	Low
Visual Quality	High	Low	Low	Low
Endangered Species Habitat	Moderate	Low	Low	Low

Boardman Lane Wetland Function and Value Assessment

The Boardman Lane site is an 89 acre parcel bounded to the east by the Yellow Freight property, Boardman Lane to the south and Bradley Brook to the west. The site extends north from Boardman Lane approximately 0.47 miles towards the Ken Dooley Drive site. Site boundaries on the south circumvent the properties at 132 Boardman Lane and 275 Boardman Lane, as well as a small pond on an industrial parcel between the Boardman Lane site and the Yellow Freight property. A sanitary sewer easement cuts across the eastern half of the property from the Bysiewicz Industrial Subdivision to the sewer system along Boardman Lane. Richards Brook crosses the center of the property from the northeast to the southwest and connects to Sawmill Brook behind a residential house located at 132 Boardman Lane. Approximately 35 acres of wetlands are located in the eastern portion of the site, bordering Richards Brook while 3.5 acres of isolated wetlands are located in the forested western portion of the site.

Groundwater Recharge / Discharge

The Connecticut method assesses the "groundwater use potential" of a wetland by considering wetland juxtaposition with existing or potential public water supplies, quality of associated ground and surface waters, and the shape of the associated water course. The Hollands and Magee method rates seven characteristics considered to influence groundwater functions, with the underlying surficial geology, hydrologic position (e.g., perched vs. water table condition), transmissivity of the associated aquifer, and wetland size the most important factors. The ACOE Descriptive Approach uses similar criteria.

Wetlands in the glaciated northeast occur in a wide variety of hydrogeological settings. The ground and surface water interactions within a wetland are strongly related to the properties of the soil and surficial geologic deposits underlying the wetland. In general, wetlands set in stratified sands and gravels are most likely to be associated with the regional groundwater system, and are most often areas of groundwater discharge although some recharge may occur at certain times of the year. Wetlands set in less permeable till or glaciolacustrine deposits typically have reduced ground and surface water interactions, and may be perched above the regional water table.

The western portion of the Boardman Lane property consists of Yalesville and Cheshire-Holyoke complex, well drained coarse-loamy melt-out till soils derived from basalt and/or sandstone and shale. Wetlands situated in this area are function primarily as groundwater discharge or seepage zones. While there may be some interflow (water moving laterally in the unsaturated zone) or shallow groundwater seepage into the wetlands on a seasonal basis, the potential for significant ground and surface water interactions is low for the site's wetlands. The eastern portion of the property consists primarily of Wilbraham silt loam, a coarse-loamy lodgment till derived from basalt and/or sandstone and shale. The soil is poorly drained with a low available water capacity.

Flood Control (Floodflow Alteration)

The ACOE Descriptive Method cites eighteen (18) factors to consider in assessing the flood control function of a wetland area, including: the size of the wetland relative to its watershed; location of the wetland in its watershed; watershed characteristics; wetland association with watercourses; and outlet conditions. The Connecticut wetland evaluation method assesses three basic factors to evaluate wetland flood storage capacity and reduction of downstream peak flows and flooding. These are: (1) the estimated volume of storage during the 1% chance (100-year) flood; (2) the effectiveness of that storage in relation to the total runoff and other storage in the watershed; and (3) the existing flooding concerns downstream. The Hollands and Magee Assessment Method rates fourteen (14) characteristics considered to influence flood storage capacity, with size, vegetative density, hydrologic connection, and the rate of water movement through the wetland most important.

In general, wetlands within 100-year floodplains and having some form of a constricted outlet to enhance water impoundment, a low gradient and dense vegetation (preferably woody) to slow water velocity, and sizable enough to contain a significant volume of water (although cumulative volumes from several smaller units need to be considered) are most important in decreasing peak flood flows and lessening flooding downstream.

Considering these factors, the eastern wetland resources on the site offer varying opportunity to store appreciable flood waters to affect flood flows and flood elevations in downstream watercourses. These wetlands have the capacity to retain high volumes of water, receive and detain excessive flood water as well as provide depressional storage. In addition, the floodplain and pond in this wetland system have the potential to provide peak rate control function which serves to attenuate flood peaks downstream. The topographic conditions, which are relatively flat shrub and emergent lowlands, contribute to flood storage. Although some of the wetland vegetation has been grazed and as such lost their capacity to slow water velocity, particularly the portion located southwest of Richards Brook in the southern portion of the site. The wetlands located in the western hilly portion of the site provide depressional areas that have some potential flood storage.

Wildlife Habitat / Fish and Shellfish Habitat

Most of the evaluation methods employ similar criteria for assessing overall wildlife habitat or biological functions; the Golet wetland wildlife evaluation provides the standard which most of the subsequent methods were developed from, and uses ten criteria in determining wildlife habitat value. Wetland size, variety and interspersion of vegetative cover types, availability of open water, juxtaposition to other wetlands, and surrounding habitat are important variables.

By contrast, wetland areas of less value generally contain a lack of plant community diversity and/or a typically disturbed plant community, are often isolated hydrologically or functionally from other wetlands, are smaller sized, and have an unproductive water regime. Accordingly, they are considered of low habitat quality, whereas the wooded wetland areas offer moderate quality habitat.

The most significant wetland within the site in terms of overall diversity of wildlife habitat is clearly the large wetland system associated Richards Brook, located in the eastern portion of the site. This wetland system (Richards Brook Wetland System) is considered by the City of Middletown as one of its outstanding wetlands and it is ranked 11th of the top 25 wetlands in Middletown. It provides wooded, shrub and emergent wetland habitat. In addition, the wetland system includes a lowland brook with deep pools and very high aesthetic quality which flows to the Mattabessett River via Sawmill Brook. In addition, the small pond located to the south east of the site is adjacent to the Brook and provides additional open water habitat for fish and shellfish. Species most commonly found within these types of habitat include waterfowl and other aquatic/riparian species such as fish, aquatic invertebrates, amphibians, and certain mammals such as raccoons, muskrats, otters, and mink. In addition, Eastern box turtle have been documented on the site. The most significant wildlife component of the site is related to the contiguous riparian corridor along Richards Brook in the eastern. The wooded hillside wetlands areas and adjacent forested uplands in the western portion of the site provide habitat for the Eastern box turtle as well as nesting and foraging passerine birds, deer, and other small mammals.

Sediment / Toxicant Retention

This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland to trap sediments, toxicants, or pathogens in runoff water from surrounding uplands or upstream eroding wetland areas. The Richards Brook wetland system provides the most significant sediment and toxicant retention function on the site. As a floodplain wetland, this system is associated with a perennial brook and provides floodwater storage. In some areas its dense vegetation cover contributes to diffuse water flow and sediment trapping capability. The western wetland system is primarily hillside seeps that provide little sediment or toxicant trapping qualities.

Nutrient Removal / Water Quality

The Connecticut method assesses the value of a wetland at reducing levels of nutrients by examining characteristics of the upstream watershed (potential sources of contaminants), the size of the wetland relative to that watershed, the type of vegetation in the wetland, the presence of impoundments in the wetland, and flood storage capacity of the wetland. The Hollands and Magee method rates 11 characteristics as influencing water quality maintenance, the most important being the dominant wetland class, vegetative density, topographic configuration, wetland size, and the rate of water movement through the wetland. The Corps' Descriptive Approach considers similar characteristics in assessing the "sediment/toxicant/pathogen retention" and the "nutrient removal/retention/transformation" functions.

In general, wetlands most likely to appreciably reduce levels of contaminants in waters moving through them are those having low (flat) gradients, long detention times, and diffuse surface water flow through dense vegetation and organic soils. The conditions within the Richards Brook system is the most conducive on the site for promoting water quality functions, and the location of the wetland in the watershed conveys an opportunity for this capacity to have significance for affecting surface water quality in the downstream watercourse. The western wetlands are considered the least significant wetlands for maintaining water quality due to the gradient, low vegetative density, and lack of hydric soils.

Production Export

This function evaluates the effectiveness of wetlands to produce food or usable products for humans or other living organisms. The western wetlands provide little production export while Richards Brook wetland system provide evidence that production export is available for wildlife use including aquatic food sources for wildlife development within their pools and ponds. Much of this wetland system is situated on agriculture and pasturelands that are currently provide a food source to livestock.

Sediment / Shoreline Stabilization

This function considers the effectiveness of a wetland to stabilize stream banks and shorelines against erosion. The eastern wetland system is a broad system, with areas of dense vegetation that moderates high velocity flood flows, and therefore provides bank stabilization and erosion control along Richards Brook. However those portions of the wetland situated in the pasturelands are degraded due to grazing and may not provide stabilization at this time. The western wetlands afford little opportunity to provide stabilization functions as they are not associated with water bodies on the project site.

Recreation

Recreation value considers the suitability of the wetland and associated watercourses to provide recreational opportunities. Currently the Boardman Lane property is privately owned and not utilized for recreation, however the brook does provide potential recreation value. The pond located in the southeast provides potential recreational fishing, however the area is underutilized. The other wetlands provide no recreational potential and are difficult to access.

Educational / Scientific Value

This value considers the suitability of wetlands as sites for outdoor classrooms or as a location for scientific study or research. The northern eastern portion of the wetland system associated with Richards Brook as well as the brook is not degraded and posses natural characteristics that would be considered useful for wetland/water-based education. The southern portion of the wetland system, although somewhat degraded, provides easy access and includes the pond which provides educational value.

Uniqueness / Heritage

This value pertains to the effectiveness of the wetlands or its associated water bodies to provide certain special values such as archaeological sites, critical habitat for endangered species, health, and appearance of the ecological system, or relative importance as wetlands for the geographic location. As mentioned above, the Richards Brook wetland system is considered by the City of Middletown as one of its outstanding wetlands with very high aesthetic qualities. Bradley Brook, located beyond the western site boundary, provides a diverse environment, with wet meadows, swamp, and marsh and pond habitats and diverse flora as well as an extensive area for wildlife travel. This system is ranked 14th of the top 25 environments in the City. Although Bradley Brook and associated wetland system does not occur on the property it is in close proximity to the site and situated within the same track of forest as site's western wetland system.

Visual Quality / Aesthetics

This value considers the visual and aesthetic quality or usefulness of the wetland. As mentioned above Richards Brook wetland system is considered an outstanding wetland with high aesthetic quality. The western wetlands and their location within the hillside forest provide some aesthetic qualities.

Threatened and Endangered Species Habitat

This value considers the suitability of the wetland to support threatened or endangered species. This site has been identified as providing habitat for the eastern box turtle and the squarrose sedge, State Species of Special Concern. Both species have been documented within the site's borders.

Other Functions

There are a number of other functions and values that may be provided by wetlands and can be assessed using accepted criteria. In general, it is AECOM's experience that wetlands which are determined to be significant for functions such as wildlife habitat and water quality improvement are also likely to contribute to other functions such as recreation, educational/scientific, heritage, and visual/aesthetic. Conversely, wetlands that do not possess the characteristics that promote wildlife habitat and water quality improvement typically are also not likely to provide these other functions to a significant degree.

Table 1 provides a summary of the anticipated functional significance of the site's wetlands as discussed above. In summary, the floodplain wetland along the eastern border of the site, Richards Brook wetland system, has the greatest significance for flood storage, wildlife habitat, nutrient removal, and water quality functions. In general, wetland areas which are identified as having low value have the following characteristics:

- A low diversity of vegetative cover types with low habitat value or which are subject to disturbance (e.g., recent or past cutting).
- Limited flood storage capacity due to topographic setting or a lack of natural or manmade control features to detain surface waters.
- Minimal surface water detention time or a lack of surface water during all portions of the year, as well as minimal input of surface water from upstream areas. These conditions infer a low potential for significant portions of the delineated wetland areas to interact with surface waters to positively influence the quality of the water and downstream resources.

The following table summarizes the functional assessment of the onsite wetlands.

Table 1: Summary of Wetland Functional Assessment

Functions/Values	Richards Brook Wetland System	Western Wetlands
Flood Control	High	Low
Groundwater	Moderate	Low
Water Quality	High	Low
Shoreline Stabilization	High	Low
Wildlife Habitat	High	High
Recreation	Moderate	Low
Education	Moderate	Low
Uniqueness/Heritage	High	Low
Visual Quality	High	Low
Endangered Species Habitat	High	High

Appendix F

Draft Conservation Restriction

Appendix G

SHPO Cultural Resources Clearance Letter & CT NDDB Clearance Letter

Connecticut Commission on Culture & Tourism

Historic Preservation
and Museum Division

One Constitution Plaza
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January 16, 2009

Mr. David W. Pugh
Planning Division, Military Branch
USACE/SAM/PD-M
PO Box 2288
Mobile, AL 36628-0001

Subject: Army Reserve Center
Middletown, CT

Dear Mr. Pugh:

The State Historic Preservation Office has reviewed the cultural resources survey prepared by Brockington and Associates Inc. concerning the above-named project. In the opinion of the State Historic Preservation Office, the archival and archaeological methodologies employed by Brockington and Associates Inc. are consistent with our *Environmental Review Primer for Connecticut's Archaeological Resources.* This office concurs with Brockington and Associates Inc.'s assessment that no additional archaeological investigations appear warranted with respect to the proposed undertaking.

In the opinion of the State Historic Preservation Office, the Samuel Harris House (612 Middle Street) and the Old Westfield Cemetery (Boardman Lane) possesses historic and/or architectural significance and are eligible for the National Register of Historic Places. As such, the proposed new Army Reserve Center will effect the historic integrity of these important cultural resources. However, this office believes that the proposed undertaking will constitute no adverse effect upon the state's cultural heritage. This comment is conditional upon the professional implementation of the following mitigative measures:

- The U.S. Army Corps of Engineers, Mobile and Louisville District, shall document the Samuel Harris House (612 Middle Street) and the Old Westfield Cemetery (Boardman Lane) to the professional standards of the State Historic Preservation Office. Documentation shall consist of narrative text, photographs and/or digital images, an index to photographs, and a photographic site plan. Final documentation shall be provided to the State Historic Preservation Office for permanent archiving and public accessibility.

- The U.S. Army Corps of Engineers, Mobile and Louisville District, shall provide the State Historic Preservation Office an opportunity to review and comment upon preliminary design plans for the proposed Army Reserve Center regarding appropriate landscape design vis-à-vis the Samuel Harris House (612 Middle Street) and the Old Westfield Cemetery (Boardman Lane).

The State Historic Preservation Office believes that the Noah Bacon House (218 Boardman Lane), the MacDonald House (475 Middle Street), and 19 Bell Street lack architectural significance and/or historic integrity and are not eligible for the National Register of Historic Places.

This office appreciates the opportunity to have reviewed and commented upon the proposed undertaking.

We look forward to further coordination with the U.S. Army Corps of Engineers and all interested parties regarding the expeditious furtherance of the proposed undertaking as well as the professional management of Connecticut's cultural heritage.

For further assistance please contact Dr. David A. Poirier, Staff Archaeologist.

Sincerely,

David Bahlman
Deputy State Historic Preservation Officer

cc: Dr. Nicholas Bellantoni/OSA

Appendix H

Monitoring Forms and Invasive Species Table 4

Table 4
Invasive and other Unacceptable Plant Species[10]

a. Herbs:

Aegopodium podagraria	Goutweed or Bishop's weed
Aira caryophyllea	Silver hairgrass
Alliaria petiolata	Garlic mustard
Allium vineale	Field garlic
Ampelopsis brevipedunculata	Porcelain berry
Anthoxanthum odoratum	Sweet vernal grass
Anthriscus sylvestris	Chervil
Arctium minus	Common burdock
Asparagus officinalis	Asparagus
Barbarea vulgaris	Yellow rocket
Bromus tectorum	Drooping brome-grass
Butomus umbellatus	Flowering rush
Cabomba caroliniana	Fanwort
Callitriche stagnalis	Water-starwort
Calystegia sepium	Japanese bindweed
Cardamine impatiens	Bushy rock-cress
Cardamine pratensis	Cuckoo-flower
Carex kobomugi	Japanese sedge
Centaurea biebersteinii	Spotted knapweed
Chelidonium majus	Celandine
Cirsium arvense	Canada-thistle
Cirsium palustre	Marsh thistle
Commelina communis	Asiatic day-flower
Coronilla varia	Crown vetch
Cyperus esculentus	Yellow nutsedge
Dactylis glomerata	Orchard-grass
Datura stramonium	Jimsonweed
Echinochloa crusgalli	Barnyard grass
Egeria densa	Giant waterweed
Eichhornia crassipes	Water hyacinth
Eleusine indica	Goosegrass
Elsholtzia ciliata	Elsholtzia
Elytrigia repens	Quack-grass
Epilobium hirsutum	Hairy willow-herb
Euphorbia cyparissias	Cypress spurge
Euphorbia esula	Leafy spurge
Festuca filiformia	Hair fescue
Festuca ovina	Sheep fescue

[10] Scientific names are those used in Gleason, Henry and A. Cronquist, 1991, *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*: Second Edition, The New York Botanical Garden: New York.

Froelichia gracilis	Slender snake cotton
Geranium nepalense (G. sibericum)	Nepalese crane's-bill
Geranium thunbergii	Thunberg's geranium
Glaucium flavum	Sea- or horned poppy
Glechoma hederacea	Gill-over-the-ground
Glyceria maxima	Sweet reedgrass
Hemerocallis fulva	Tiger-lily
Heracleum mantegazzianum	Giant hogweed
Hesperis matronalis	Dame's rocket
Hydrilla verticillata	Hydrilla
Hydrocharis morsus-ranae	European frog-bit
Hylotelephium telephium (*Sedum telephium*)	Live-forever or Orpine
Hypericum perforatum	St. John's wort
Impatiens glandulifera	Ornamental jewelweed
Iris pseudacorus	Yellow iris
Kochia scoparia	Summer cypress
Lamium spp. (all)	Dead nettle
Lepidium latifolium	Tall pepperwort
Lotus corniculatus	Birdsfoot trefoil
Lysimachia nummularia	Moneywort
Lysimachia vulgaris	Garden loosestrife
Lythrum salicaria	Purple loosestrife
Malva neglecta	Cheeses or common malva
Marsilea quadrifolia	Water shamrock or Eu. water clover
Mentha arvensis	Field-mint
Microstegium vimineum	Japanese stilt-grass
Miscanthus sinensis	Eulalia
Myosotis scorpioides	True forget-me-not
Myosoton aquaticum	Giant chickweed
Myriophyllum aquaticum	Parrot feather
Myriophyllum heterophyllum	Variable water-milfoil
Myriophyllum spicatum	Eurasian water-milfoil
Najas minor	Lesser naiad
Nymphoides peltata	Yellow floating heart
Ornithogalum umbellatum	Star of Bethlehem
Pastinaca sativa	Wild parsnip
Phalaris arundinacea	Reed canary-grass
Phragmites australis	Reed grass, Phragmites
Poa compressa	Canada bluegrass
Poa pratensis	Kentucky bluegrass
Poa trivialis	Rough bluegrass
Polygonum aubertii	Silver lace-vine
Polygonum cespitosum	Cespitose knotweed
Polygonum cuspidatum	Japanese knotweed
Polygonum perfoliatum	Mile-a-minute vine

Polygonum persicaria	Lady's thumb
Polygonum sachalinense	Giant knotweed
Potamogeton crispus	Curly pondweed
Puccinellia maritima	Seaside alkali-grass
Pueraria montana	Kudzu
Ranunculus ficaria	Lesser celandine
Ranunculus repens	Creeping buttercup
Rorippa microphylla	One-row yellow cress
Rorippa nasturtium-aquaticum	Watercress
Rorippa sylvestris	Creeping yellow cress
Rumex acetosella	Sheep-sorrel
Rumex obtusifolius	Bitter dock
Salvinia molesta	Salvinia
Senecio jacobaea	Tansy ragwort
Setaria pumila (S.lutescens, S. glauca)	Yellow foxtail or y. bristlegrass
Silphium perfoliatum	Cup plant
Solanum dulcamara	Bittersweet nightshade
Stellaria graminea	Common stitchwort
Tanacetum vulgare	Tansy
Thymus pulegioides	Wild thyme
Trapa natans	Water-chestnut
Tussilago farfara	Coltsfoot
Typha latifolia[11]	Common or Broad-leaved cattail
Typha angustifolia[4]	Narrow-leaved cattail
Valeriana officinalis	Garden heliotrope
Verbascum thapsus	Common mullein
Veronica beccabunga	European speedwell
Vincetoxicum rossicum (V. nigrum)	Black swallow-wort
Xanthium strumarium	Common cocklebur

b. Woody Plants:

Acer ginnala	Amur maple
Acer platanoides	Norway maple
Acer pseudoplatanus	Sycamore maple
Actinidia arguta	Kiwi vine
Ailanthus altissima	Tree-of-heaven
Alnus glutinosa	European alder
Berberis thunbergii	Japanese barberry
Berberis vulgaris	Common barberry
Catalpa speciosa	Western catalpa

[11] *Typha* spp. are native species which provide good water quality renovation and other functions/values. However, they are aggressive colonizers which, given the opportunity, will preclude establishment of other native species. They are included in this list as species not to be planted, not because they are undesirable in an established wetland, but to provide opportunities for other species to become established. It is likely they will eventually move in without human assistance.

Celastrus orbiculatus	Oriental bittersweet
Cynanchum louiseae	Black swallow-wort
Cytisis scoparius	Scotch broom
Elaeagnus angustifolia	Russian olive
Elaeagnus umbellata	Autumn olive
Euonymus alata	Winged euonymus
Euonymus fortunei	Climbing euonymus
Humulus japonicus	Japanese hops
Hypericum prolificum	Shrubby St. John's wort
Ligustrum obtusifolium	Japanese privet
Ligustrum vulgare	Common/hedge privet
Lonicera japonica	Japanese honeysuckle
Lonicera maackii	Amur honeysuckle
Lonicera morrowii	Morrow's honeysuckle
Lonicera tartarica	Tatarian honeysuckle
Lonicera x bella	Morrow's X Tatarian honeysuckle
Lonicera xylosteum	European fly-honeysuckle
Morus alba	White mulberry
Paulownia tomentosa	Princess tree or empress tree
Phellodendron japonicum	Corktree
Populus alba	Silver poplar
Rhamnus cathartica	Common buckthorn
Rhamnus frangula	European buckthorn
Ribes sativum	Garden red currant
Robinia pseudoacacia	Black locust
Rosa multiflora	Multiflora rose
Rosa rugosa	Rugosa rose
Rubus phoenicolasius	Wineberry
Salix purpurea[12]	Basket or purple-osier willow
Sorbus aucuparia	European mountain-ash
Taxus cuspidata	Japanese yew
Ulmus pumila	Siberian elm
Wisteria floribunda	Wisteria

[12] This is not appropriate for use in wetland mitigation. In some circumstances it may be appropriate in stream bank stabilization.

ATTACHMENT 1

Project Overview Form

Corps Permit No.:
Mitigation Site Name(s):
Monitoring Report: _____ of _____
Name and Contact Information for Permittee and Agent:

Name of Party Responsible for Conducting the Monitoring:

Date(s) of Inspection(s):

Project Summary:

[include purpose of approved project, acreage and type of aquatic resources impacted, and mitigation acreage and type of aquatic resources authorized to compensate for the aquatic impacts]

Location of and Directions to Mitigation Site:

Start and Completion Dates for Mitigation:

Performance Standards **are/are not** being met:

[describe how]

Dates of Corrective or Maintenance Activities Conducted Since Last Report:

Recommendations for Additional Remedial Actions:

ATTACHMENT 2

MITIGATION REPORT
TRANSMITTAL AND SELF-CERTIFICATION

DEPARTMENT OF THE ARMY PERMIT NUMBER:
PROJECT TITLE:

PERMITTEE:
MAILING ADDRESS:

TELEPHONE:

AUTHORIZED AGENT:
MAILING ADDRESS:

TELEPHONE:

ATTACHED MITIGATION REPORT
TITLE:

PREPARERS:

DATE:

CERTIFICATION OF COMPLIANCE: I certify that the attached report is accurate and discloses that the mitigation required by the Department of the Army Permit **[is] [is not]** in full compliance with the terms and conditions of that permit.

CORRECTIVE ACTION: A need for corrective action **[is] [is not]** identified in the attached report.

CONSULTATION: I **[do] [do not]** request consultation with the Corps of Engineers to discuss a corrective strategy or permit modification.

CERTIFIED:_____
(Signature of permittee) Date

ENVIRONMENTAL ASSESSMENT AND DRAFT FINDING OF NO SIGNIFICANT IMPACT FOR THE ACQUISITION OF 53.8 ACRES AT 218 BOARDMAN LANE AS MITIGATION FOR THE BRAC 05 REALIGNMENT AT MIDDLETOWN, CONNECTICUT

TO INTERESTED AGENCIES AND INDIVIDUALS

Please find enclosed the Environmental Assessment and Draft Finding of No Significant Impact for the proposed acquisition of 53.8 acres at 218 Boardman Lane (Boardman Lane parcel) as mitigation for the loss of 1.5 acres of jurisdictional wetlands from the construction and operation of the Middletown, Connecticut Armed Forces Reserve Center on Smith Street (formerly Cucia Park).

The EA addresses the potential environmental and socioeconomic effects associated with the acquisition the Boardman Lane parcel as off-site compensatory mitigation required under the Clean Water Act (CWA) Section 404(b)(1) Permit No. NAE-2008-2372. Off-site compensatory mitigation includes about 17 acres of wetland and 23 acres of upland (40.9 acres total). An additional 12.9 acres is proposed to be purchased because the acreage has been determined to be an uneconomic remnant.

Two alternatives are presented in the EA: (1) the Proposed Action, which involves the acquisition of 53.8 acres at 218 Boardman Lane, and (2) the No Action Alternative. Following a detailed review of the other sites available, the U.S. Army Corps of Engineers, New England District, Regulatory Division and the U.S. Environmental Protection Agency, in consultation with the U.S. Army Corps of Engineers, Louisville District concluded that the Boardman Lane parcel provided the conditions for compensatory mitigation that could directly offset the unavoidable functional impacts to wetlands from development of the AFRC on Smith Street. The off-site mitigation would provide permanent preservation and enhancement of wetland and upland habitats.

The EA and Draft Finding of No Significant Impact (FNSI) will undergo a 30-day public comment period, beginning June 30, 2010 through July 29, 2010. This is in accordance with requirements specified in 32 CFR Part 651.14 Environmental Analysis of Army Actions. Throughout this process, the public may obtain information and/or submit written comments on the proposed action and the EA and draft FNSI through the 99th Regional Support Command. For additional information, contact Ms. Laura Dell'Olio, BRAC Environmental Coordinator at: (609) 562-7661. The mailing address to submit comments is:

Ms. Laura Dell'Olio
99th Regional Support Command
c/o Innovar Environmental Inc.
5231 South Scott Plaza
Fort Dix, NJ 08640

The EA and draft FNSI are available for review on the World Wide Web at:
http://www.hqda.army.mil/acsim/brac/env_ea_review.htm

ENVIRONMENTAL ASSESSMENT AND DRAFT FINDING OF NO SIGNIFICANT IMPACT FOR THE ACQUISITION OF 53.8 ACRES AT 218 BOARDMAN LANE AS MITIGATION FOR THE BRAC 05 REALIGNMENT AT MIDDLETOWN, CONNECTICUT

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