The attached document contains 5 Final Wetland Mitigation Monitoring Reports for the F.E. EVERETT TURNPIKE project in Nashua, NH.

WETLAND MITIGATION MONITORING REPORT
FINAL ASSESSMENT

F.E. EVERETT TURNPIKE
NASHUA, NEW HAMPSHIRE
SEARLES ROAD SITE 11057
USACOE # 1991-01009
NH WETLANDS BUREAU PERMIT NO. 1997-01678
NASHUA, NEW HAMPSHIRE

August 2007

WETLAND MITIGATION MONITORING REPORT
FINAL ASSESSMENT

BENSON'S MITIGATION SITE
HUDSON, NEW HAMPSHIRE
STATE PROJECT # 10623-Q
NHDES PERMIT #91-01370, 91-01371, 97-01678
ACOE PERMIT # 1991-01009

Prepared by:

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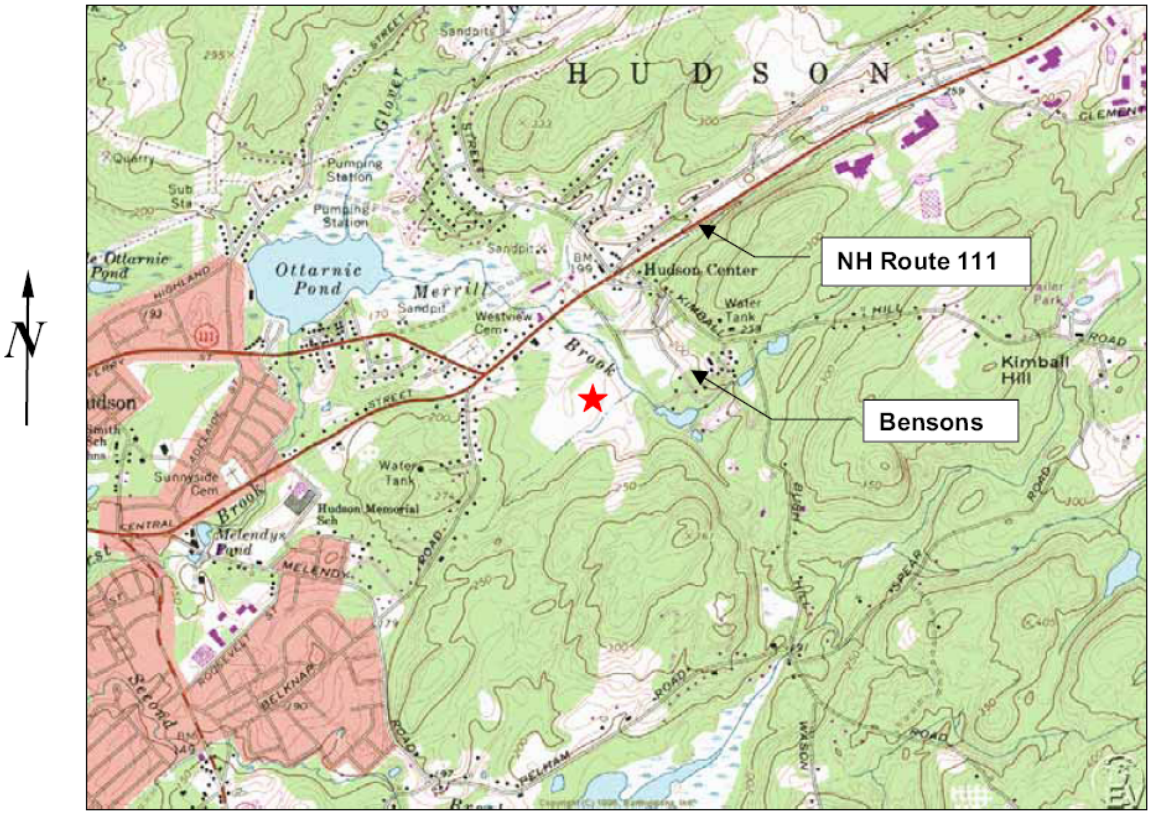
August 2007

Introduction

The Louis Berger Group, Inc. (Berger) conducted wetland mitigation monitoring at the Benson's mitigation site (State Project No. 10623-Q) located in Hudson on August 22, 2007 for the New Hampshire Department of Transportation (NHDOT), Bureau of Environment (USGS Locus map, below; general site plan, page 5). Previous monitoring reports for the Benson's mitigation site were prepared by Parsons in 2003 (baseline report) and 2004 (2-year monitoring report).



USGS Locus Map

Methodology

Previous data plots and photo stations used in 2004 were relocated for assessment during 2007. Vegetative cover between 2004 and 2007 are documented and compared in the end of this report. Overall vegetation cover, survival and spread of planted wetland species, and colonization of native and exotic wetland species were photographed and recorded. Wildlife sightings and presumed activity as well as general site conditions such as hydrology or functional role, were also recorded.

Plot stakes were located or replaced due to stake rot or inability to locate the original plot in the tall vegetation, and marked with pink flagging tape for future identification and assessment. Plant species and estimated percent aerial cover were documented for each plot location in accordance with applicable U.S. Army Corps of Engineers procedures specified in the 1987 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands;* non-woody herbaceous and woody species < 3.2 feet tall were recorded within a 5-foot radius and woody saplings and shrubs > 3.2 feet tall were recorded within a 15-foot radius. Changes in species composition at specific sites may be attributed to natural succession or approximations of site plots when original plots could not be located. An accompanying plan showing the mitigation site, vegetation data plot survey

information, and site photos can be found at the end of this report.

Site Descriptions and Observations

Overall, site observations are consistent with the 2004 report with the exception of ongoing plant succession and beaver activity. Beaver activity in the adjacent unnamed stream has partially dammed the outlet structure located along the trail east of the site. The damming activity has altered the site's hydrology and currently impounds water at an elevation 3-4 inches above the upstream pipe invert (documented in photos section).

Sapling trees planted at higher elevations experienced lower mortality than plantings at lower elevations. Green ash, American larch, swamp white oak, and willow species are in good health. Earlier reports cite that water levels may have contributed to mortality, particularly to plantings within the lower portions of the scrub shrub zone. Shrubs and saplings located at the lower extent of the scrub-shrub zone are not visible from a distance due to the prevalence of broad-leaved cattail cover, although upon close inspection of the lower elevations, various shrubs species such as buttonbush, red-osier dogwood, and arrowwood can be found (refer to Site Photographs section of this report). Buttonbush was planted at the site and although not observed in 2004 are common and in good health at lower elevations where fatality was thought to have occurred. The 2004 report included a list of observed plant species and conditions, documenting planting success approximately one year after planting took place. We concur with the 2004 monitoring report with the exception that buttonbush plantings/volunteers are in good health. Woody native wetland volunteer species have colonized available habitats, particularly gray birch, speckled alder, and willow species.

Herbaceous vegetation in the lower marsh is dominated by cattail and duckweed, with inclusions of various wetland plants dependent upon location. The upper marsh is generally co-dominated by boneset, spotted joe-pye weed, blue vervain, fox sedge and *Solidago sp*. Purple loosestrife is present at the site and is particularly abundant at the northwest portion of the site although the species is generally not dominant throughout the site. According to the *2004 Annual Report on the Biological Control of Purple Loosestrife*[1]biological controls of purple loosestrife have been employed at this site each year from 2001 through 2004. Common invasives such as oriental bittersweet, multiflora rose, winged eonymous, European and glossy buckthorn, tatarian honeysuckle, Japanese barberry, *Phragmites*, and reed canary grass. Japanese knotweed (previously observed in wetland surrounds in 2004) was not observed.

Soils at observation plots were compared to *Field Indicators for Identifying Hydric Soils in New England*[2] *to* confirm that hydrological conditions are adequate to support hydric soils at the mitigation site.

The Benson's mitigation site provides excellent wildlife habitat for a variety of species. Beaver activity (felled debris) are very common at the site. A very dense population of green frogs was observed throughout the site. Leopard frogs and a single gray tree frog were also observed. The higher marsh between the two pools provides excellent cover for predators. Two adult black racer snakes, approximately 5 feet in length, were observed in the vicinity of plot F-1. Two great

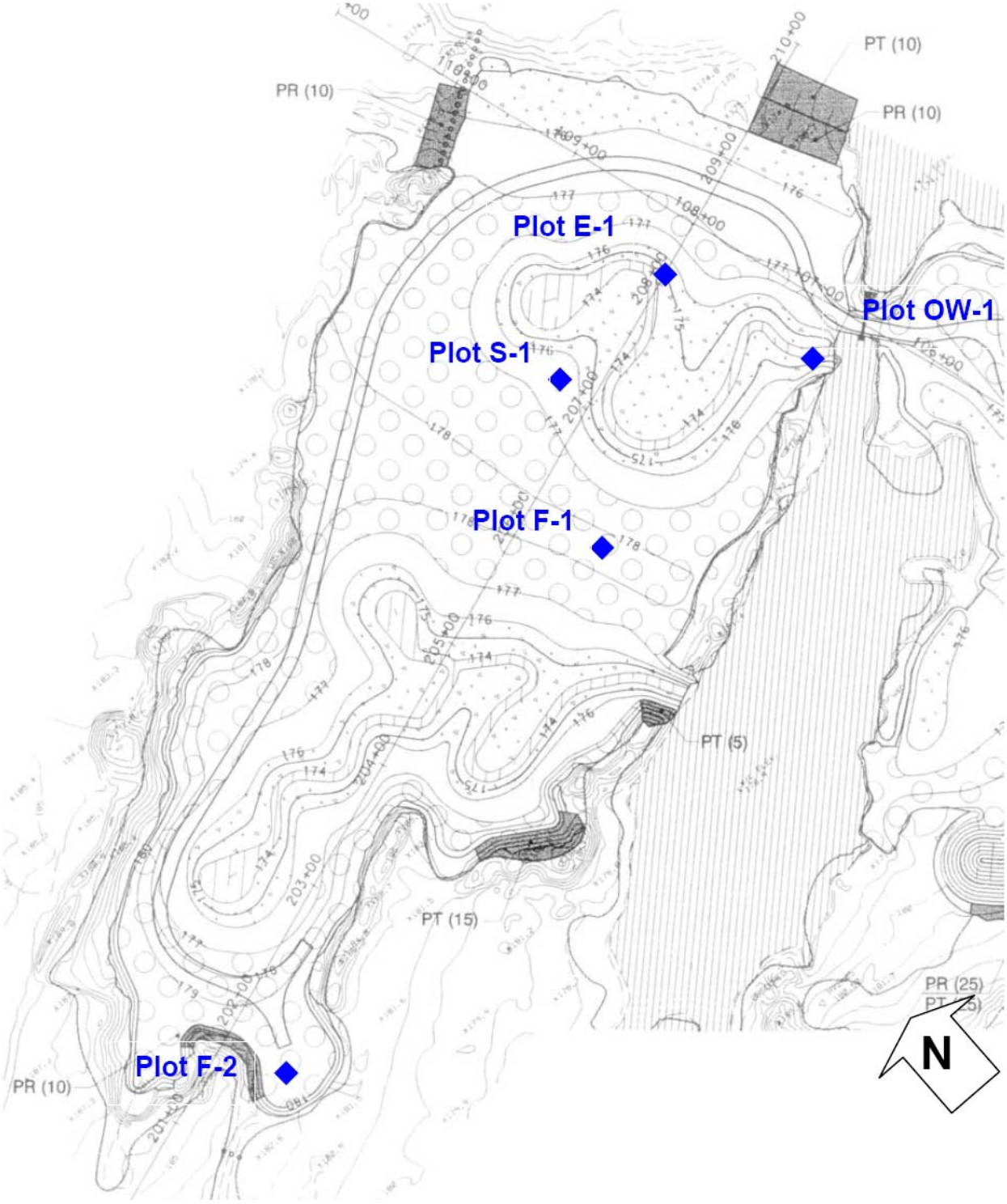
[1]New Hampshire Department of Agriculture, Markets and Food, Plant Industry Division and New Hampshire Department of Transportation Bureau of Environment, 2005. Biological Control of Purple Loosestrife, 2004 Annual Report.
[2] New England Hydric Soils Technical Committee. 2004. 3rd ed., *Field Indicators for Identifying Hydric Soils in New England*. New England Interstate Water Pollution Control Commission, Lowell, MA.

blue herons were observed at the mitigation site. Coyote scat was observed along the trail. Deer have been using the northern edge of the site for bedding, and a well established deer trail is located in the vicinity of S-1. Deer and raccoon tracks are prevalent along the edge of the lower, now permanently inundated marsh. Evidence of muskrat feeding is present. Bee activity was preeminent on the day of the observation. European and native bees were seen at a density that is presumed to be highly uncommon (approximately 15 feeding bees per square meter along the upper marsh). The site is surrounded a large tract of land that is relatively unfragmented by development, and the mitigation area itself is surrounded by a diverse mosaic of habitats in terms of general succession and wetland/upland edges. Surrounding wetland areas host turtles, hawks, largemouth bass (an adult bass was observed feeding at the surface and juveniles were observed in the unnamed stream). Wildlife habitat value is a prime function of this mitigation site.

Conclusion

The 2004 monitoring report focused on the early development of the replication site, focusing on the favorable groundwater levels and documentation of initial planting success. Groundwater levels demonstrated that sufficient hydrology was achieved. The Benson's mitigation site experienced substantial planting mortality after construction. Fortunately, the remaining woody vegetation is in good health. Woody, native, wetland volunteer species have colonized available habitats, particularly gray birch, speckled alder, and willow species, as well as trembling aspen along the upland edge. Natural succession has and will continue to correct for the partial mortality of planted woody species. The herbaceous stratum in the upper marsh consists of a diverse assemblage of native wetland plants. The lower marsh is dominated by common cattail with inclusions of herbaceous and shrub species. Open water areas are dominated by duckweed. Wetland hydrology has been achieved throughout the site. Design elevations are adequate. Continued control of purple loosestrife may be required under the state program, although the species is currently not dominant at the majority of the site. The Benson's mitigation site provides primary wetland functions including but not limited to floodflow alteration, sediment and toxicant retention and wildlife habitat. The site has some value in a recreational aesthetic and educational sense due to the trail network, habitat mosaic, interesting disturbance history, presence of wildlife and wildflowers and presence of keystone species (beaver). The outlet structure should be monitored for substantial clogging due to beaver damming activity as further damming of the outlet structure may cause unintended habitat transition to the extent that the recreational trails are affected by higher water levels.

GENERAL SITE PLAN


Plot E-1
Plot OW-1
Plot S-1
Plot F-1
Plot F-2
PR (10)
PT (10)
PR (10)
PT (5)
PT (15)
PR (25)
PR (10)
N

SITE PHOTOGRAPHS

Photo series of western pool, station 204+00 vicinity

Photo series of eastern pool connection, original wetland at left, mitigation site at right

Western pool (left) connection to original wetland (right)

Original wetland beside western pool connection, flooded by beaver dam

Eastern pool connection to original wetland

Upstream side of mitigation site outlet structure, dammed by beavers

Interior of outlet structure; note: pipe clogged 3-4 inches with debris

Outlet structure, down gradient of constructed wetland

Downgradient wetland; note: purple loosestrife not as common at mitigation site.

Natural habitat structure in the vicinity of plot OW-1

Evidence of beaver activity at upgradient wetland

Green frogs are very abundant at the Benson's mitigation site

Gray tree frog positioned on a common boneset plant

Bees feeding on the nectar of common boneset, a late blooming plant

Juvenile largemouth bass observed in downstream wetland

Deer trail within lower marsh

Evidence of muskrat activity, common at the mitigation site

A planted arrowwood shrub in cattail-dominated marsh provides habitat for birds

Heavily fruiting (planted) green ash sapling

Planted tamarack, green ash, and white oak saplings in good health

Red-osier dogwood within cattail marsh

Common winterberry within lower marsh

Black Chokeberry along water's edge

Red-osier dogwood with bird nest

Buttonbush at center of western depression

A planted ash sapling, felled by beavers, survives

Unsuccessful planting, presumably due to shock

Typical area along path at northwest quadrant of site; note successful saplings, loosestrife

Path at western edge of site with abundant speckled alder, willow, and grey birch volunteers

WETLAND OBSERVATION PLOT DATA

Plot OW-1

Plot OW-1 occurs at the open water connection of the eastern depression. The plot is dominated by common duckweed and includes the shrub cover from the adjacent peninsula. Soils were not sampled due to the water depth of greater than 2 feet. The area meets Category 1 (Frequently Ponded or Flooded Soils) of the *Field Indicators for Identifying Hydric Soils in New England*. "Frequently flooded" means that the soil has a 50 percent chance of being flooded in any year and "frequently ponded:" means that the soil has a 50 percent chance of being ponded in any one year.

Plot OW-1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Lemna minor	Common Duckweed	100%	OBL
	Shrubs/Saplings		
Acer rubrum	Red maple	10%	FAC
Alnus rugosa	Speckled alder	15%	FACW+
Viburnum recognitum	Arrowwood	10%	FACW-

Plot E-1

Plot E-1 is situated within the lower emergent marsh dominated by cattails. Soils meet hydric soil Category 3 (Histosols) due to the depth of the organic layer and presence of redoximorphic features; and, Category 7 (Depleted or Gleyed Matrix) as the soil has a gleyed matrix within ten inches of the top of the mineral soil. Due to the wavy soil surface, the water level ranged from 2 inches above the surface to 2 inches below the surface.

Plot E-1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Broad-leaved cattail	70%	OBL
Lemna minor	Common duckweed	25%	OBL
Carex lupulina	Hop sedge	5%	OBL

Plot E-1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
Oe	24 to 0		10YR 2/1	Histosol
C	24+	fine sandy loam	Gley 7/10Y	Stripped matrix Gley 5N mottles

Plot S-1

Plot S-1 is situated within the lower emergent marsh dominated by cattail and contains duckweed, woolgrass, soft rush and hop sedge. Soils meet hydric soil Category 3 (Histosols) due to the depth of the organic layer and presence of redoximorphic features; and, Category 7 (Depleted or Gleyed Matrix) as the soil has a gleyed matrix within ten inches of the top of the mineral soil. Due to the wavy soil surface, the water level ranged from 2 inches above the surface to 2 inches below the surface.

Plot S-1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Broad-leaved cattail	40%	OBL
Lemna minor	Common Duckweed	20%	OBL
Scirpus cyperinus	Woolgrass	10%	FACW+
Juncus effusus	Soft rush	15%	FACW+
Carex lupulina	Hop Sedge	5%	OBL
	Bare Ground	5%	

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
Oe	24 to 0		10YR 2/1	Histosol
C	24+	fine sandy loam	Gley 7/10Y	Stripped matrix Gley 5N mottles

Plot F1

Plot F-1 is situated in the upper emergent/scrub-shrub marsh (El 176 to 178). The upper emergent zone maintains a high water table throughout the growing season. Plants at this elevation are FACW or wetter (OBL) signifying that the targeted hydrology has been achieved. The plot is dominated by boneset, spotted joe pye weed, swamp beggarticks and fox sedge with 5 species of shrubs/saplings. The upper emergent/scrub-shrub marsh zone between the eastern and western depressions provides important wildlife cover. Wildlife movement, (presumably from small mammals) was audible while traveling through the dense vegetation. Soils meet hydric soil Categories 7 (Depleted Below Dark Surface) as well as 10A & 10B (Sandy with Redox) due to multiple qualifiers. The soil was moist at 14 inches.

Plot F1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Eupatorium perfoliatum	Boneset	20%	FACW+
Eupatoriadelphus maculatus	Spotted joe pye weed	20%	FACW
Bidens discoidea	Swamp beggarticks	20%	FACW
Carex vulpinoidea	Fox sedge	20%	OBL
Verbana hastata	Blue vervain	10%	FACW+
Solidago uliginosa	Bog goldenrod	10%	OBL
	Shrubs/Saplings		
Betula populifolia	Gray birch	20%	FAC
Larix laricina	Tamarack	10%	FACW
Salix discolor	Pussy willow	5%	FACW
Quercus bicolor	Swamp white oak	5%	FACW+
Cornus amomum	Silky dogwood	5%	FACW

Plot F1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
A	0 to 10		2.5Y 3/1	very dark
B	10 to 15	loamy sand	2.5Y 7/4	mottling prominent
C	15 to 22	loamy sand	2.5Y 8/2	high contrast mottling *sandy soil

Plot F2

Plot F-2 is situated in the transition between the upper emergent/scrub-shrub marsh and upland (El 179-180). The plot contains mostly facultative wetland species (or wetter) and contains hydric soils. This plot is not an optimal representation of the upper emergent/scrub-shrub marsh found throughout the site. Shrubs and sapling planted in the immediate vicinity have had good success; gray birch volunteers are numerous and are in excellent heath. Due to the constructed nature of the soil, it does not absolutely key out to the hydric soil categories of New England. The soil is sandy with prominent mottling within 10 inches and has a depleted matrix (due to wetness) at 14 inches. Professional judgment would deem this soil hydric due to combined characteristics of hydric soil Categories 10B & 10C. Soils were not saturated at the sampling depth.

Plot F2 Soil Profile: High contrast between depleted soil matrix and masses within the C-horizon

Plot F2 Vicinity: Sedges on trail (foreground), boneset and joe-pye weed (edge), dense sapling layer (rear)

Plot F2 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Euthamia graminifolia	Flat-top goldentop	50%	FAC
Asclepias syriaca	Common milkweed	25%	not indexed
Polygonum sp.	Polygonum sp.	20%	n/a
Solidago altissima	Late goldenrod	5%	FACU-
	Shrubs/Saplings		
Betula populifolia	Gray birch	20%	FAC
Sambucus canadensis	Common elderberry	10%	FACW-
Rubus allegheniensis	Allegheny Blackberry sp.	10%	FACU-
Pinus resinosa	Red Pine	5%	FACU
Fraxinus pennsylvanica	Green Ash	5%	FACW
Quercus bicolor	Swamp White Oak	5%	FACW+
Amelanchier canadensis	Shadblow Serviceberry	5%	FAC

Plot F2 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
A	0 to 8	sandy loam	2.5Y 3/2	
B	8 to 14	loamy sand	2.5Y 6/6	prominent mottling
C	14+	loamy sand	2.5Y 8/2	high contrast mottling *sandy soil

WETLAND MITIGATION MONITORING REPORT
FINAL ASSESSMENT

MITIGATION SITE TSA-1
MAIN DUNSTABLE ROAD
NASHUA, NEW HAMPSHIRE
Nashua 11057
USACOE #1991-01009
NH Wetlands Bureau Permit # 97-01678

August, 2007

WETLAND MITIGATION MONITORING REPORT
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MITIGATION SITE TSA-1
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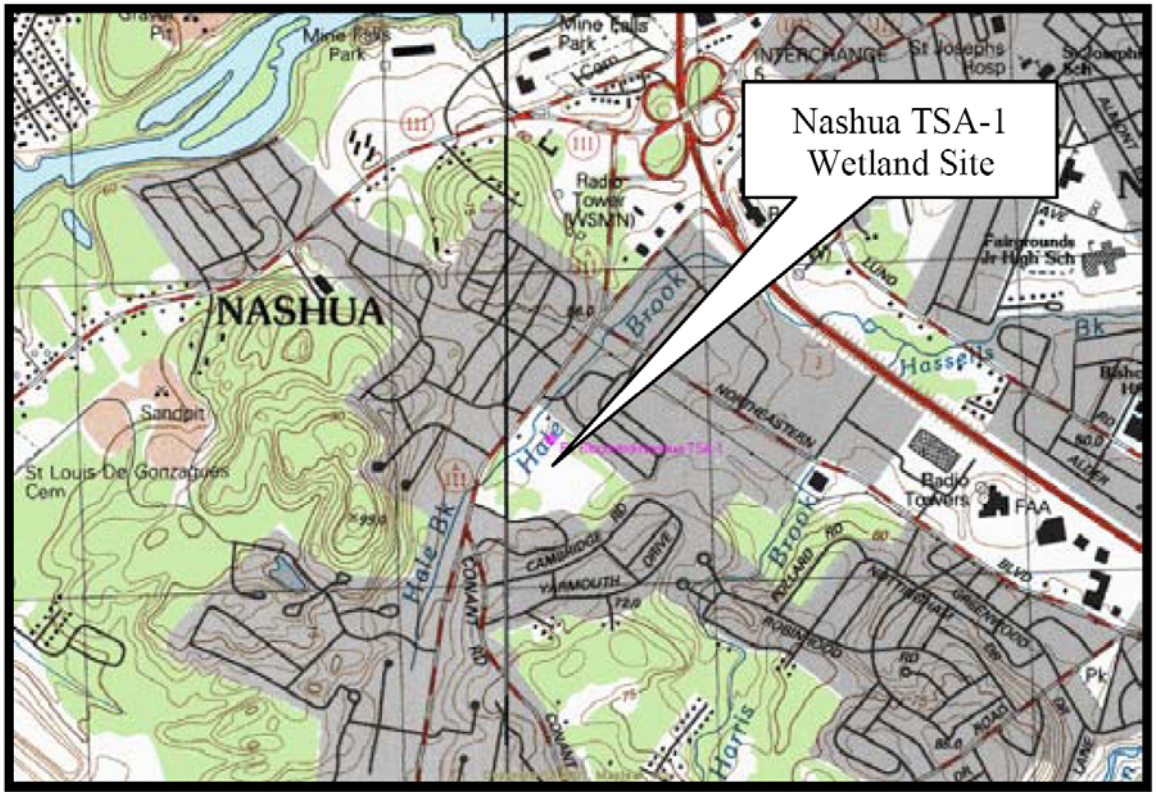
August 2007

Introduction

The Louis Berger Group, Inc. (Berger) conducted a wetland mitigation monitoring assessment at the Main Dunstable Road TSA-1 (Pig farm) site on August 14, 2007 for the New Hampshire Department of Transportation (NHDOT), Bureau of Environment. A previous monitoring report for the TSA-1 site was prepared by Berger in 2002. The mitigation was required as compensation for wetland impacts created during the widening and reconstruction of the F.E. Everett Turnpike from the Massachusetts state line north to Nashua, NH. The TSA-1 mitigation site is located on a 25 acre parcel adjacent to Main Dunstable Road (see USGS locus map) and is composed of a 2.8 acre northern wetland area and a 5.7 area southern wetland area separated by an existing wooded knoll. According to the *2004 Annual Report on the Biological Control of Purple Loosestrife*[1] the site has undergone tremendous vegetative changes. In 1997, the site was estimated to contain 90 percent cover of purple loosestrife. Biological controls lead to a near collapse of the population in 2000. Signs of herbivory are present and the purple loosestrife population appears to be under control.



USGS Locus Map

Methodology

Previous data plots and photo stations originally used in 1997 and 2002 were relocated for assessment during 2007. Overall vegetation cover, survival and spread of planted wetland species, and colonization of native and exotic wetland species were photographed and recorded. Wildlife sightings and presumed activity as well as general site conditions such as hydrology or

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functional role, were also recorded.

Plot stakes were located or replaced due to stake rot or inability to locate the original plot in the tall vegetation, and marked with pink flagging tape for future identification and assessment. Plant species and estimated percent aerial cover were documented for each plot location in accordance with applicable U.S. Army Corps of Engineers procedures specified in the 1987 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands;* non-woody herbaceous and woody species < 3.2 feet tall were recorded within a 5-foot radius and woody saplings and shrubs > 3.2 feet tall were recorded within a 15-foot radius. Changes in species composition at specific sites may be attributed to natural succession or approximations of site plots when original plots could not be located. An accompanying plan showing the mitigation site, vegetation data plot survey information, and site photos can be found at the end of this report.

Site Descriptions and Observations

The TSA-1 mitigation site is located on a 25 acre parcel and is composed of two areas separated by an existing wooded knoll and an access gravel road. This site was constructed with the intent to create a scrub/shrub complex with areas of shallow and deep marsh and open water. The northern area is adjacent to Hale Brook. The southern area is adjacent to a forested area and drains into an existing forested wetland. Hydrology is reportedly provided by groundwater at both areas, however, the northern area also receives surface water from Hale Brook during high water events. In addition, there is a drainage ditch fronting the east side of the property which collects surface waters from the surrounding neighborhood and from the existing forested wetland. The 1997 Monitoring Report prepared for this site stated that the ditch connects with the northern area and provides constant saturation to this portion of the area even when there is no overt flow. This portion of the mitigation site was impounded with standing water as a result of beaver activity in 2002 although in 2007 the area was not impounded and would not be considered open water/deep marsh.

Landscaping around the site consisted of a variety of facultative trees and shrubs that are common to New England such as buttonbush, willow, red osier dogwood, speckled alder, and common winterberry. The site is well-vegetated with a variety of herbaceous species. Survival and growth of these species in both upland and wetlands were healthy. For example, alders in both the northern and southern areas that were measured at heights of 8 feet or more in 2002 can now be found at heights closer to or surpassing 15 feet. One larch tree was estimated to be 22 feet tall.

The approximately 2.8 acre northern area was constructed by expanding upon a narrow band of existing wetland bordering Hale Brook. The diversion of flow from Hale Brook during higher flows supplements the hydrology to this area resulting in a well-developed organic soil horizon from prolonged saturation. The constructed wetlands consist primarily of emergent shallow marsh with smaller areas of shrub swamp generally along the upland/wetland border. Much of the inundated vegetation appeared to be persistent emergent vegetation typical of shallow marsh habitats. The wetland is completely vegetated with species such as broad-leaved cattail, lurid sedge, soft rush, dark green bulrush, marsh bedstraw, woolgrass, and interspersed patches of purple loosestrife which remains dominant in many upper emergent marsh portions of the site.

The southern area was constructed to provide 5.7 acres of scrub/shrub, deep and shallow marsh, and small open water habitats. The wetland is completely vegetated with species such as broad-leaved cattail, goldenrod, beggarticks, and dense stands of purple loosestrife in several locations. An approximately 3,000-3,500 s.f. patch of *Phragmites* is present at the site in the vicinity of plot

T4 P1; this population is expanding and is in need of control. Additional invasives found at the site include Russion olive and oriental bittersweet. The southern area also contains areas of maturing scrub/shrub vegetation which, over time, will occupy larger areas of both the northern and southern portions of the site.

Wildlife observations were more prevalent in the southern area possibly due to the greater variety and larger size of the area compared to the smaller northern wetland area. In 2002, a small flock of mallard ducks were using the open water habitat to feed and rest. Scat (presumably fox) was found on two occasions. Game trails, bedding, browsing, and scat from deer were common in the site especially in the southern area. A variety of common songbirds (grackle, blue jay, mourning dove, song sparrow) as well as a broad-winged hawk were observed in 2002 and 2007. A single yellowthroat was observed in 2007, as well as green and leopard frogs.

The TSA-1 site appears to be providing floodflow alteration and sediment and toxicant retention functions. The floodflow alteration function is enhanced by the presence of several indicators including storage potential, a constricted outlet, diffuse and low-velocity flow through the wetland, the extent of impervious surfaces in contributing watershed and the high stem density of persistent emergent vegetation. Many of these qualifiers are also indicative of the sediment and toxicant retention function. Additional indicators include prolonged water retention time, presence of sediment and toxicant sources within the contributing watershed, and the lack of erosion or scouring within the wetland. Wildlife habitat functions are enhanced by the relatively large size, the connection to a watercourse, habitat diversity both within the wetland and surrounding uplands (forest and meadow), relatively high species richness and the lack of degradation by human activity. It is clear the site is providing important wildlife habitat within a largely developed region of Nashua.

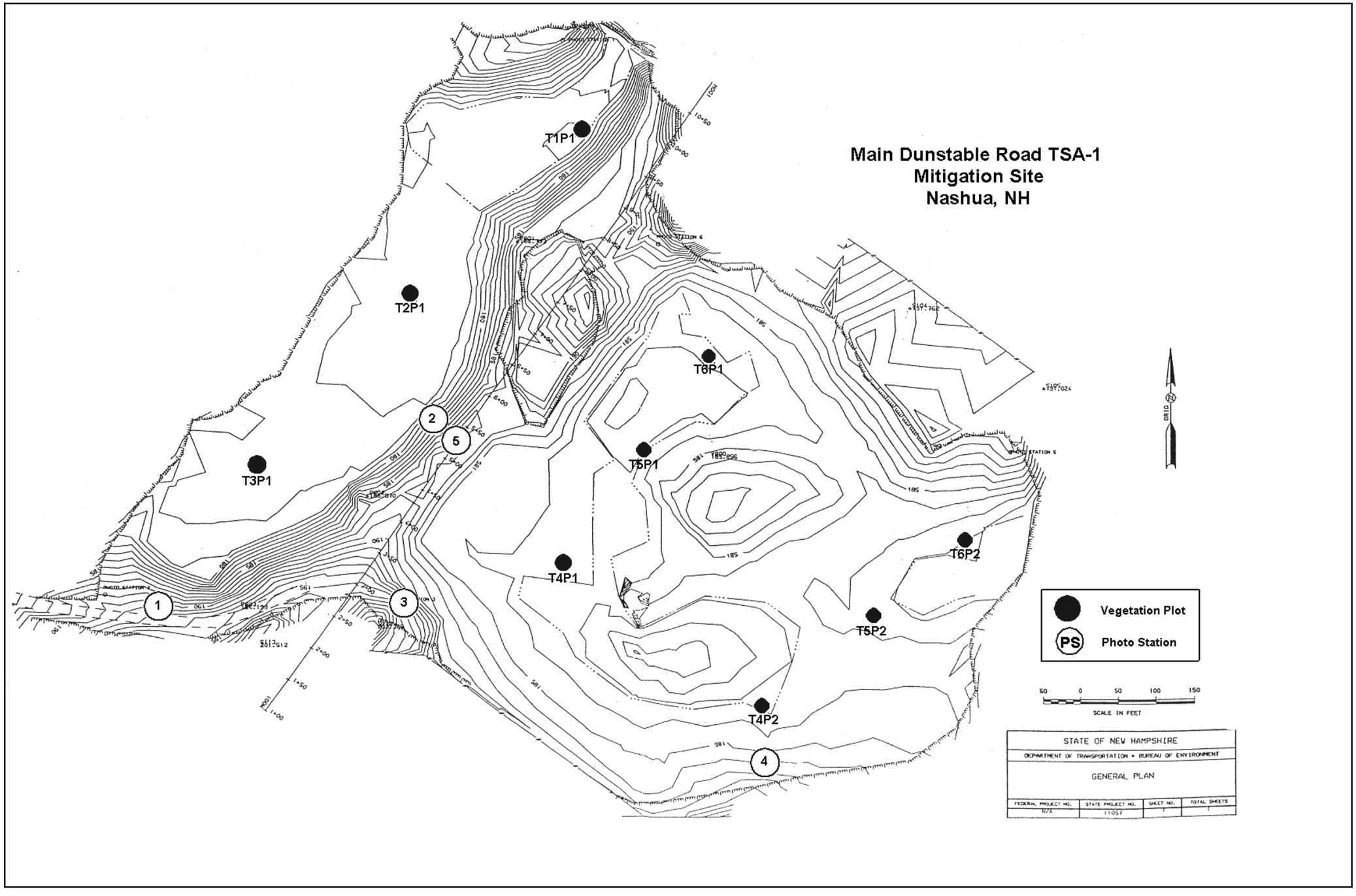
Plot descriptions are provided in the end of this report.

Conclusion

Following more than a decade of successional development, native and planted species in both wetland and upland areas are healthy and well established. Within the entire mitigation site, vegetation cover based on plot data was greater than 100% with all dominant vegetation consisting of wetland species and included relatively high species richness. The development of an organic soil horizon was also evident within the semi persistently inundated portions of the site. All associated side slopes were stabilized and well vegetated. No major erosion or sedimentation was observed at this site. There were no signs of human degradation at this site. *Phragmites* management is a concern at the TSA mitigation site. Other invasive species such as autumn olive and oriental bittersweet are also of concern. Percent coverage of purple loosestrife has continued to decrease since the 2002 report although the species remains dominant throughout the upper emergent marsh areas.

In addition to providing important wildlife habitat within a largely developed region of Nashua, the mitigation site is providing floodflow alteration and sediment and toxicant retention functions. Utilization of the mitigation area by the wildlife observed is an indicator of design success.

GENERAL SITE PLAN


Main Dunstable Road TSA-1
Mitigation Site
Nashua, NH
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T2P1
T3P1
T4P1
T4P2
T5P1
T5P2
T6P1
T6P2
1
2
3
4
5
Vegetation Plot
PS
Photo Station
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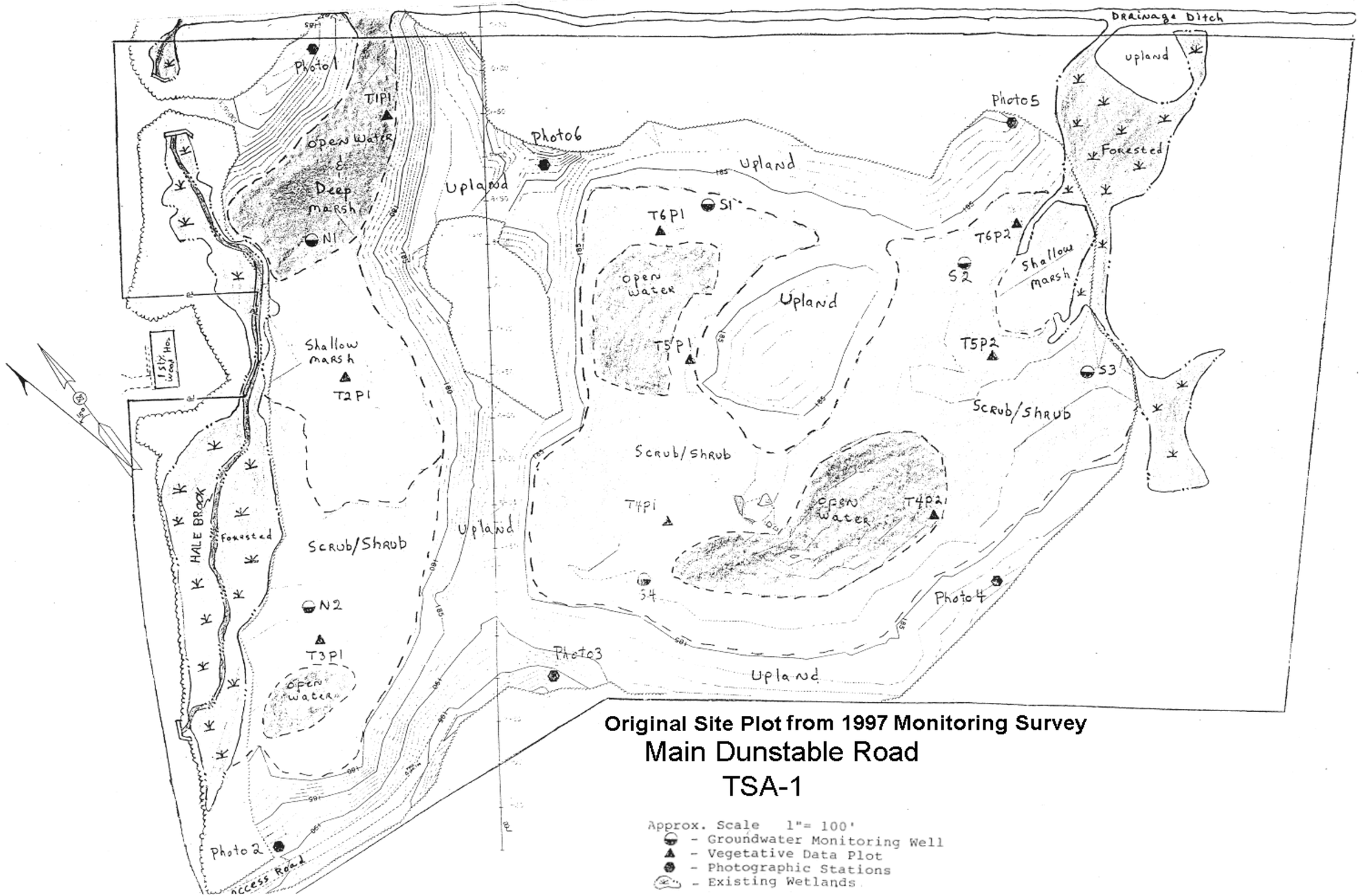
SCALE IN FEET
STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION • BUREAU OF ENVIRONMENT
GENERAL PLAN
FEDERAL PROJECT NO.
STATE PROJECT NO.
SHEET NO.
TOTAL SHEETS
N/A
11057


Drainage Ditch
upland
Photo1
T1P1
Open Water
&
Deep
marsh
N1
Photo6
Upland
Upland
Photo5
Forested
T6P1
S1
T6P2
S2
Shallow
marsh
Open
Water
Upland
T5P1
T5P2
S3
Shallow
marsh
T2P1
Scrub/Shrub
Scrub/Shrub
T4P1
Open
Water
T4P2
S4
Photo4
HALE BROOK
Forested
Scrub/Shrub
Upland
N2
T3P1
Open
water
Photo3
Upland
Photo2
Access Road
Original Site Plot from 1997 Monitoring Survey
Main Dunstable Road
TSA-1
Approx. Scale 1"= 100'
- Groundwater Monitoring Well
- Vegetative Data Plot
- Photographic Stations
- Existing Wetlands

SITE PHOTOGRAPHS

Photo Station 1

Photo Station 2

Photo Station 3

Photo Station 4

Photo Station 5

WETLAND OBSERVATION PLOT DATA

Plot T1P1

This plot is located in the eastern end of the northern portion of the mitigation area in an open water/ marsh wetland. This plot site has been relocated since the original plot was submerged and could not be located. Approximately 4 inches of standing water were present at the upper edge of open water area, similar to the estimated 3 inches present in 2002. The plot is developing into a broad-leaved cattail dominated, semi-persistently flooded marsh with a somewhat diverse assemblage of non-dominant species. Shrub cover in this plot has not expanded due to the persistent flooding although the nearby shrubs, mainly speckled alder, are vigorous. Purple loosestrife cover has decreased from 20 percent cover in 2002 to 15 percent cover in 2007. Based on soil observation, the area meets category 1 (Frequently Ponded or Flooded Soils) of the *Field Indicators for Identifying Hydric Soils in New England*[2] due to

[2] New England Hydric Soils Technical Committee. 2004. 3rd ed., *Field Indicators for Identifying Hydric Soils in New England*. New England Interstate Water Pollution Control Commission, Lowell, MA.

observed flooding or ponding. "Frequently flooded" means that the soil has a 50 percent chance of being flooded in any year and "frequently ponded:" means that the soil has a 50 percent chance of being ponded in any one year. Field indicators to confirm Category 1 include 5 or more percent redoximorphic features within the upper 6 inches of the soil surface, which were exceeded at this plot.

Plot T1 P1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Broad-leaved cattail	75%	OBL
Lythrum salicaria	Purple loosestrife	15%	FACW+
Galium palustre	Marsh bedstraw	10%	OBL
Agrostis alba	Redtop	5%	FACW
Scirpus cyperinus	Woolgrass	5%	FACW+
Polygonum sp.	*Polygonum sp.*	2%	n/a
Impatiens capensis	Spotted touch-me-not	2%	FACW
Sagittaria latifolia	Arrowhead	2%	OBL
Eleocharis sp.	Spikerush sp.	2%	n/a
Glyceria canadensis	Rattlesnake mannagrass	trace	OBL

Plot T1 P1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
O	2 to 0			
A	0 to 3	fine sandy loam	2.5Y 4/1	
B	3 to 14	silt loam	2.5Y 4/1	redox features
C	14+	silt loam	2.5y 5/3	bright mottles prominent

Plot T2 P1

This plot is located in the northern portion of the mitigation area in an early successional scrub/shrub wetland dominated by cattails. The plot has experienced comparably less changes than other plots at the site. Woolgrass and bedstraw have replaced sensitive fern and Canada goldenrod. Approximately 4 inches of standing water was present at the data plot, consistent with the 6 inches present during the 2002 evaluation. Purple loosestrife percent cover decreased from 30 percent in 2002 to 25 percent in 2007. The area meets Category 1 (Frequently Ponded or Flooded Soils). Field indicators to confirm Category 1 include 5 or more percent redoximorphic features within the upper 6 inches of the soil surface, which is exceeded at this plot.

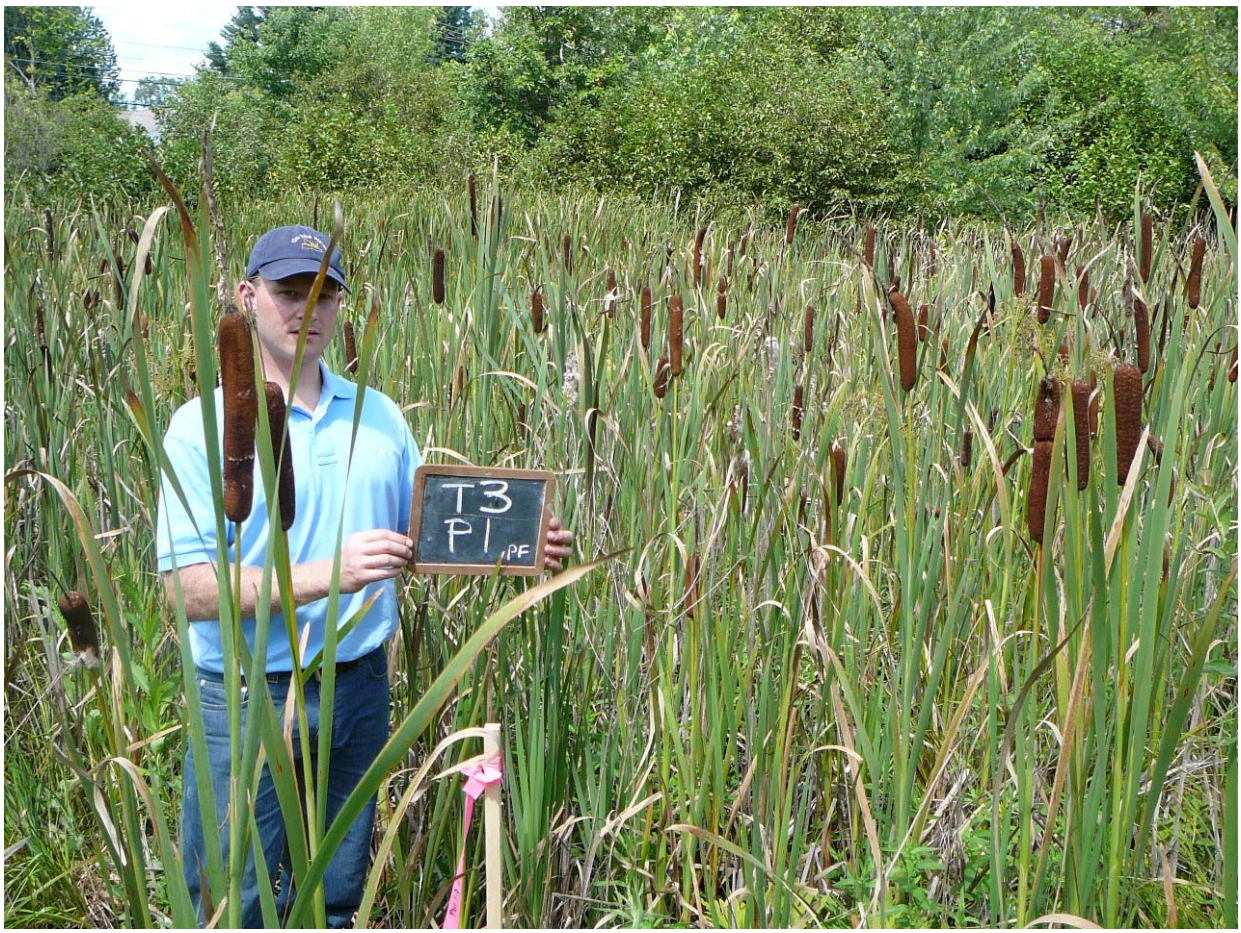
Plot T2 P1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Broad-leaved cattail	65%	OBL
Carex lurida	Lurid sedge	25%	FACW+
Lythrum salicaria	Purple loosestrife	25%	FACW+
Galium palustre	Marsh bedstraw	15%	OBL
Agrostis alba	Red-top grass	10%	FACW
Impatiens capensis	Spotted touch-me-not	trace	FACW
Scirpus cyperinus	Woolgrass	trace	FACW+

Plot T2 P1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
O	2.5 to 0			
A	0 to 6	fine sandy loam	10YR 3/1	
B1	6 to 20	sandy loam	10YR 1/1	low chroma redox,
B2	20 to 34+	sandy loam	10YR 1/2	organic streaking

Plot T3 P1



This plot is located in the western end of the northern mitigation area within an early successional scrub/shrub wetland. The broad-leaved cattail dominated plot contains a diverse assemblage of herbaceous species. Several grass species have been replaced by several volunteer species. Purple loosestrife decreased in abundance between 2002 (20 percent) and 2007 (15 percent). The plot now contains groundcover plants such as club moss. Free water was found at 4 inches below the soil surface and the soil was saturated to the soil surface. The soil at this plot meets hydric soil Category 10B as beginning within 10 inches of the top of the mineral soil material and directly underlying a dark A or Ap horizon (with or without an O horizon) is a horizon with a loamy fine sand or coarser texture with a matrix color due to wetness of chroma 3 or less, value 4 or more, with 2 percent or more redoximorphic features.

Plot T3 P1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Broad-leaved cattail	45%	OBL
Lythrum salicaria	Purple loosestrife	15%	FACW+
Carex lurida	Lurid sedge	5%	FACW+
Juncus effusus	Soft rush	5%	FACW+
Scirpus cyperinus	Woolgrass	5%	FACW+
Onoclea sensibilis	Sensitive fern	5%	FACW
Galium palustre	Marsh bedstraw	5%	OBL
Polytrichum commune	Hair cap moss	5%	n/a
	Bare ground	5%	n/a
Cyperus strigosus	Umbrella sedge	2%	FACW
Lactuca serriola	Prickly lettuce	2%	FAC-
Carex stricta	Tussock Sedge	2%	OBL
Eupatorium perfoliatum	Common Boneset	2%	FACW+
Thelypteris palustris	Marsh Fern	trace	OBL
Myosotis sp.	Forget-me-not	trace	n/a
Leersia oryzoides	Rice cutgrass	trace	OBL

Plot T3 P1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
O	1.5 to 0			
A	0 to 6	fine sandy loam	10YR 3/1	
B1	6 to 10	loamy sand	10 YR 3/3	40% 10 YR 6/1 (high contrast)
B2	10 to 15	loamy sand	10 YR 3/1	
C	15+	loamy sand	Gley 5/5GY	10 YR 5/6 mottles, org streaking

Plot T4 P1

This plot is located in the south central area of the mitigation site in a scrub/shrub wetland. The shrub layer in this plot is dominated by speckled alder which average 15 feet in height; percent cover has more than doubled since the 2002 assessment. The shading influence has probably played a factor in the substantial changes in the herbaceous layer. Purple loosestrife still dominates this site, although percent cover in this plot has been reduced from 85 percent in 2002 to 50 percent in 2007. The presence of *Phragmites* is a concern for this portion of the mitigation site. *Phragmites* has increased its percent cover in this plot by 15 percent. Free water was observed at 2 inches below the ground surface and the soil was saturated to the surface. The soils meet hydric soil Categories 1 (Flooded or Ponded Soils), 7 (Depleted or Gleyed Matrix) , and 11A (Any Texture) for multiple criteria.

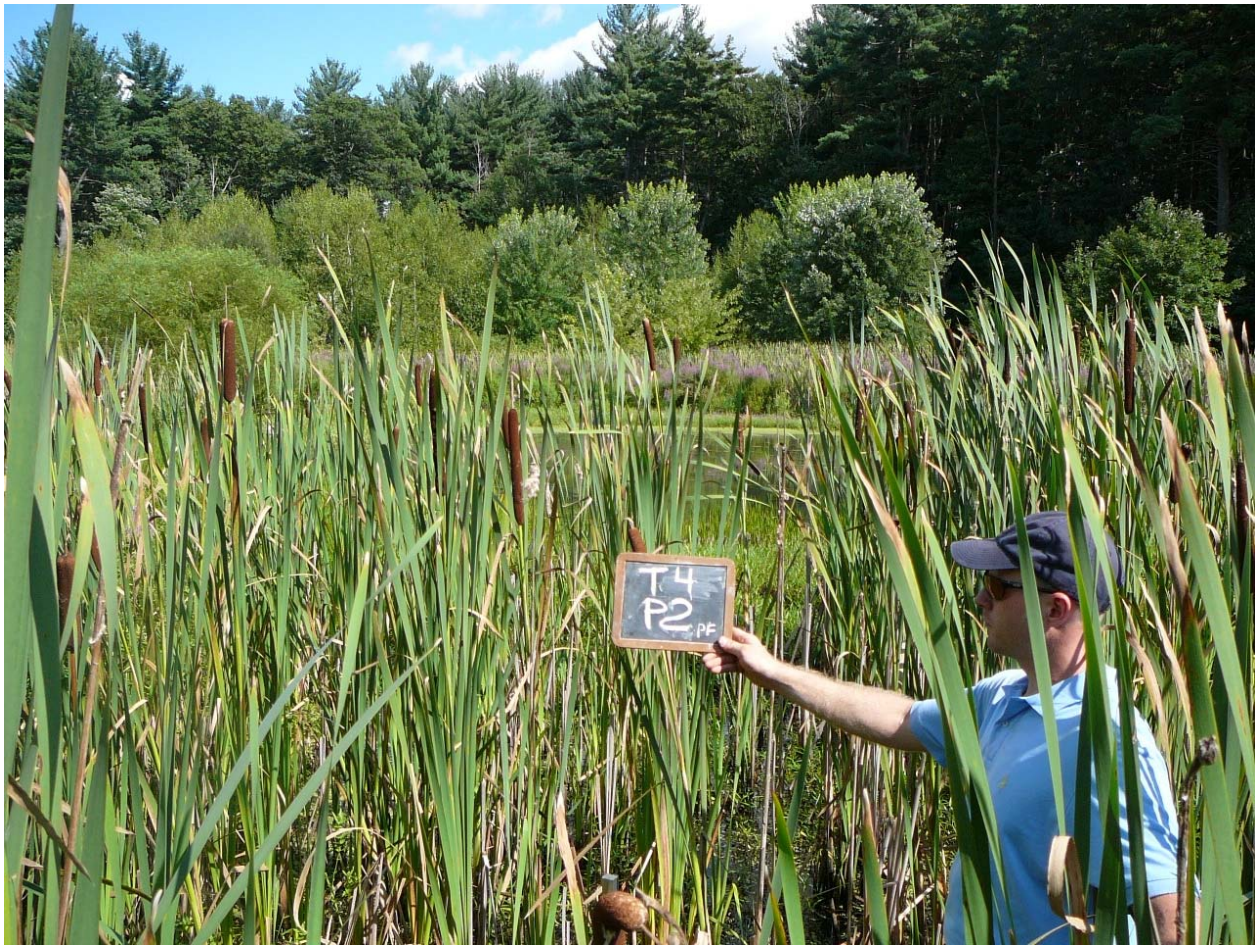
Plot T4 P1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Lythrum salicaria	Purple loosestrife	50%	FACW+
Phragmites australis	Common reed	25%	FACW
Solanum sp.	Nightshade sp.	10%	n/a
Impatiens capensis	Spotted touch-me-not	10%	FACW
Onoclea sensibilis	Sensitive fern	5%	FACW
Solidago canadensis	Canada goldenrod	1%	FACW
Solidego rugosa	Rough-Stemmed Goldenrod	1%	FAC
Verbana hastata	Blue vervain	trace	FACW+
Epilobium coloratum	Willowherb	trace	OBL
	Shrubs		
Alnus rugosa	Speckled alder	75%	FACW+
Ilex verticillata	Common winterberry	2%	FACW+

Plot T4 P1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
O	1 to 0			
A	0 to 5	fine sandy loam	10YR 3/2	greater than 5% redox features
B1	5 to 12	sandy loam	10 YR 4/1	greater than 5% redox features
B2	12 to 17	sandy loam	10 YR 4/2	high contrast mottles prominent
C	17+	sand	10 YR 6/1	stripped matrix

Plot T4 P2



This plot is located in the south east area of the mitigation site near open water in a scrub/shrub wetland. The plot had 14 inches of standing water, whereas in 2002 the plot had a dry soil surface. In 2002 the site was strongly dominated by purple loosestrife with inclusions of grasses, sedges and rushes. The plot now exists as a fringe of semipermanently or permanently flooded emergent marsh dominated by smartweed and broad-leaved cattail with inclusions of duckweed. Soils were not observed due to water depth. Soils automatically meet hydric soil Category 1 due to observed surface hydrology.

Plot T4 P2 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Polygonum hydropiper	Marshpepper knotweed	45%	OBL
Typha latifolia	Broad-leaved cattail	35%	OBL
	Open Water	25%	
Lythrum salicaria	Purple loosestrife	25%	FACW+
Lemna minor	Common Duckweed	trace	OBL
Galium palustre	Marsh bedstraw	trace	OBL

Plot T5 P1

This plot is located within the center of the southern portion of the mitigation site in between an upland area and a depression which is currently dry. The plot is a mixed scrub-shrub/emergent marsh. The soil is saturated to the surface and no standing water was present at the time of the assessment. Silver maple has volunteered at this location. Black willow, perhaps a volunteer, is growing vigorously, with percent cover of 60 percent as opposed to 15 percent in 2002. Adventitious roots were seen on individual black willows. Purple loosestrife remains the most dominant herbaceous plant within the plot, although percent cover has reduced from 60 percent (2002) to 45 percent (2007). Signs of *Galerucella* beetle herbivory appear to be present. Broad-leaved cattail is the next dominant species at 35 percent. The soil meets hydric soil Category 1 (Flooded or Ponded Soils) due to presumed hydrology. As the soil within the wetland was constructed, the soil in this particular plot will not key out to additional hydric soil categories, however the soil contains many characteristics of various categories. With time, the soil may acquire a deeper O horizon, a darker A horizon or a reduced matrix higher in the soil profile in which case hydric soil categories would be met with more accuracy.

Plot T5 P1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Lythrum salicaria	Purple loosestrife	45%	FACW+
Typha latifolia	Broad-leaved cattail	35%	OBL
Scirpus cyperinus	Woolgrass	5%	FACW+
Agrostis alba	Redtop	trace	FACW
Calamagrostis canadensis	Blue-joint reedgrass	trace	FACW+
Acer rubrum	Red maple	trace	FAC
	Shrubs/Saplings		
Salix nigra	Black willow	60%	FACW+
Acer saccharinum	Silver Maple	5%	FACW
Acer rubrum	Red maple	5%	FAC

Plot T5 P1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
O	1 to 0			
A	0 to 2	fine sandy loam	2.5Y 5/3	
B1	2 to 9	sandy loam	2.5Y 5/4	
B2	9 to 18	sandy loam	2.5Y 6/4	40% 2.5Y 6/2
C	18+	fine sandy loam	2.5Y 6/1	stripped matrix

Plot T5 P2

This plot is located toward the back of the southern area in an early successional scrub/shrub wetland bordering the site perimeter. Formerly a diverse emergent marsh free of cattail and almost free of purple loosestrife, the plot now consists of a cattail and purple loosestrife dominated marsh with a more established shrub stratum. Signs of *Galerucella* herbivory are present. Grey birch is no longer present at the plot, perhaps due to hydrology. Soil was saturated to the surface and no standing water was present at the data plot. The soil meets hydric soil Category 1 (Flooded or Ponded Soils) due to presumed hydrology. As the soil within the wetland was constructed, the soil in this particular plot will not key out to additional hydric soil categories, however the soil contains many characteristics of various categories. With time, the soil may acquire a deeper O horizon, a darker A horizon or a reduced matrix higher in the soil profile in which case hydric soil categories would be met with more accuracy.

Plot T5 P2 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Broad-leaved cattail	30%	OBL
Lythrum salicaria	Purple loosestrife	30%	FACW+
Juncus effusus	Common rush	5%	OBL
Carex lurida	Lurid Sedge	5%	OBL
Leersia oryzoides	Rice cutgrass	2%	OBL
	Shrubs/Saplings		
Salix nigra	Black willow	35%	FACW+

Plot T5 P2 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
O	.5 to 0			
A	0 to 2	sandy loam	10YR 4/2	
B	2 to 24	sandy loam	10YR 4/1	oxidized rhizoshere
C	24+	loamy sand	10YR 5/1	matrix reduced, prom. redox features

Plot T6 P1

This plot is located in the eastern end of the southern mitigation area in an early successional scrub/shrub wetland bordering the site perimeter. Overall, compared to other plots, the vegetation at this plot has changed little from the 2002 inspection. Purple loosestrife percent cover has decreased from 35 percent (2002) to 25 percent (2007). Signs of *Galerucella* herbivory were observed. Blue joint reeedgrass has become dominant and broad-leaved cattail has become present and dominant. Just outside of the plot towards the deeper pool area, burr-reed and cut grass are dominant. Pussy willow, silver and red maple can be found just upgradient of the plot. Buttonbush growth is vigorous within and surrounding the plot. Two inches of standing water were present during the 2007 assessment; considerably drier conditions were present during the 2002 assessment. The area meets Category 1 (Frequently Ponded or Flooded Soils). Field indicators to confirm Category 1 include 5 or more percent redoximorphic features within the upper 6 inches of the soil surface, which is exceeded at this plot.

Plot T6 P1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Calamagrostis canadensis	Blue-joint reedgrass	55%	FACW+
Lythrum salicaria	Purple loosestrife	25%	FACW+
Typha latifolia	Broad-leaved cattail	25%	OBL
Bidens cenura	Nodding beggarticks	10%	OBL
Echinochloa crusgalli	Japanese millet	10%	FACU
Typha latifolia	Broad-leaved cattail	5%	OBL
Agrostis alba	Redtop	2%	FACW
Solanum sp.	Nightshade sp.	trace	n/a
Verbana hastata	Blue vervain	trace	FACW+
	Shrubs		
Cephalanthus occidentalis	Buttonbush	20%	OBL
Salix nigra	Black willow	10%	FACW+

Plot T6 P1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
O	1 to 0			
A	0 to 8	fine sandy loam	10 YR 3/1	redox features
B1	8 to 14	silt loam	10YR 1/1	
B2	14 to 20	sandy loam	10YR 3/2	
C	20+	fine sandy loam	5Y 5/3	

Plot T6 P2

This plot is located in the northeastern side of the mitigation site in a scrub/shrub wetland bordering the site perimeter. No substantial changes in the plant community have occurred since the 2002 assessment. Purple loosestrife remains moderately abundant although not dominant. The soil is saturated to six inches below the ground surface. The area meets Category 1 (Frequently Ponded or Flooded Soils). Field indicators to confirm Category 1 include 5 or more percent redoximorphic features within the upper 6 inches of the soil surface, which is exceeded at this plot.

Plot T6 P2 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Juncus effusus	Soft rush	35%	FACW+
Lythrum salicaria	Purple loosestrife	15%	FACW+
Scirpus atrovirens	Dark green bulrush	15%	OBL
Agrostis alba	Redtop	5%	FACW
Galium palustre	Marsh bedstraw	5%	OBL
Solidago ulignosa	Swamp goldenrod	3%	OBL
Solidego rugosa	Rough-Stemmed Goldenrod	3%	FAC
Impatiens capensis	Spotted touch-me-not	3%	FACW
Polygonum arifolium	Halberdleaf tearthumb	2%	OBL
Solidago gigantea	Giant goldenrod	2%	FACW
Euthamia graminifolia	Flat-top goldentop	2%	FAC
	Shrubs		
Alnus rugosa	Speckled alder	40%	FACW+
Salix discolor	Pussy willow	5%	FACW

Plot T6 P2 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
A	0 to 3	sandy loam	7.5YR 2/1	oxidized rhizosphere
B1	3 to 6	loamy sand	7.5YR 5/1	sandy soil crit met, redox present
B2	6 to 12	sandy loam	7.5 YR 3/1	
C	12+	fine sandy loam	2.5Y 6/4	20% 2.5Y 6/2 mottles

WETLAND MITIGATION MONITORING REPORT
FINAL ASSESSMENT

NASHUA WELCOME CENTER
NASHUA, NEW HAMPSHIRE
Nashua 11057
USACOE #1991-01009
NH Wetlands Bureau Permit # 97-01678

August 2007

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NASHUA WELCOME CENTER
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August 2007

Introduction

The Louis Berger Group, Inc. (Berger) conducted the initial wetland mitigation monitoring assessment at the Nashua New Hampshire Welcome Center in 2002. Berger revisited the site on July 26, 2007 for the New Hampshire Department of Transportation (NHDOT), Bureau of Environment. The mitigation was required as part of a compensation package for approximately 23.89 acres of wetland impacts resulting from the widening and reconstruction of the F. E. Everett Turnpike from the Massachusetts state line north to Nashua, NH. The Welcome Center mitigation site includes a 0.7 acre wetland area which serves to provide water quality renovation functions impacted as a result of roadway construction.

Methodology

Based upon general location recommendations provided by NHDOT staff, data plots and photo stations were established and documented on project plans. Overall vegetation cover, survival and spread of planted wetland species, colonization of native and exotic wetland species were photographed and recorded. Detailed plant and soil data were collected at the preestablished monitoring plots. Wildlife sightings and presumed activity as well as general site conditions such as hydrology or functional role, were also recorded.

Plot stakes for vegetation surveys were replaced and marked with pink flagging tape for future identification and assessment. Plant species and estimated percent aerial cover were documented for each plot location in accordance with applicable U.S. Army Corps of Engineers procedures specified in the 1987 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands;* non-woody herbaceous and woody species < 3.2 feet tall were recorded within a 5-foot radius and woody saplings and shrubs > 3.2 feet tall were recorded within a 15-foot radius. Following the conclusion of the report are the mitigation site plan, site photos and vegetation data plot survey information.

Site Descriptions and Observations

The Nashua Welcome Center is located south of Broad Street, east of the Route 3, Exit 6 interchange in Nashua, NH. This wetland mitigation site includes a 0.5 acre basin, a 0.2 acre detention pond to treat runoff from the Welcome Center, and a 10-foot-wide access road to accommodate the new sewer line servicing the Welcome Center building. The primary function of this site is to perform water quality renovation function as required in NHDES Permit #97-01678. Hydrology is largely provided by a direct hydraulic connection to Colrain Brook which flows to the West of the site and to a lesser extent by back watering of the Nashua River (during flood conditions). All associated side slopes and culvert outlets were stabilized and well vegetated with planted and volunteer species. The culverts and spillway are also in good working order.

The Welcome Center site was designed with differing elevations allowing for the establishment of a shallow aquatic bed zone, two scrub-shrub berms, and shallow marsh areas providing interspersion of habitat types. Initial landscaping around the site consisted of a variety of facultative trees and shrubs that are common to New England such as speckled alder, red maple, red osier dogwood, buttonbush, and highbush blueberry. Beaver activity has killed a number of buttonbush and alder shrubs as well as cottonwood and other saplings at the site, although volunteer and remaining planted woody species are progressing well. Mortality of the planted saplings was estimated at 30%, however, volunteer species such as quaking aspen and grey birch

have established in other locations along the wetland boundary. Dominant herbaceous vegetation included various rushes, sedges, redtop, and cattail (see Vegetation Data). All plots were dominated by wetland species. No evidence of biological controls were found. The presence of purple loosestrife remains a concern for this site. Other invasive plants such as reed canary grass, and oriental bittersweet were observed, but were not extensive. Sideslopes of the mitigation site are generally dominated by purple crown vetch, which can be considered a weedy species although this plant is attracting bumblebees and European honey bees. The sewer main/access road contains a diverse assortment of wildflowers. Butter and eggs, mullen, and dock were common. It appears that the area is mowed semi-frequently. It was noted that mowing activities damaged some of the larger plant stock on the mitigation area sideslopes.

The detention pond held approximately 2 inches of standing water at the very center at the time of the assessment. The remaining pool hosted a population of tadpoles. Beaver activity persists at the site. In 2002, the beavers harvested some of the buttonbush shrubs, whereas now a small dam exists just downstream of WC-4 which is documented in the site photographs section of this report. A small berm originally planted with red maple separates the detention pond from the basin. The basin was designed at approximately the same elevation as Colrain Brook, which enters the site to the west through a cut in the berm. This inlet provides inflow of surface water to this wetland with the exception of times of low-flow conditions. The aquatic bed portion of the basin contained several sparsely dispersed species of waterweed (*Elodea*) and curly leaf pondweed at the time of the assessment. The water was very clear and relatively cold. No offensive odors, colors, or other deleterious conditions were detected.

The basin has the ability to intercept a portion of the surface water flows of 144 cubic feet per second (cfs) flow in Colrain Brook. It remains evident, however, that during higher flow events, greater flows are entering the basin at higher velocities such that the banks of the inlet and fence structure have been substantially eroded as noted in 2002; current conditions are documented in the site photographs section of this report. The footings to the fence remain exposed at the inlet, however the problem has not substantially worsened. The footings appear to be holding the fence in place although the footings and surrounding grade would benefit from slope repairs and slight toe protection. It is likely that during substantial flooding events within the Nashua River, backwater conditions result in higher water elevations within the basin.

The Welcome Center mitigation site serves as wildlife habitat for a multitude of species. A number of bird species were observed at the site during the site inspection: rock dove, eastern king bird, song sparrow, starling, goldfinch, mourning dove, robin, and red-wing blackbird. Smallmouth bass were observed within the lagoon/stream area upstream and downstream of the small beaver dam. Other species of smaller fish were observed but not identified. Muskrat and/or groundhog burrows were present at multiple locations at the site. High bush blueberry, American cranberrybush (see photograph) common winterberry and blackberry shrubs are very productive at this site. These shrubs serve as excellent sources of food for wildlife.

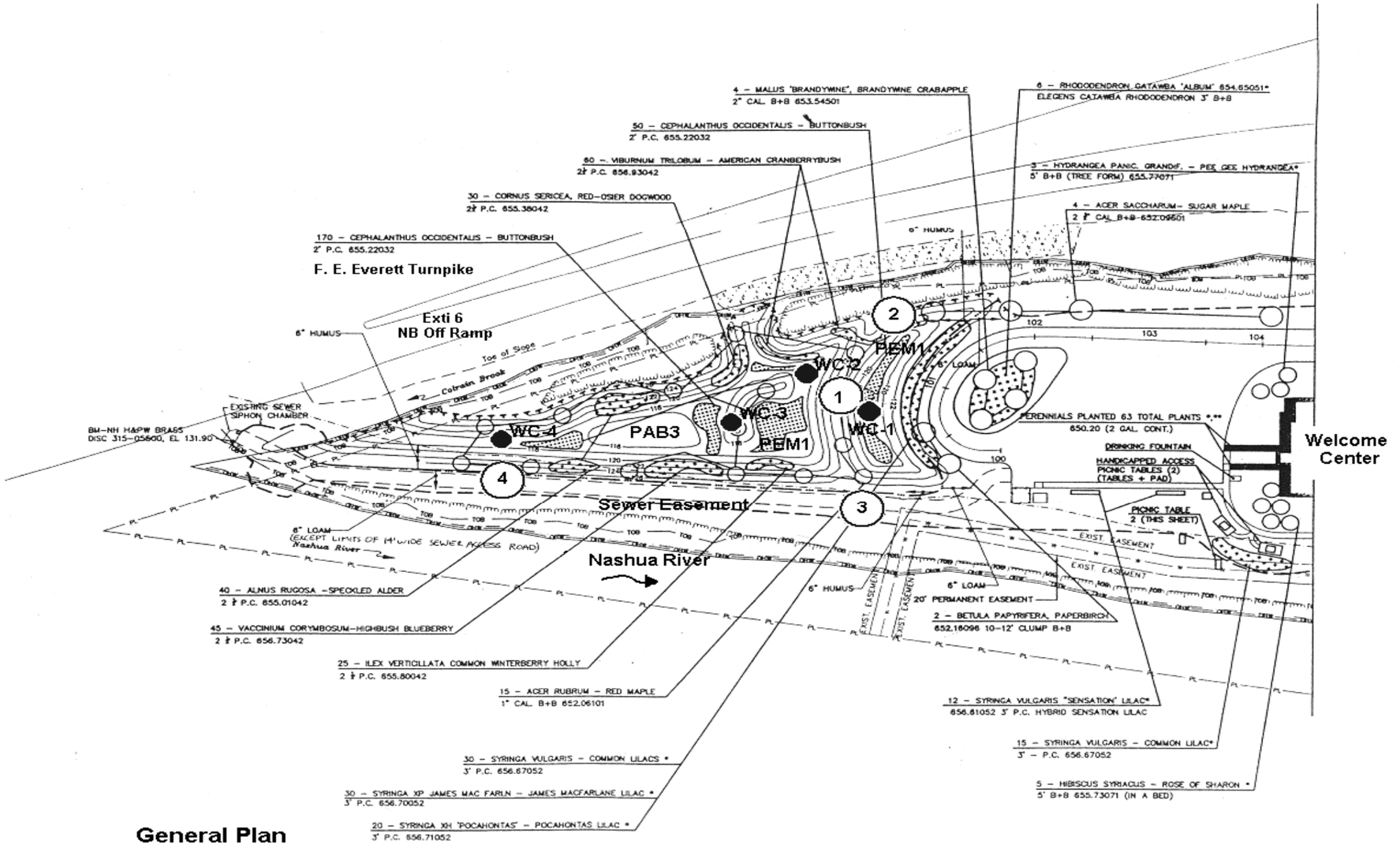
Conclusion

The Welcome Center mitigation site includes a 0.7 acre wetland area which serves to provide water quality renovation functions impacted as a result of roadway construction. Overall, mitigation at this site meets expectations and permit requirements. Soils are stable and native and planted species in both wetland and upland areas are well established. Vegetation cover development was well developed with all dominant vegetation consisting of wetland species. Existing emergent areas planted with shrubs within the basin will eventually succeed over time

into scrub-shrub habitat. It is anticipated that the site will always be susceptible to water-transported invasive species due to its landscape setting. The water quality renovation function appears to be met; no algae mats or profusion of nuisance aquatic weeds were observed in the basin and water quality was considered good. The Welcome Center Mitigation site is a good example of an integrated wetland and storm water treatment design which provides detention and pretreatment of runoff with further polishing within the created basin. The combined sources of hydrology are adequate to support emergent and aquatic bed vegetation. There were no signs of human degradation at this site.

No major erosion or sedimentation was observed. Fence footings near the inlet remain exposed, however the problem has not substantially worsened. The footings and surrounding grade would benefit from slope repairs and slight toe protection. The detention basin would benefit from improvement of the visitor center roadway. Vehicles appear to be cutting the corner at the loop located on the south/southwest side of the visitor center parking lot, causing exposure and erosion of the soil and sediment/gravel transport from the unpaved island to the catch basin and ultimately to the fore bay within the detention basin/wetland. The site would benefit from stabilizing the gravel surface within the island.

SITE LOCATION / GENERAL PLAN



General Plan

Nashua Welcome Center
Mitigation Site
Nashua, NH

NOTE: Areas planted with shrub species witin the basin (PEM1) will become PSS1 over time.

SITE PHOTOGRAPHS

Photo station 1 facing south/southwest

Photo station 2 facing east/southeast

Photostation 3. View of west of Welcome Center lagoon and detention basin

Photostation 4. View north of Welcome Center lagoon

Scouring at western edge of fence line near the inlet at Colrain Brook

American cranberrybush fruits which serve as important wildlife forage

Beaver dam located between WC-4 and Colrain Brook

Submerged aquatic bed at lagoon just upstream of WC-4 facing northwest

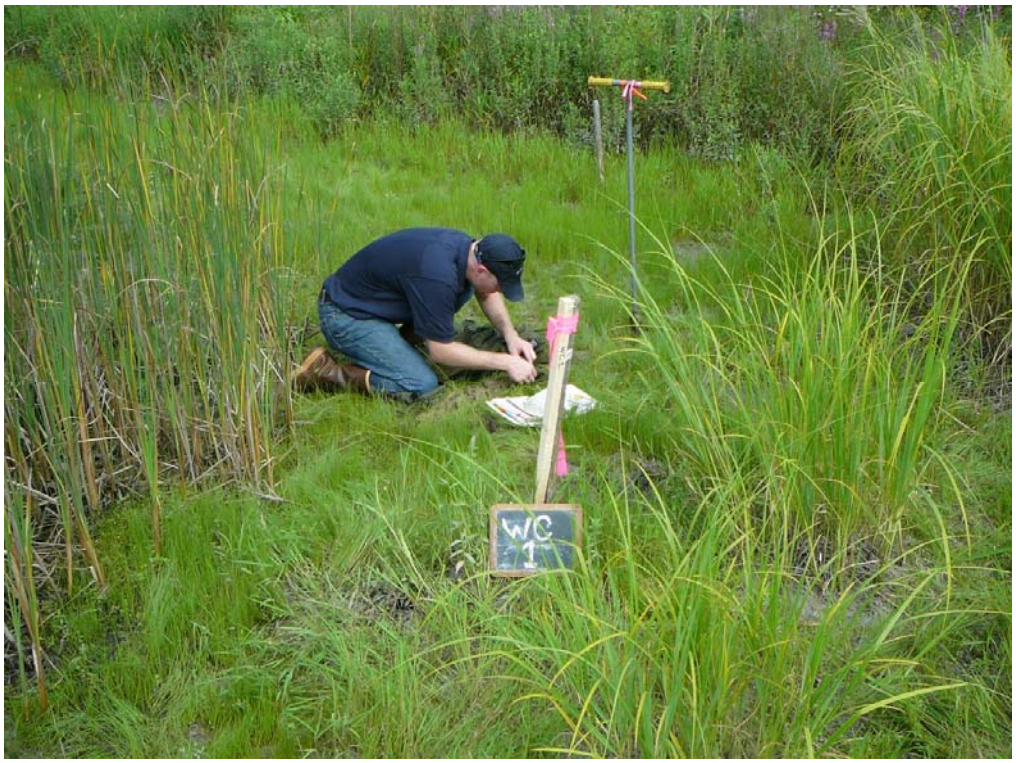
Gravel and sand within sediment forebay of detention basin/constructed wetland

Traffic loop area at south of Welcome Center, improvements of which would benefit wetland

WETLAND OBSERVATION PLOT DATA

Plot WC-1

Site Comments:
The detention pond contained a pocket of very shallow standing water (2 inches). The site plays an important wildlife function for amphibians. Plot WC-1, located at the 0.2 acre detention pond site has experienced noticeable and varying changes since the 2002 monitoring report. Purple loosestrife has decreased substantially (decreased from 25 to 5 percent) within the plot since 2002. Narrowleaf cattail is now present at the vegetation plot (10%), whereas soft rush, which in 2002 was present at 10% is now not present. Prairie cordgrass has become established within the detention basin. Although the vegetation plot data shows 15 percent cordgrass cover, this is not representative of majority of the basin and particularly the northern end of the basin where a monotypic patch of prairie cordgrass is expanding. Prairie cordgrass favors, or at least has a competitive advantage in slightly saline environments; perhaps the use of road salt in the contributing drainage area plays a role in the presence of this species on site. Reed canary grass is now absent from plot WC-1. Planted buttonbush has been grazed by beaver at this site but showed some signs of regrowth. Soils were saturated to the soil surface. Water marks and water stained debris were present within the plot, signifying that the soil within the detention area meets Category 1 (Frequently Ponded or Flooded Soils) of the *Field Indicators for Identifying Hydric Soils in New England*[1]. Additionally, the soil meets hydric soil Category 6 as there is a depleted matrix (matrix value of 4 or 5 and chroma 2 or less with 2 percent or more redoximorphic features) within 10 inches of the mineral soil material. Other hydric soil indicators are present.



Wetland Observation Plot WC-1

[1] New England Hydric Soils Technical Committee. 2004. 3rd ed., *Field Indicators for Identifying Hydric Soils in New England*. New England Interstate Water Pollution Control Commission, Lowell, MA.

Plant Percent Cover, Plot WC-1

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Eleocharis acicularis	Spike-rush	50%	OBL
Spartina pectinata	Prairie cordgrass	15%	OBL
Typha angustifolia	Narrowleaf cattail	10%	OBL
Lythrum salicaria	Purple loosestrife	5%	FACW+
Agrostis alba	Redtop	5%	FACW
Cyperus strigosus	Umbrella sedge	5%	FACW
Leersia oryzoides	Rice cutgrass	5%	OBL
Lycopus uniflorus	Bugleweed	5%	OBL
Polygonum persicaria	Ladysthumb	trace	FACW+
	Shrub Cover		
Cephalanthus occidentalis	Buttonbush	10%	OBL

Soil Data, Plot WC-1

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
Oa	0-1.5	fine sandy loam		
A	1.5-4..0	fine sandy loam	2.5Y 3/2	
B	5.5+	fine sandy loam	2.5Y 5/3	2.5Y 5/2 mottles

Plot WC-2

Site Comments:
Upon inspection, plot WC-2 had 6 inches of standing water. Purple loosestrife previously dominated this plot (65% in 2002) and was thought to increase in percent cover. However, the percent cover of purple loosestrife has decreased from 65 percent in 2002 to 10 percent in 2007, a remarkable change considering the similar trend in Plot WC-1. Arrowhead and American great bulrush were formerly not present in this plot and have heavily colonized this plot at 35% and 25% respectively. Soils contained a reduced matrix in the B horizon and other hydric soil indicators are present. The soil surface is clearly submerged for a predominance of the growing season, if not the entire year, therefore meeting category 1 (Frequently Ponded or Flooded Soils) of the *Field Indicators for Identifying Hydric Soils in New England* as well as category 6 as there is a depleted matrix (matrix value of 4 or 5 and chroma 2 or less with 2 percent or more redoximorphic features) within 10 inches of the mineral soil material. Other hydric soil indicators are present such as organic streaking and prominent, high contrast mottles.

Wetland Observation Plot WC-2

Plant Percent Cover, Plot WC-2

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Sagittaria latifolia	Arrowhead	35%	OBL
Schoenoplectus tabernaemontani	American great bulrush	25%	OBL
Juncus effusus	Soft rush	20%	FACW+
Lythrum salicaria	Purple loosestrife	10%	FACW+
Typha latifolia	Common cattail	5%	OBL
Phalaris arundinacea	Reed canary grass	5%	FACW+
Cicuta maculata	Spotted water hemlock	5%	OBL
	Shrub Cover		
Cephalanthus occidentalis	Buttonbush	Dead	OBL

Soil Data, Plot WC-2

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
Oe	0-1.5	sandy loam		
Oa	1.5-3.0	sandy loam		
A	3.0-12.0	sandy loam	10YR 1/1	org. streaking
B	12+	sandy loam	2.5Y 5/2	reduced matrix, mottles prom.

Plot WC-3

Site Comments:
Site location - eastern end small 'island" in basin. Soil surface approximately one foot higher than adjacent marsh vegetation. Currently a shrub swamp with patches of wet meadow, the area will become wooded swamp as woody vegetation matures. A green frog was seen while conducting field work and several signs of beaver activity were observed, namely the downing of a planted red maple sapling. Purple loosestrife has become more prevalent in this plot since 2002 (an increase of 20%). Reed canary grass has experienced a small increase in percent cover. Generally, this plot has expanded to include a new, more diverse assemblage facultative wetland and obligate wetland plants, including late goldenrod, narrowleaf cattail, and duckweed. Winterberry holly and high bush blueberry are thriving in the general vicinity of this plot. Volunteer shrubs appear to be present. Soils at this location have multiple and overlapping hydric soil indicators such as oxidized rhizospheres and a reduced B-horizon matrix with prominent mottling. Soils meet category 5 (Mineral Histic) of *Field Indicators for Identifying Hydric Soils in New England* as there is a mucky A horizon directly underlain by a depleted matrix: although the depleted matrix criterion in this case was 1 color chip away from meeting the key precisely, professional judgment was used to factor in the age of the constructed wetland, omnipresent oxidized rhizospheres and the fact that high contrast mottling was prominent. Nevertheless, the soil meets category 1 for being frequently flooded as the water level presumably rises and inundates the plot frequently (more than a fifty percent chance per year).

Wetland Observation Plot WC-3

Plant Percent Cover, Plot WC-3

Scientific Name	Common Name	% Cover Cover	Status
	Herbaceous Cover		
Agrostis alba	Redtop	25%	FACW
Lythrum salicaria	Purple loosestrife	25%	FACW+
Sagittaria latifolia	Arrowhead	15%	OBL
Phalaris arundinacea	Reed canary grass	10%	FACW+
Typha latifolia	Common cattail	5%	OBL
Toxicodendron radicans	Poison ivy	5%	FAC
Juncus effusus	Common rush	5%	FACW+
Galium palustre	Marsh bedstraw	5%	OBL
Verbena hastata	Swamp verbena	5%	FACW+
Vicia cracca	Cow vetch	trace	FAC
Schoenoplectus tabernaemontani	American great bulrush	trace	OBL
Myosotis scorpioides	True forget-me-not	trace	OBL
Epilobium strictum	Downy willowherb	trace	OBL
Solidego gigantea	Late goldenrod	trace	FACW
Equisetum fluviatile	Water horsetail	trace	OBL
Glyceria canadensis	Rattlesnake mannagrass	trace	OBL
Lemna sp.	Duckweed	trace	OBL
	Shrub Cover		
Ilex verticillata	Common winterberry holly	45%	FACW+
Acer rubrum	Red maple	10%	FACW+
Cornus amomum	Silky dogwood	5%	FACW

Soil Data, Plot WC-3

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
O	0-2.5.0	sandy loam		oxidized rhizosphere
A	2.5-8.0	sandy loam	10YR 2/1	mucky, organic streaking
B	8.0+	fine sandy loam	2.5Y3/2	mottles prominent

Plot WC-4

Site Comments:
Plot WC-4 is situated at southern end of the basin near confluence with Colrain Brook. The center point of the plot stood within 4 inches of water at the time of this evaluation. The plot lies on the border of two wetland communities, a fringe of palustrine emergent marsh along the basin's shallow aquatic bed, along with a minor amount of upland side slope. As such, species inclusion within the vegetation plot was more diverse than other plots, demonstrating the presence of a wide variety of species within the mitigation site. Purple loosestrife has decreased at this plot by 10% since the 2002 evaluation. Other than the purple loosestrife, there is low dominancy as the wide variety of species that are more or less evenly distributed. The shallow aquatic bed side of the plot contains 25% bare ground. Soil within this plot meets category 1 (Frequently Ponded or Flooded Soils) of the *Field Indicators for Identifying Hydric Soils in New England*. Additionally, the soil meets hydric soil category 5 (Mineral Histic) as there is a mucky A Horizon directly underlain by a depleted matrix: although the depleted matrix criterion in this case was 1 color chip off from the key, professional judgment was used to factor in the age of the constructed wetland, omnipresent oxidized rhizospheres and the fact that high contrast mottling was prominent. Nevertheless, the soil meets category 1 for being persistently ponded.

Wetland Observation Plot WC-4

Plant Percent Cover, Plot WC-4

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
	Exposed Ground	25%	
Lythrum salicaria	Purple loosestrife	25%	FACW+
Phalaris arundinacea	Reed canary grass	15%	FACW+
Agrostis alba	Redtop	10%	FACW
Juncus effusus	Common rush	10%	FACW+
Leersia oryzoides	Rice cutgrass	10%	OBL
Juncus canadensis	Canadian rush	5%	OBL
Elodea canadensis	Waterweed	trace	OBL
Carex lurida	Lurid sedge	trace	OBL
Phleum pratense	Timothy	trace	FACU
Solidego rugosa	Rough-stemmed goldenrod	trace	FAC
Lobelia inflata	Indian tobacco	trace	FACU
Daucus carota	Queen anne's lace	trace	n/a (UPL)
Sagittaria latifolia	Arrowhead	trace	OBL
Linaria vulgaris	Butter-and-eggs	trace	n/a (UPL)
Potamogeton crispus	Curly pondweed	trace	OBL
Acer rubrum	Red maple (sapling)	trace	FAC
Prunus serotina	Black cherry (sapling)	trace	FACU
Populus deltoides	Eastern cottonwood (sapling)	trace	FAC
Impatiens capensis	Spotted touch-me-not	trace	FACW
Cyperus strigosus	Umbrella sedge	trace	FACW

Soil Data, Plot WC-4

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
	4.0	Standing Water		
A	0-6.0	fine sandy loam	G 10Y	Mucky
B1	6.0-13.0	fine sandy loam	2.5Y 4/2	redox features
B2	13.0+	fine sandy loam	2.5Y 4/3	2.5Y 4/2 mottles prominent

WETLAND MITIGATION MONITORING REPORT

FINAL ASSESSMENT

BENSON'S MITIGATION SITE
HUDSON, NEW HAMPSHIRE
STATE PROJECT # 10623-Q
NHDES PERMIT #91-01370, 91-01371, 97-01678
ACOE PERMIT # 1991-01009

August 2007

WETLAND MITIGATION MONITORING REPORT
FINAL ASSESSMENT

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HUDSON, NEW HAMPSHIRE
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NHDES PERMIT #91-01370, 91-01371, 97-01678
ACOE PERMIT # 1991-01009

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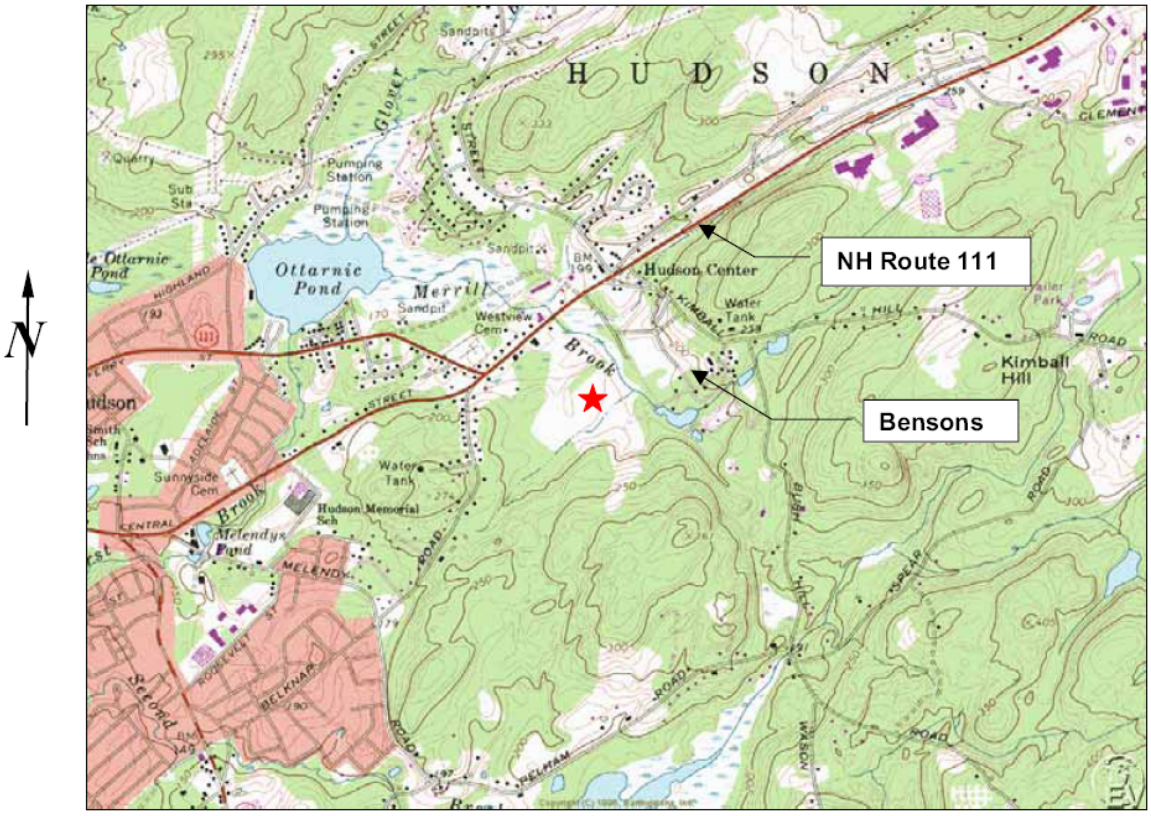
August 2007

Introduction

The Louis Berger Group, Inc. (Berger) conducted wetland mitigation monitoring at the Benson's mitigation site (State Project No. 10623-Q) located in Hudson on August 22, 2007 for the New Hampshire Department of Transportation (NHDOT), Bureau of Environment (USGS Locus map, below; general site plan, page 5). Previous monitoring reports for the Benson's mitigation site were prepared by Parsons in 2003 (baseline report) and 2004 (2-year monitoring report).



USGS Locus Map

Methodology

Previous data plots and photo stations used in 2004 were relocated for assessment during 2007. Vegetative cover between 2004 and 2007 are documented and compared in the end of this report. Overall vegetation cover, survival and spread of planted wetland species, and colonization of native and exotic wetland species were photographed and recorded. Wildlife sightings and presumed activity as well as general site conditions such as hydrology or functional role, were also recorded.

Plot stakes were located or replaced due to stake rot or inability to locate the original plot in the tall vegetation, and marked with pink flagging tape for future identification and assessment. Plant species and estimated percent aerial cover were documented for each plot location in accordance with applicable U.S. Army Corps of Engineers procedures specified in the 1987 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands;* non-woody herbaceous and woody species < 3.2 feet tall were recorded within a 5-foot radius and woody saplings and shrubs > 3.2 feet tall were recorded within a 15-foot radius. Changes in species composition at specific sites may be attributed to natural succession or approximations of site plots when original plots could not be located. An accompanying plan showing the mitigation site, vegetation data plot survey

information, and site photos can be found at the end of this report.

Site Descriptions and Observations

Overall, site observations are consistent with the 2004 report with the exception of ongoing plant succession and beaver activity. Beaver activity in the adjacent unnamed stream has partially dammed the outlet structure located along the trail east of the site. The damming activity has altered the site's hydrology and currently impounds water at an elevation 3-4 inches above the upstream pipe invert (documented in photos section).

Sapling trees planted at higher elevations experienced lower mortality than plantings at lower elevations. Green ash, American larch, swamp white oak, and willow species are in good health. Earlier reports cite that water levels may have contributed to mortality, particularly to plantings within the lower portions of the scrub shrub zone. Shrubs and saplings located at the lower extent of the scrub-shrub zone are not visible from a distance due to the prevalence of broad-leaved cattail cover, although upon close inspection of the lower elevations, various shrubs species such as buttonbush, red-osier dogwood, and arrowwood can be found (refer to Site Photographs section of this report). Buttonbush was planted at the site and although not observed in 2004 are common and in good health at lower elevations where fatality was thought to have occurred. The 2004 report included a list of observed plant species and conditions, documenting planting success approximately one year after planting took place. We concur with the 2004 monitoring report with the exception that buttonbush plantings/volunteers are in good health. Woody native wetland volunteer species have colonized available habitats, particularly gray birch, speckled alder, and willow species.

Herbaceous vegetation in the lower marsh is dominated by cattail and duckweed, with inclusions of various wetland plants dependent upon location. The upper marsh is generally co-dominated by boneset, spotted joe-pye weed, blue vervain, fox sedge and *Solidago sp*. Purple loosestrife is present at the site and is particularly abundant at the northwest portion of the site although the species is generally not dominant throughout the site. According to the *2004 Annual Report on the Biological Control of Purple Loosestrife*[1]biological controls of purple loosestrife have been employed at this site each year from 2001 through 2004. Common invasives such as oriental bittersweet, multiflora rose, winged eonymous, European and glossy buckthorn, tatarian honeysuckle, Japanese barberry, *Phragmites*, and reed canary grass. Japanese knotweed (previously observed in wetland surrounds in 2004) was not observed.

Soils at observation plots were compared to *Field Indicators for Identifying Hydric Soils in New England*[2] *to* confirm that hydrological conditions are adequate to support hydric soils at the mitigation site.

The Benson's mitigation site provides excellent wildlife habitat for a variety of species. Beaver activity (felled debris) are very common at the site. A very dense population of green frogs was observed throughout the site. Leopard frogs and a single gray tree frog were also observed. The higher marsh between the two pools provides excellent cover for predators. Two adult black racer snakes, approximately 5 feet in length, were observed in the vicinity of plot F-1. Two great

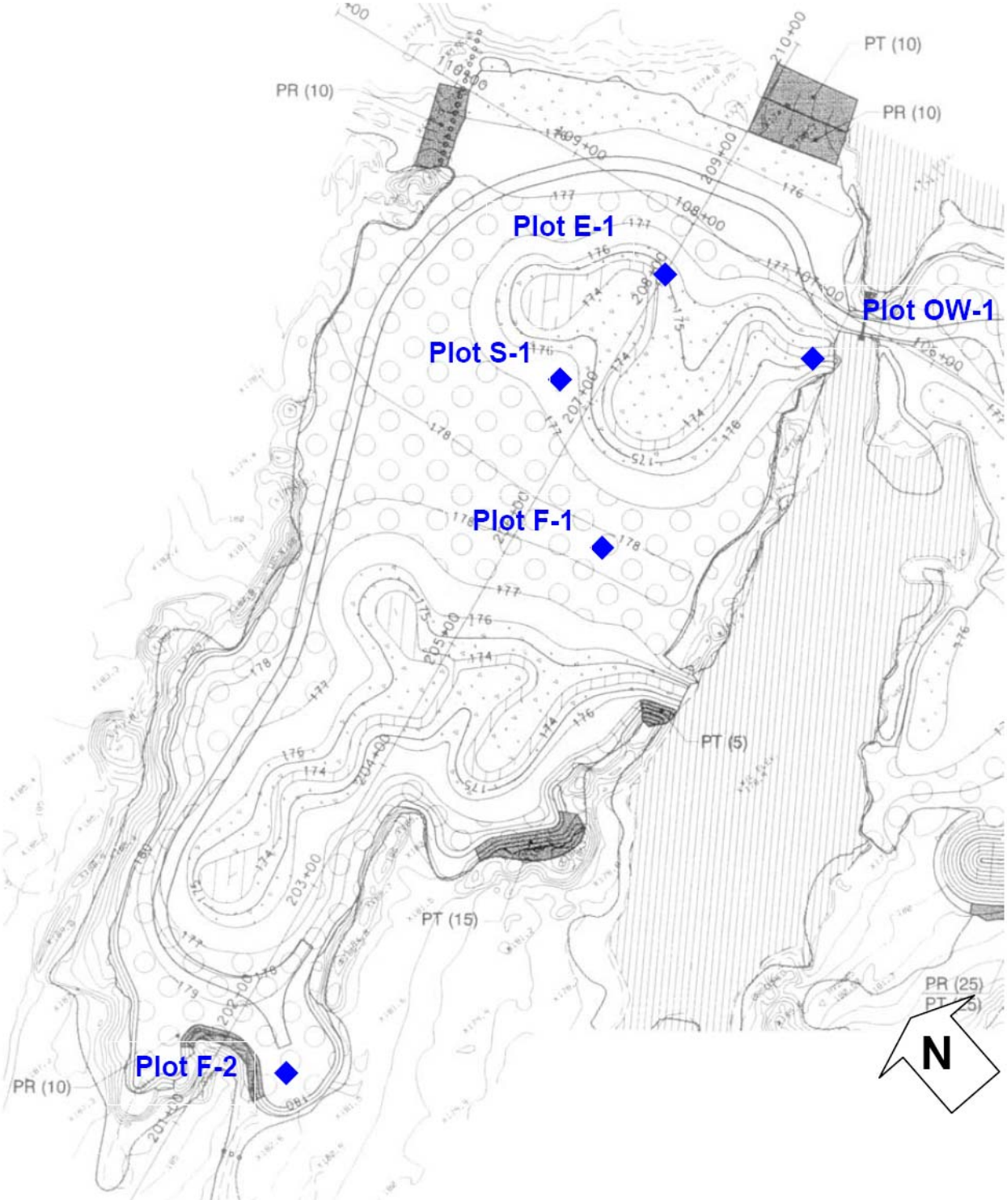
[1]New Hampshire Department of Agriculture, Markets and Food, Plant Industry Division and New Hampshire Department of Transportation Bureau of Environment, 2005. Biological Control of Purple Loosestrife, 2004 Annual Report.
[2] New England Hydric Soils Technical Committee. 2004. 3rd ed., *Field Indicators for Identifying Hydric Soils in New England*. New England Interstate Water Pollution Control Commission, Lowell, MA.

blue herons were observed at the mitigation site. Coyote scat was observed along the trail. Deer have been using the northern edge of the site for bedding, and a well established deer trail is located in the vicinity of S-1. Deer and raccoon tracks are prevalent along the edge of the lower, now permanently inundated marsh. Evidence of muskrat feeding is present. Bee activity was preeminent on the day of the observation. European and native bees were seen at a density that is presumed to be highly uncommon (approximately 15 feeding bees per square meter along the upper marsh). The site is surrounded a large tract of land that is relatively unfragmented by development, and the mitigation area itself is surrounded by a diverse mosaic of habitats in terms of general succession and wetland/upland edges. Surrounding wetland areas host turtles, hawks, largemouth bass (an adult bass was observed feeding at the surface and juveniles were observed in the unnamed stream). Wildlife habitat value is a prime function of this mitigation site.

Conclusion

The 2004 monitoring report focused on the early development of the replication site, focusing on the favorable groundwater levels and documentation of initial planting success. Groundwater levels demonstrated that sufficient hydrology was achieved. The Benson's mitigation site experienced substantial planting mortality after construction. Fortunately, the remaining woody vegetation is in good health. Woody, native, wetland volunteer species have colonized available habitats, particularly gray birch, speckled alder, and willow species, as well as trembling aspen along the upland edge. Natural succession has and will continue to correct for the partial mortality of planted woody species. The herbaceous stratum in the upper marsh consists of a diverse assemblage of native wetland plants. The lower marsh is dominated by common cattail with inclusions of herbaceous and shrub species. Open water areas are dominated by duckweed. Wetland hydrology has been achieved throughout the site. Design elevations are adequate. Continued control of purple loosestrife may be required under the state program, although the species is currently not dominant at the majority of the site. The Benson's mitigation site provides primary wetland functions including but not limited to floodflow alteration, sediment and toxicant retention and wildlife habitat. The site has some value in a recreational aesthetic and educational sense due to the trail network, habitat mosaic, interesting disturbance history, presence of wildlife and wildflowers and presence of keystone species (beaver). The outlet structure should be monitored for substantial clogging due to beaver damming activity as further damming of the outlet structure may cause unintended habitat transition to the extent that the recreational trails are affected by higher water levels.

GENERAL SITE PLAN


Plot E-1
Plot OW-1
Plot S-1
Plot F-1
Plot F-2
PR (10)
PT (10)
PR (10)
PT (5)
PT (15)
PR (25)
PR (10)
N

SITE PHOTOGRAPHS

Photo series of western pool, station 204+00 vicinity

Photo series of eastern pool connection, original wetland at left, mitigation site at right

Western pool (left) connection to original wetland (right)

Original wetland beside western pool connection, flooded by beaver dam

Eastern pool connection to original wetland

Upstream side of mitigation site outlet structure, dammed by beavers

Interior of outlet structure; note: pipe clogged 3-4 inches with debris

Outlet structure, down gradient of constructed wetland

Downgradient wetland; note: purple loosestrife not as common at mitigation site.

Natural habitat structure in the vicinity of plot OW-1

Evidence of beaver activity at upgradient wetland

Green frogs are very abundant at the Benson's mitigation site

Gray tree frog positioned on a common boneset plant

Bees feeding on the nectar of common boneset, a late blooming plant

Juvenile largemouth bass observed in downstream wetland

Deer trail within lower marsh

Evidence of muskrat activity, common at the mitigation site

A planted arrowwood shrub in cattail-dominated marsh provides habitat for birds

Heavily fruiting (planted) green ash sapling

Planted tamarack, green ash, and white oak saplings in good health

Red-osier dogwood within cattail marsh

Common winterberry within lower marsh

Black Chokeberry along water's edge

Red-osier dogwood with bird nest

Buttonbush at center of western depression

A planted ash sapling, felled by beavers, survives

Unsuccessful planting, presumably due to shock

Typical area along path at northwest quadrant of site; note successful saplings, loosestrife

Path at western edge of site with abundant speckled alder, willow, and grey birch volunteers

WETLAND OBSERVATION PLOT DATA

Plot OW-1

Plot OW-1 occurs at the open water connection of the eastern depression. The plot is dominated by common duckweed and includes the shrub cover from the adjacent peninsula. Soils were not sampled due to the water depth of greater than 2 feet. The area meets Category 1 (Frequently Ponded or Flooded Soils) of the *Field Indicators for Identifying Hydric Soils in New England*. "Frequently flooded" means that the soil has a 50 percent chance of being flooded in any year and "frequently ponded:" means that the soil has a 50 percent chance of being ponded in any one year.

Plot OW-1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Lemna minor	Common Duckweed	100%	OBL
	Shrubs/Saplings		
Acer rubrum	Red maple	10%	FAC
Alnus rugosa	Speckled alder	15%	FACW+
Viburnum recognitum	Arrowwood	10%	FACW-

Plot E-1

Plot E-1 is situated within the lower emergent marsh dominated by cattails. Soils meet hydric soil Category 3 (Histosols) due to the depth of the organic layer and presence of redoximorphic features; and, Category 7 (Depleted or Gleyed Matrix) as the soil has a gleyed matrix within ten inches of the top of the mineral soil. Due to the wavy soil surface, the water level ranged from 2 inches above the surface to 2 inches below the surface.

Plot E-1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Broad-leaved cattail	70%	OBL
Lemna minor	Common duckweed	25%	OBL
Carex lupulina	Hop sedge	5%	OBL

Plot E-1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
Oe	24 to 0		10YR 2/1	Histosol
C	24+	fine sandy loam	Gley 7/10Y	Stripped matrix Gley 5N mottles

Plot S-1

Plot S-1 is situated within the lower emergent marsh dominated by cattail and contains duckweed, woolgrass, soft rush and hop sedge. Soils meet hydric soil Category 3 (Histosols) due to the depth of the organic layer and presence of redoximorphic features; and, Category 7 (Depleted or Gleyed Matrix) as the soil has a gleyed matrix within ten inches of the top of the mineral soil. Due to the wavy soil surface, the water level ranged from 2 inches above the surface to 2 inches below the surface.

Plot S-1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Broad-leaved cattail	40%	OBL
Lemna minor	Common Duckweed	20%	OBL
Scirpus cyperinus	Woolgrass	10%	FACW+
Juncus effusus	Soft rush	15%	FACW+
Carex lupulina	Hop Sedge	5%	OBL
	Bare Ground	5%	

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
Oe	24 to 0		10YR 2/1	Histosol
C	24+	fine sandy loam	Gley 7/10Y	Stripped matrix Gley 5N mottles

Plot F1

Plot F-1 is situated in the upper emergent/scrub-shrub marsh (El 176 to 178). The upper emergent zone maintains a high water table throughout the growing season. Plants at this elevation are FACW or wetter (OBL) signifying that the targeted hydrology has been achieved. The plot is dominated by boneset, spotted joe pye weed, swamp beggarticks and fox sedge with 5 species of shrubs/saplings. The upper emergent/scrub-shrub marsh zone between the eastern and western depressions provides important wildlife cover. Wildlife movement, (presumably from small mammals) was audible while traveling through the dense vegetation. Soils meet hydric soil Categories 7 (Depleted Below Dark Surface) as well as 10A & 10B (Sandy with Redox) due to multiple qualifiers. The soil was moist at 14 inches.

Plot F1 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Eupatorium perfoliatum	Boneset	20%	FACW+
Eupatoriadelphus maculatus	Spotted joe pye weed	20%	FACW
Bidens discoidea	Swamp beggarticks	20%	FACW
Carex vulpinoidea	Fox sedge	20%	OBL
Verbana hastata	Blue vervain	10%	FACW+
Solidago uliginosa	Bog goldenrod	10%	OBL
	Shrubs/Saplings		
Betula populifolia	Gray birch	20%	FAC
Larix laricina	Tamarack	10%	FACW
Salix discolor	Pussy willow	5%	FACW
Quercus bicolor	Swamp white oak	5%	FACW+
Cornus amomum	Silky dogwood	5%	FACW

Plot F1 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
A	0 to 10		2.5Y 3/1	very dark
B	10 to 15	loamy sand	2.5Y 7/4	mottling prominent
C	15 to 22	loamy sand	2.5Y 8/2	high contrast mottling *sandy soil

Plot F2

Plot F-2 is situated in the transition between the upper emergent/scrub-shrub marsh and upland (El 179-180). The plot contains mostly facultative wetland species (or wetter) and contains hydric soils. This plot is not an optimal representation of the upper emergent/scrub-shrub marsh found throughout the site. Shrubs and sapling planted in the immediate vicinity have had good success; gray birch volunteers are numerous and are in excellent heath. Due to the constructed nature of the soil, it does not absolutely key out to the hydric soil categories of New England. The soil is sandy with prominent mottling within 10 inches and has a depleted matrix (due to wetness) at 14 inches. Professional judgment would deem this soil hydric due to combined characteristics of hydric soil Categories 10B & 10C. Soils were not saturated at the sampling depth.

Plot F2 Soil Profile: High contrast between depleted soil matrix and masses within the C-horizon

Plot F2 Vicinity: Sedges on trail (foreground), boneset and joe-pye weed (edge), dense sapling layer (rear)

Plot F2 Vegetation Percent Cover

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Euthamia graminifolia	Flat-top goldentop	50%	FAC
Asclepias syriaca	Common milkweed	25%	not indexed
Polygonum sp.	Polygonum sp.	20%	n/a
Solidago altissima	Late goldenrod	5%	FACU-
	Shrubs/Saplings		
Betula populifolia	Gray birch	20%	FAC
Sambucus canadensis	Common elderberry	10%	FACW-
Rubus allegheniensis	Allegheny Blackberry sp.	10%	FACU-
Pinus resinosa	Red Pine	5%	FACU
Fraxinus pennsylvanica	Green Ash	5%	FACW
Quercus bicolor	Swamp White Oak	5%	FACW+
Amelanchier canadensis	Shadblow Serviceberry	5%	FAC

Plot F2 Soil Data

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
A	0 to 8	sandy loam	2.5Y 3/2	
B	8 to 14	loamy sand	2.5Y 6/6	prominent mottling
C	14+	loamy sand	2.5Y 8/2	high contrast mottling *sandy soil

WETLAND MITIGATION MONITORING REPORT

FINAL ASSESSMENT

F.E. EVERETT TURNPIKE
NASHUA, NEW HAMPSHIRE
M-I AND M-II SITES
Nashua 11057
USACOE #1991-01009
NH DES Permit #97-01678

August 2007

WETLAND MITIGATION MONITORING REPORT
FINAL ASSESSMENT

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August 2007

Introduction

The Louis Berger Group, Inc. (Berger) performed wetland assessments on the M-I and M-II wetland mitigation sites during the first week of August, 2007 for the New Hampshire Department of Transportation (NHDOT), Bureau of Environment. Berger conducted a previous wetland mitigation monitoring assessment at the M-I and M-II sites on November 1, 2002. The mitigation was required as compensation for approximately 23.89 acres of wetland impacts created during the widening and reconstruction of the F.E. Everett Turnpike from the Massachusetts state line north to Nashua, NH. The M-I and M-II sites are located east of Daniel Webster Highway on the inside interchange of the Route 3 - 3A connector in Nashua and are intended to replace floodflow alteration and sediment and toxicant retention functions impacted by roadway construction.

Methodology

Based upon general location recommendations provided by NHDOT staff, data plots and photo stations were established and documented on project plans. Overall vegetation cover, survival and spread of planted wetland species, and colonization of native and exotic wetland species were photographed and recorded. Wildlife sightings and presumed activity as well as general site conditions such as hydrology or functional role, were also recorded.

Plot stakes for vegetation surveys were placed and marked with pink flagging tape for future identification and assessment. Plant species and estimated percent aerial cover were documented for each plot location in accordance with applicable U.S. Army Corps of Engineers procedures specified in the 1987 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands;* non-woody herbaceous and woody species < 3.2 feet tall were recorded within a 5-foot radius and woody saplings and shrubs > 3.2 feet tall were recorded within a 15-foot radius. An accompanying plan showing the mitigation site, vegetation data plot survey information, and site photos can be found at the end of this report.

Site Descriptions and Observations

The M-I and M-II sites are located east of Daniel Webster Highway on the inside interchange of the Route 3 - 3A connector in Nashua, NH. Both sites were constructed in 2001. The primary functions of these two sites include floodflow alteration and sediment and toxicant retention as required in NHDES Permit #97-01678. Hydrology is largely provided by highway drainage at both sites. Both sites have several culverts, which convey stormwater and/or catch basin flow into the mitigation sites. The two mitigation sites were designed with a base elevation of approximately 130.0 feet with a 48 inch culvert connecting them to enable the transfer of stormwater between the two sites. Both sites have a single outleting culvert, which drains directing to the Merrimack River. All associated side slopes at both sites were stabilized and well vegetated with upland species. No major erosion or sedimentation was observed, however the presence of two sink holes in M-1 are of concern.

M-I

Sources of hydrology at the 4.4-acre M-I site include discharges from catch basins along the Connector Road and ramps to US Route 3, overland flow from the small contributing watershed and presumably some groundwater discharge. The 48-inch culvert connecting to M-II contained several inches of standing water but no perceptible flow was observed. The culvert operates primarily as an equalizing pipe with inverts of 130.5 in M-II and 130.0 in M-I. However, during periods of higher flows, water flows from M-II into M-I due to the larger contributing watershed of M-II and a slightly lower invert

elevation on the outlet culvert. No perceptible flow paths were observed in the wetland, however, higher water levels can exit through an 18-inch culvert with a 130.25 invert located at the southeast corner of the mitigation area and flow into an existing wetland prior to entering the Merrimack River. Water clarity in at the M-1 site was clear. The sources of this water were likely a combination of recent overland flow and groundwater discharge.

The M-I site was designed with differing elevations allowing for the establishment of several pools of prolonged standing water. The approximate locations of these pools of standing water are shown on the attached General Plan. Cover types sketched in 2002 are generally the same with the exception of *Phragmites* patches that expanded on the northwestern portion of the site and are called out on the General Site Plan. At least 2 small pockets of PUB were observed at the site (approx. 1,000-2,000 s.f.); this cover type was not mapped. Slight variations in the size and locations of these pools occurred during construction and are not reflected on the construction plans. Water levels within M-I fluctuate substantially, and emergent FACW vegetation in soils that are unsaturated for parts of the growing season (see M-I P1 plot data photographs) can experience frequent or prolonged flooding. The border of the created wetland within the southern end of the mitigation site is also slightly different than the relatively straight edges shown on the General Plan. These variations are due to bedrock encountered during excavation. This southern area consisted of emergent wetland and two "bump-outs." The shrubs proposed for planting on the two upland islands noted on the original site plans were transferred to these bump-outs. Likewise, the northern island indicated on the original site plans was not constructed to replace the lost area of wetland mitigation associated with the "bump-outs". Initial herbaceous plantings reportedly included pickerelweed and cattail, the latter being the most abundant. Pickerelweed was not observed during this site visit. The northern tip of the mitigation site at the wetland transition to upland was planted with wetland shrubs which generally appear to be in good condition. The construction plans indicate that the marsh areas were seeded with millet, annual rye grass, and bulrush. Shrub species included willow, elderberry, speckled alder, staghorn sumac, silky dogwood, and buttonbush.

A visual observation of the planted species survival rate has been estimated at 85%, the same as the 2002 growing season. Overall, the wetland was dominated by broad-leaved cattail. Various sedge and rush species were also relatively common. Four small stands of *Phragmites* identified and photodocumented in the 2002 report have expanded considerably and are a management priority (see General Plan and Photographs). A second invasive species, purple loosestrife is also present but less common in the wetland. The shrubs planted such as willow, buttonbush, speckled alder, and winterberry holly were healthy where observed. Overall, the vegetation community is indicative of an early successional landscape where a trend toward persistent emergent wetland species will become more dominant over time.

The culvert outleting from a catch basin located at the southeastern side of the wetland (see photograph and general plan) remains a concern for this site due to the development of a sinkhole, as well as what appears to be a sinkhole in the center of the site, between plot MI-P1 and the southeastern extent of the PEM1F (see photograph and general plan). The riprap apron has been undercut to the point where it has created a depression in the immediate area and the aforementioned sinkhole within the site remain of interest, as the depressions may be exposing more permeable soils which have the potential to negatively influence wetland hydrology. Insufficient information precludes the ability to identify this as a substantial problem; however, without looking into matters more, there is probable cause to have the sinkholes capped with silt or clay and the outlet area restored to the design grade with riprap.

The site appears to be providing the intended primary functions of floodflow alteration and sediment and toxicant retention. The floodflow alteration function is enhanced by the presence of several indicators

including storage potential, a constricted outlet, diffuse and low-velocity flow through the wetland and the extent of impervious surfaces in contributing watershed. Many of these qualifiers are also indicative of sediment and toxicant retention functions. Additional indicators include prolonged water retention time, presence of sediment and toxicant sources within the contributing watershed and the lack of erosion or scouring within the wetland.

Due primarily to the large surface area and availability of wildlife food sources (largely herbaceous seeds), this 4.4 acre mitigation site provides some wildlife habitat function in addition to its primary functions. Wildlife, such as waterfowl (teal) and passerine birds, were using the small area of open water for preening and resting at the time of the assessment. Although not directly observed, the wet meadow nature of much of the basin would provide excellent opportunities for raptors to hunt for small mammals. Overall, wildlife habitat is limited by a lack of species richness, low wetland class interspersion, isolated location and recent, dense residential development to the south side of the mitigation area which has substantially decreased the wooded buffer.

M-II

Hydrology at this site is largely provided by highway drainage through a culvert on the western side of the area. Several additional culverts carrying flow from catch basins also outlet into the basin. The M-II site is hydraulically connected to M-I via a 48-inch culvert at the southern side of the mitigation area. Excess surface water which does not enter M-I can also exit M-II via a 48-inch culvert located in the eastern edge of the mitigation site and flow to the Merrimack River. The invert of this culvert is set at 130.9 verses an invert of 130.5 on the culvert connecting to M-I. Water clarity throughout the basin was good. The inflow culvert at the southwest was flowing.

The 4.7-acre M-II site consisted primarily of monotypic beds of broad-leaved cattail (PEM1) and interspersed shallow open water classified as Palustrine Unconsolidated Bottom. Since 2002, the PEM1 area has expanded, resulting in two isolated patches of PUB at the East and West sides of the M-II mitigation area (see General Plan). Consistent with the 2002 monitoring report, the entire emergent zone within this basin was flooded at the observation date. The bottom contours appear to be generally uniform.

Currently, the emergent wetland is dominated by broad-leaved cattail (see vegetation plot data). The construction plans indicate that the marsh areas were seeded with millet, annual rye grass, and bulrush. None of these species are present in the wetland due to the amount of standing water. Project documentation indicates that, aside from the seeding, no emergent or woody planting were proposed within the basin due to potential flood-related mortality. Saplings planted along the shoreline for bank stabilization included golden weeping willow, speckled alder, staghorn sumac, autumn olive, and honey locust. The majority of these plantings are in good condition with the sumac faring the worst. Volunteer species included silver maple, speckled alder, elderberry, red maple, and buttonbush. Japanese knotweed, an invasive species, is present along the southeastern slope of the mitigation site.

As suspected in the 2002 report, the existing cattail stands have expanded into the unvegetated open water areas at the center of the site (PUB) (see photographs). The amount of cattail in the basin will be largely influenced by the muskrat population, which in contrast to the 2002 report, do appear to be present as a

feeding platform was observed on the south side of M-II (see photograph). Currently, purple loosestrife is confined to the basin perimeter.

Similar to M-I, the M-II site appears to be providing the intended primary functions of floodflow alteration and sediment and toxicant retention. The floodflow alteration function is enhanced by the presence of several indicators including storage potential, a constricted outlet, diffuse and low-velocity flow through the wetland, the extent of impervious surfaces in contributing watershed and the high stem density of persistent emergent vegetation. Many of these qualifiers are also indicative of the sediment and toxicant retention function. Additional indicators include prolonged water retention time, presence of sediment and toxicant sources within the contributing watershed, the lack of erosion or scouring within the wetland, and the high degree of open water and vegetation interspersion.

Due primarily to the large surface area and high degree of open water and vegetation interspersion, this 4.7 acre mitigation site provides some wildlife habitat function in addition to its primary functions. Small fish and what was thought to be a predated crayfish were seen in the open water area at the east of the site. Redwing blackbirds are numerous at this and use the site for breeding. A single yellowlegs species was seen on two separate days feeding in the mud-bottomed PUB area at the east of the site. Groundhog burrows are very common along the slopes of the M-II site. Rock doves and ring-billed gulls were observed using the open water. Mourning doves were also seen at the site. In 2002, a small flock of waterfowl (mallards) were seen preening and resting in the open water near the culvert on the western edge of the site. Overall, wildlife habitat is limited by a lack of species richness, low wetland class interspersion and isolated location.

Although invasive species colonization at the M-II site is not a major concern at this time, it was noted that Japanese knotweed, autumn olive, and glossy buckthorn are present in the uplands.

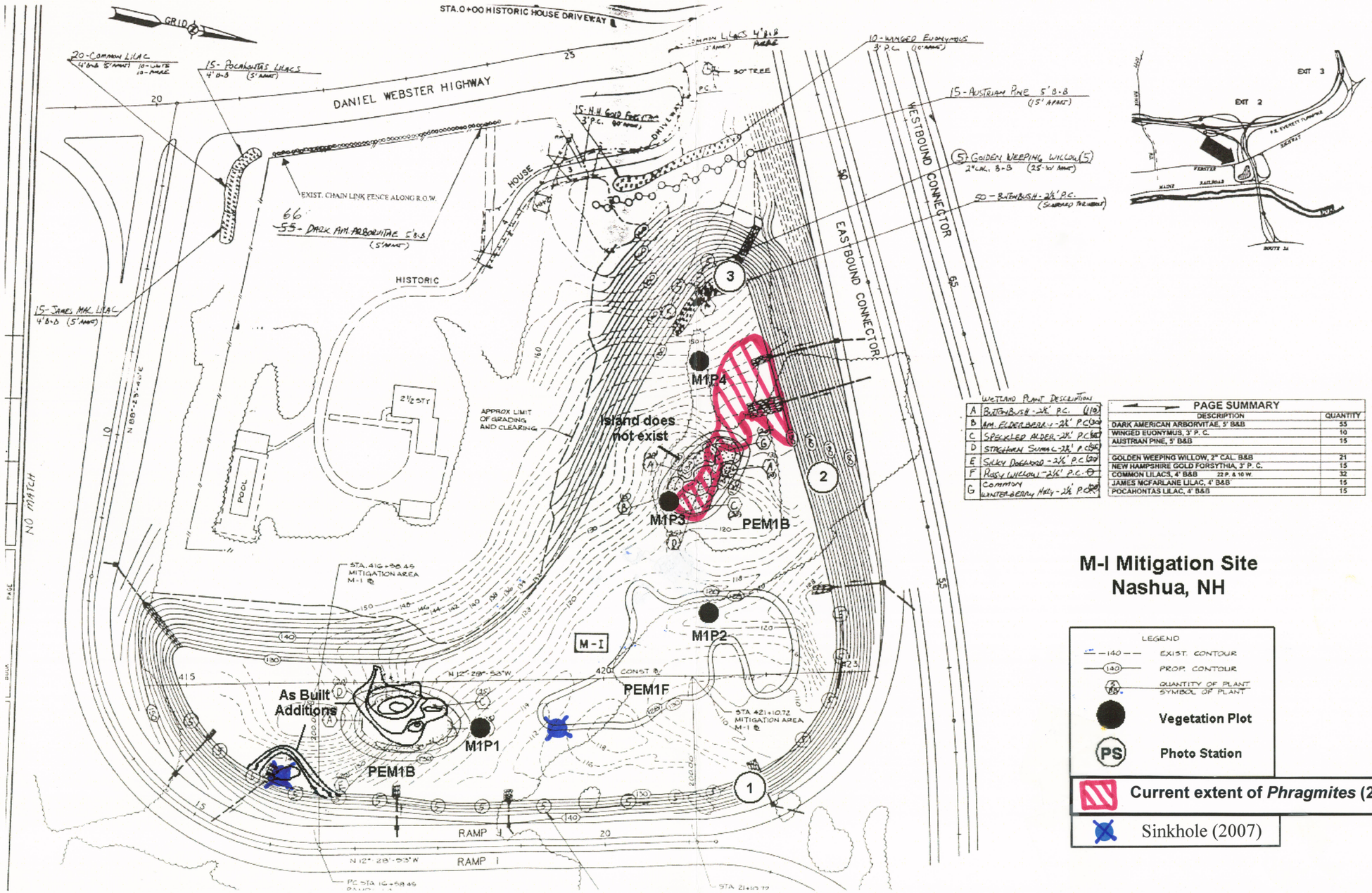
Conclusion

Overall, the wetland mitigation at these sites appear to meet expectations and permit requirements to provide the primary functions of floodflow alteration and sediment and toxicant retention. The floodflow alteration function is enhanced by the presence of several indicators including storage potential, a constricted outlet, diffuse and low-velocity flow through the wetland, the extent of impervious surfaces in contributing watershed and the high stem density of persistent emergent vegetation. Many of these qualifiers are also indicative of the sediment and toxicant retention function. Additional indicators include prolonged water retention time, presence of sediment and toxicant sources within the contributing watershed, the lack of erosion or scouring within the wetland, and (in the case of M-II) the high degree of open water and vegetation interspersion which has lessened.

The general size and configuration of the sites is consistent with the construction plans. Soils are stable and native and planted species in both wetland and upland areas are well established. Purple loosestrife was not abundant. *Galerucella* beetle herbivory was observed. As discussed in the 2002 report, *Phragmites* management remains a serious concern for the M-I site as the more or less monotypic stand(s) now total approximately 15,000 s.f. and will continue to expand rapidly without control. There were no signs of human degradation at either of these sites.

The culvert outleting from a catch basin located at the southeastern side of the wetland (see photograph) remains a concern for this site due to the development of a sinkhole, as well as what appears to be a sinkhole in the center of the site (between plot M-I PI and the southeastern extent of the PEM1F). The riprap apron has been undercut to the point where it has created a depression in the immediate area and the aforementioned sinkhole within the site remain of interest, as the depressions may be exposing more permeable soils which have the potential to negatively influence wetland hydrology. Insufficient information precludes the ability to identify this as a substantial problem; however, without looking into matters more, there is probable cause to have the sinkholes capped with silt or clay and the outlet area restored to the design grade with riprap.

M-I SITE LOCATION / GENERAL PLAN



	Wetland Plant Description
A	Buttonbush - 2½' P.C. (4'o.c.)
B	Am. Elderberry - 2½' P.C. (3'o.c.)
C	Speckled Alder - 2½' P.C. (5'o.c.)
D	Staghorn Sumac - 2½' P.C. (5'o.c.)
E	Silky Dogwood - 2½' P.C. (3'o.c.)
F	Pussy Willow - 2½' P.C. (5'o.c.)
G	Common Winterberry Holly - 2½' P.C. (3'o.c.)

PAGE SUMMARY

DESCRIPTION	QUANTITY
DARK AMERICAN ARBORVITAE, 5' B&B	55
WINGED EUONYMUS, 3' P. C.	10
AUSTRIAN PINE, 5' B&B	15
GOLDEN WEEPING WILLOW, 2" CAL. B&B	21
NEW HAMPSHIRE GOLD FORSYTHIA, 3' P. C.	15
COMMON LILACS, 4' B&B 23 P. & 10 W.	32
JAMES MCFARLANE LILAC, 4' B&B	15
POCAHONTAS LILAC, 4' B&B	15

M-I Mitigation Site
Nashua, NH

LEGEND
- EXIST. CONTOUR
- PROP. CONTOUR
- QUANTITY OF PLANT / SYMBOL OF PLANT
- Vegetation Plot
- PS Photo Station
- Current extent of *Phragmites* (2007)
- Sinkhole (2007)

M-I SITE PHOTOGRAPHS

M-I Photo Station 1

M-I Photo Station 2

M-I Photo Station 3

Open water at center of M-I mitigation site

***Phragmites* patches at eastern side of M-I mitigation site**

Evidence of muskrat activity at center of M-I Site

Blackberry and other fruit bearing volunteer shrubs are common on M-I sideslopes

Sinkhole between plot M-I P1 and southeastern extent of the proposed PEM1F.

Sinkhole at culvert outlet along southeastern embankment of M-I mitigation site.

M-I WETLAND OBSERVATION PLOT DATA

Plot M-I PI

Photograph of plot M-I P1 taken during vegetation assessment

Photograph of plot M-I P1 taken during soil assessment one week later (note 14 inches of standing water)

Plot M-I P1 is within a palustrine emergent marsh dominated by ovate spike rush, soft stem bulrush and common cattail. Purple loosestrife is present albeit in small quantity. The water table in this area fluctuates rapidly as observed during two site visits approximately a week apart. Based on soil observation, the area meets category 1 (Frequently Ponded or Flooded Soils) of the *Field Indicators for Identifying Hydric Soils in New England*[1] due to observed flooding or ponding. "Frequently flooded" means that the soil has a 50 percent chance of being flooded in any year and "frequently ponded:" means that the soil has a 50 percent chance of being ponded in any one year. Field indicators to confirm Category 1 include 5 or more percent redoximorphic features within the upper 6 inches of the the soil surface, which is exceeded at this plot. As the mitigation site is a constructed wetland, soil development and horizons are not going to conform to standards based on natural processes (note that the soil data excludes a B horizon). It is believed that through time the soil will either take on the characteristics of Category 5 or 6 (Mineral Histic, Depleted or Gleyed Matrix) by developing a mucky A horizon or by developing a reduced matrix higher in the soil profile.

Strong evidence of *Galerucella* beetle herbivory on purple loosestrife was present at this location. Notable changes since the 2002 report include that the percentage cover of purple loosestrife has decreased by 20 percent and percent cover of spike rush has increased by 30 percent.

Plant Percent Cover, Plot M-I PI

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Eleocharis obtusa	Ovate spike-rush	35%	OBL
Scirpus validus	Soft stem bulrush	25%	OBL
Typha latifiolia	Common cattail	25%	OBL
	Bare ground	10%	
Lythrum salicaria	Purple loosestrife	5%	FACW+

Soil Data, Plot M-I PI

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
A	0-16	sandy loam	2.5Y 3/3	2.5Y 5/2 mottles
C	16-refusal at 25	sandy silt loam	2.5 6/1	extremely reduced

[1] New England Hydric Soils Technical Committee. 2004. 3rd ed., *Field Indicators for Identifying Hydric Soils in New England*. New England Interstate Water Pollution Control Commission, Lowell, MA.

Plot M-I P2

Photograph of plot M-I P2

Plot M-I P2 contained 75 percent cattail and 25 percent open water with a trace of duckweed. Soils were not sampled as the site was inundated with approximately 15 inches of water and accurate testing with a spade or Dutch auger was not possible. The area meets Category 1 (Frequently Ponded or Flooded Soils). The area at this plot has experienced considerable changes in the vegetative community and species percent cover from the 2002 report. In summary, the area has transitioned from a diverse wet meadow to a cattail marsh. Pockets of open water are interspersed in this area and muskrat activity was present in the vicinity of this plot.

Plant Percent Cover, Plot M-I P2

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Common Cattail	70%	OBL
	Open Water	25%	
Lemna sp.	Duckweed	5%	OBL

Plot M-I P3

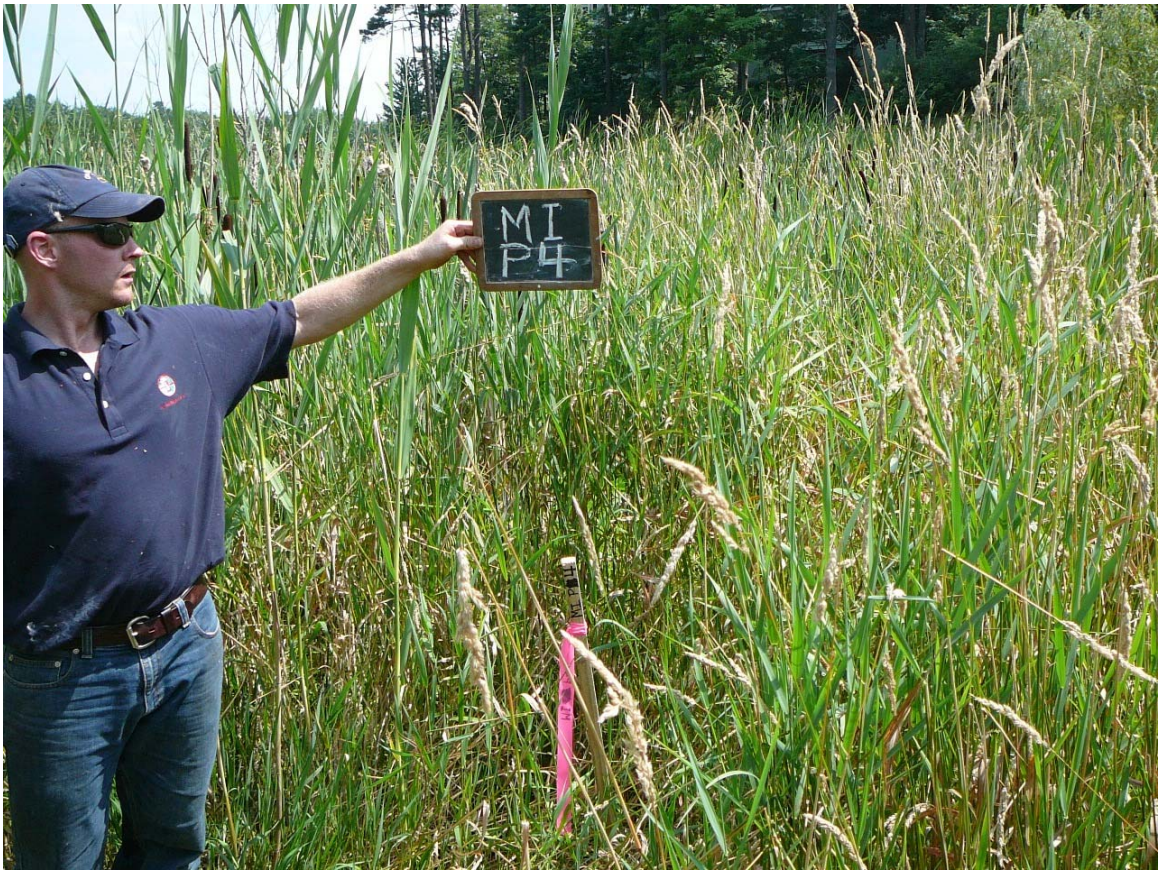
Photograph of plot M-I P3

Plot M-I P3 contained 50 percent cattail and 50 percent water with a trace of duckweed. Soils were not sampled as the site was inundated with approximately 14 inches of water. The area meets Category 1 (Frequently Ponded or Flooded Soils). Due to the standing water depth, soil testing with a spade or Dutch auger was not possible. The area at this plot has experienced considerable changes in the vegetative community and species percent cover from the 2002 report. In summary, the area has transitioned from a diverse wet meadow to a cattail marsh.

Plant Percent Cover, Plot M-I P3

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Typha latifolia	Common Cattail	50%	OBL
	Open Water	50%	
Lemna sp.	Duckweed	trace	OBL

Plot M-I P4



Photograph of plot M-I P4

Plot M-I P4 contains an assortment of wetland grasses and herbaceous shrub cover. Of concern is the presence and dominance of reed canary grass and *Phragmites*, both of which are listed on the Army Corps Noxious and Nuisance Plant List for Northeastern States. Plot M-I P4 is in close proximity to the monotypic patches of *Phragmites*. Interspersion of willows within the wetland and along the wetland border contribute to the wildlife habitat function of the site. Adventitious roots are present and individual trees may be expanding by these roots and associated sucker growth. Soils were sampled and meet Hydric Soil Categories 1 and 6 (Frequently Flooded or Ponded and Depleted or Gleyed Matrix). The depleted matrix (value of 5 or more and chroma of 2 or less) occurs in a horizon within 10 inches of the mineral soil material, therefore meeting Category 6.

Plot M-I P4 has experienced a drop in plant diversity and an increase in non-native species presence and percent cover. *Phragmites* (30 percent) and common reed (50 percent) have encroached into and now dominate this plot. Small quantities of native herbaceous wetland plants are present. Plot M-I P4 contained 30 percent purple loosestrife in 2002, decreasing to 5 percent in 2007. *Phragmites* control is a high priority for the M-I mitigation site.

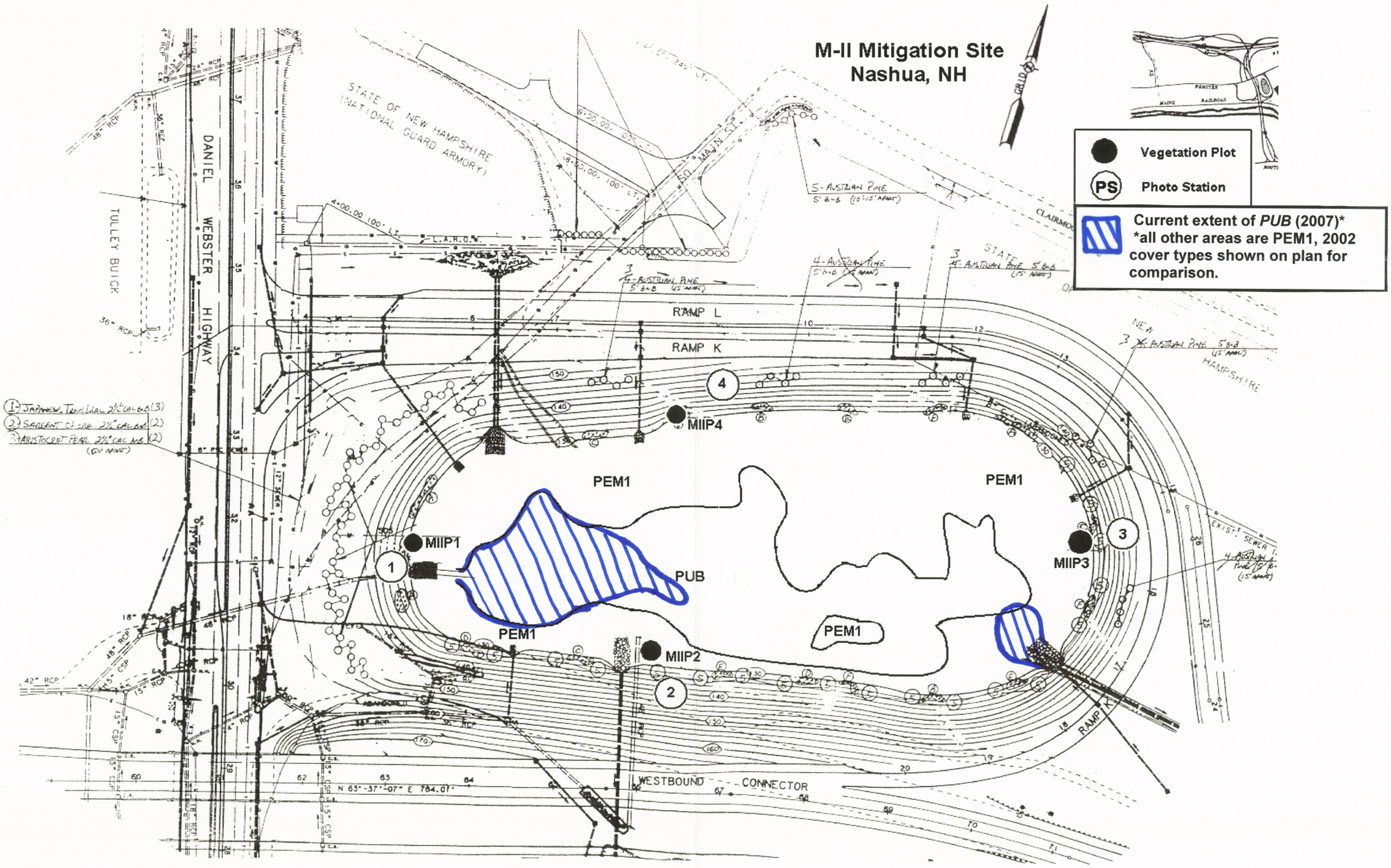
Plant Percent Cover, Plot M-I P4

Scientific Name	Common Name	% Cover	Status
	Herbaceous Cover		
Phalaris arundinacea	Reed Canary Grass	35%	FACW+
Phragmites australis	Common Reed	20%	FACW
Bidens connata	Swamp Beggar's Ticks	10%	FACW+
Eleocharis obtusa	Ovate spike-rush	10%	OBL
Scirpus validus	Soft stem bulrush	10%	OBL
Lythrum salicaria	Purple loosestrife	5%	FACW+
	Bare Ground	10%	
	Shrubs		
Salix nigra	Black Willow	10%	FACW+
Populus deltoides	Eastern Cottonwood	10%	FAC

Soil Data, Plot M-I P4

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
	3	Standing Water		
A	0 to 5	stony sandy loam	10YR 3/1	multiple redox features
B1	5 to 10	very fine sandy loam	10YR 5/2	reduced matrix
B2	10 to 22	sandy loam	2.5Y 4/4	50% 2.5Y 4/2

M-II SITE LOCATION / GENERAL PLAN


M-II Mitigation Site
Nashua, NH
Vegetation Plot
PS
Photo Station
Current extent of PUB (2007)*
*all other areas are PEM1, 2002 cover types shown on plan for comparison.
MIIP1
MIIP2
MIIP3
MIIP4
PUB
PEM1
PEM1
PEM1
PEM1
DANIEL WEBSTER HIGHWAY
TULLEY BUICK
STATE OF NEW HAMPSHIRE (NATIONAL GUARD ARMORY)
RAMP L
RAMP K
RAMP K
WESTBOUND CONNECTOR
1
2
3
4

M-II SITE PHOTOGRAPHS

M-II Photo Station 1

M-II Photo Station 2

M-II Photo Station 3

M-II Photo Station 4

Evidence of muskrat activity at southern side of M-II mitigation site

Open water (PUB) area at eastern side of M-II mitigation site

M-II WETLAND OBSERVATION PLOT DATA

Plot M-II P1

Photograph of plot M-II P1

Plot M-II P1 was dominated by common cattail with inclusions of woolgrass and various herbaceous wetland plants. Purple loosestrife was present with low percent cover. Standing water was found at 1 inch below the soil surface. Soils were sampled and meet Hydric Soil Categories 1 and 6 (Frequently Flooded or Ponded and Depleted or Gleyed Matrix). The depleted matrix (value of 5 or more and chroma of 2 or less) occurs in a horizon within 10 inches of the mineral soil material, therefore meeting Category 6. Field indicators to confirm Category 1 include 5 or more percent redoximorphic features within the upper 6 inches of the soil surface, which is exceeded at this plot.

Plot M-II P1 has experienced beneficial vegetative changes compared to other plots within the M-II mitigation area. 3 native wetland plants are new to this plot. Purple loosestrife has decreased from 10 percent in 2002 to 5 percent in 2007.

Plant Percent Cover, Plot M-II P1

Scientific Name	Common Name	% Cover	Status
Typha latifiolia	Common cattail	70%	OBL
Scirpus cyperinus	Woolgrass	15%	FACW+
Juncus effusus	Common rush	5%	OBL
Lythrum salicaria	Purple loosestrife	5%	FACW+
Impatiens capensis	Spotted Touch-Me-Not	5%	FACW
Verbana hastata	Blue vervain	3%	FACW+
Carex tribuloides	Blunt broom sedge	Trace	FACW+

Soil Data, Plot M-II P1

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
Oe	0-3			
A	3 to 11	sandy loam	10YR 4/1	oxidized rhizosphere
B	11 to 28	sandy loam	2.5 Y 5/2	reduced matrix
C	28+	rock/gravel	non-soil	

Plot M-II P2

Photograph of plot M-II P2

Plot M-II P2 was dominated by common cattail and contained 3 inches standing water. Purple loosestrife had the second greatest amount of percentage cover (15 percent) with the remaining herbaceous cover comprised of FACW and OBL species. The shrub layer consisted of three species of willow, buttonbush and red maple. Soils were sampled and meet Hydric Soil Categories 1 and 6 (Frequently Flooded or Ponded and Depleted or Gleyed Matrix). The gleyed horizon occurs in a horizon within 10 inches (in this case ½ inch) of the mineral soil material, therefore meeting Category 6. An A-horizon was not present based on the constructed nature of the site.

Plot M-II P2 has experienced unsubstantial vegetative changes compared the 2002 evaluation. Three native wetland plants are new to this plot. Purple loosestrife has maintained its percent cover at 15 percent. Shrubs are growing wider and therefore entering the plot area. Five species were documented in the shrub layer in 2007 as opposed to a single species in 2002 showing that the constructed wetland is maturing and offering a variety of habitat.

Plant Percent Cover, Plot M-II P2

Scientific Name	Common Name	% Cover	Status
Typha latifolia	Common Cattail	60%	OBL
Lythrum salicaria	Purple loosestrife	15%	FACW+
Juncus effusus	Common rush	5%	OBL
Carex vulpinoidea	Fox Sedge	5%	OBL
Phalaris arundinacea	Reed Canary Grass	5%	FACW+
Juncus brevicaudatus	Narrow-panicle rush	trace	OBL
Carex tribuloides	Blunt broom sedge	trace	FACW+
Lemna sp.	Duckweed	trace	OBL
	Shrubs		
Cephalanthus occidentalis	Buttonbush	10%	OBL
Salix babylonica	Weeping willow	10%	FACW-
Salix discolor	Pussy Willow	5%	FACW
Salix nigra	Black Willow	5%	FACW+
Acer rubrum	Red Maple	trace	FAC

Soil Data, Plot M-II P2

Horizon	Depth (in)	Texture	Matrix Color	Redox Notes
Oi	0-1/2			
B	1/2 to 30	sandy silt loam	Gley 5/10Y	Stripped
C	30+	loamy sand	Matrix is 50% / 50%: 10YR 4/4 and 4/2	

Plot M-II P3

Photograph of plot M-II P3

Plot M-II P3 had 4 inches of standing water and was dominated by cattails. Some duckweed was present due to the 25 percent open water which probably persists throughout the growing season at lower elevations. The willow trees planted in this area are maturing and are healthy. Soil data was also collected. The area meets Category 1 (Frequently Ponded or Flooded Soils). Field indicators to confirm Category 1 include 5 or more percent redoximorphic features within the upper 6 inches of the soil surface, which is exceeded at this plot. As the mitigation site is a constructed wetland, soil development and horizons are not going to conform to standards based on natural processes. It is believed that the soil will either take on the characteristics of Category 5 or 6 (Mineral Histic, Depleted or Gleyed Matrix) by developing an entirely mucky A (and therefore the stripped matrix would be in direct contact with the mucky A (or O) or the development of a depleted or gleyed matrix higher in the soil profile.

Overall, the plot has changed little since the 2002 evaluation. It is worthy to note that purple loosestrife is no longer present at this plot, however, this is probably due to the extended hydroperiod and more or less homogenous nature of many cattail marshes.

Plant Percent Cover, Plot M-II P3

Scientific Name	Common Name	% Cover	Status
Typha latifolia	Common Cattail	70%	OBL
	Open Water	25%	
Lemna sp.	Duckweed	5%	OBL
	Canopy		
Salix babylonica	Weeping willow	20%	FACW-

Soil Data, Plot M-II P3

Horizon	Depth (in)	Texture	Matrix Color	Notes
Oi	0-1			
A1	1 to 5	fine sandy loam	10YR 3/1	dark, mucky A horizon
A2	5 to 15	fine sandy loam	10YR 3/1	mottles prominent
B	15 to 17	silty sandy loam	Gley 5/5 GY	stripped matrix (gley)
C	Refusal at 17	rock/gravel		

Plot M-II P4

Photograph of plot M-II P4

Plot M-II P4 is dominated by cattail with inclusions of open water. A small portion of the percent cover is comprised of duckweed and purple loosestrife. Purple loosestrife is perhaps being outcompeted by the established cattail population and its advantage in semi permanently flooded areas. Soils collected at the plot meet Category 1 (Frequently Ponded or Flooded Soils). Field indicators to confirm Category 1 include 5 or more percent redoximorphic features within the upper 6 inches of the soil surface, which is exceeded at this plot. The soil also meets Categories 5 and 6 (Mineral Histic, Depleted or Gleyed Matrix). The gleyed horizon is within 10 inches of the mineral soil surface; additionally, the depleted matrix directly underlies a mucky A horizon.

Since 2002 the plot has increased in maturity (shrub expansion into plot), changes in the herbaceous layer include a decrease in cattail cover making way for the inclusion of common rush within the plot.

Plant Percent Cover, Plot M-II P4

Scientific Name	Common Name	% Cover	Status
Typha latifolia	Common Cattail	75%	OBL
	Open Water	20%	
Lythrum salicaria	Purple loosestrife	5%	FACW+
Lemna sp.	Duckweed	5%	OBL
	Canopy		
Populus deltoides	Eastern Cottonwood	35%	FAC
Salix nigra	Black Willow	25%	FACW+

Soil Data, Plot M-II P4

Horizon	Depth (in)	Texture	Matrix Color	Notes
Oi	0-1/2			
Oe	1/2 to 1			
A	1 to 6	sandy loam	10YR 3/1	mucky A horizon
B	6 to 20	sandy loam	Gley 5/5GY	stripped matrix (gley)
C	20+	Gravel		