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NAE-2011-0346
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BY:

December 9, 2014

Ms. Marty Abair, Senior Project Manager
U.S. Army Corps of Engineers, Regulatory Division
11 Lincoln Street, Room 210
Essex Junction, Vermont 05452

RE: VTrans Maidstone STP 0271(20)
2014 Wetland Monitoring Report

Dear Ms. Abair:

Enclosed please find the 2014 Wetland Monitoring Report for the Maidstone STP 0271(20) that was prepared by Marc Lapin (Ecosystem Conservation Service) and Mary Nealon (Bear Creek Environmental, LLC) of the Bear Creek Environmental Biological Services Team. This annual report is the second of five annual reports that will be submitted in accordance with the "Invasive Species Management, Planting and Monitoring Plan".

Please feel free to contact me if you have questions.

Sincerely,

Mary M. Nealon

Mary Nealon
Principal, River Scientist

Enclosure

cc: John Lepore, VTrans (via email)
Shauna Clifford, VTrans (via email)
Shannon Morrison, VDEC (via email)
Bob Popp, VF&W (via email)
Marc Lapin, Ecosystem Conservation Service (via email)
Dean Grover, Grover Engineering, PC (via email)

Maidstone Slide – STP 0271 (20)

Year 2 Report

Wetland and Invasive Species Monitoring and Control Recommendations

9 December 2014

Marc Lapin, Ecosystem Conservation Science

239 Cider Mill Road, Cornwall, VT 05753

and

Mary Nealon, Bear Creek Environmental, LLC

149 State Street, Suite 3, Montpelier, VT 05602

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Summary Conclusions and Recommendations

A second year of monitoring of the wetland impacted by the construction of a temporary access road was conducted in accordance with the Invasive Species Management, Planting and Monitoring Plan[1] for the Maidstone STP 0271(20) project. The temporary access road was constructed during spring 2013 and was restored following construction. During late September 2013, observation plots were used to assess the overall vegetative success in the restored wetland and the presence/absence of invasive species. In mid-August 2014 the same plots were resampled and Year 2 assessment of site stability, wetland hydrology and wetland function was made by ecologist Marc Lapin.

After two years of monitoring, the wetland area disturbed by the construction of the access road appeared stable and was successfully revegetated with native species. Vegetative cover was estimated to be over 90 percent, a slight increase from Year 1 coverage, and no invasive exotic shrubs were found in the re-vegetated area. There were, however, invasive exotic shrubs (glossy buckthorn and Eurasian honeysuckles) adjacent to the restored area, in the zone that was the roadway margin. Trees and some shrubs were cut in that margin during construction in spring 2013. Numerous non-native herbaceous species were observed in the restored area; none of these species are listed in Vermont or New Hampshire as invasive species. Control of wild parsnip by hand pulling and chemical control of glossy buckthorn and Eurasian honeysuckles in the roadway margin and along the stabilized slope were conducted during the 2014 growing season. The chemical control of Japanese knotweed on the stabilized slope and the wetland buffer along the former access road was planned for early October 2014, but could not be undertaken due to the apparent die off of the plants. Knotweed control is recommended for spring or summer 2015. No Japanese knotweed was seen in the restored wetland. No control of reed canary grass was undertaken; the non-native species was documented in the restored wetland in both 2013 and 2014. We observed a small increase in its population size in our wet-zone

[1] Bear Creek Environmental, LLC. Biological Services Team. 2012. Invasive Species Management, Planting and Monitoring Plan for Maidstone STP 0271(20). Vermont Agency of Transportation-Slope Failure on VT Route 102 Adjacent to Connecticut River. Montpelier, Vermont.

sample plot in 2014 and a small decrease in the drier-zone plot. Reed canary grass is difficult to control; we recommend mechanical control, with clipping and bagging of immature seed heads and cutting of vegetative parts to be started in 2015.

There continues to be no evidence that the project hindered the wetland's ability to perform its previously documented functions of water storage, surface and groundwater protection and erosion control. Differences pre- and post-project in these functions are minor and are attributed to the microtopography of the wetland being altered and the presence of angular stone in scattered parts of the surface horizon. Alterations due to compaction and soil mounding were estimated in 2013 to be less than 5% of the project area. In 2014 these alterations were still evident but were largely hidden beneath the dense herbaceous vegetation and did not appear to be substantially detrimental to documented pre-disturbance wetland functions. Wildlife habitat functionality has been diminished from the natural condition due to a shift from a forest-dominated wetland to herbaceous vegetation. It is hoped that this cover change is temporary and we expect that tree and shrub cover will re-establish over time, and thus the wildlife habitat functionality would improve. Year 2 monitoring, however, revealed extremely small amounts of woody plant regeneration. We observed sprouts from one white ash stump, several butternut seedlings, only one silver maple seedling, and no other woody plant regeneration on the restored traveled access road.

Background

The Bear Creek Environmental, LLC Biological Services Team was retained by the Vermont Agency of Transportation to prepare an Invasive Species Management, Planting and Monitoring Plan for the Maidstone STP 0271(20) project. The Plan includes measures to reduce impacts to wetlands, to prevent the proliferation of invasive species, to restore wetland disturbed by the construction of a temporary access road, and to monitor the restored wetland. The following report provides a summary of the second year of monitoring after the construction of the temporary access road and subsequent restoration of the wetland. Monitoring of the restored wetland is a

condition of the Army Corps of Engineers' Permit NAE-2011-0346 dated December 17, 2012.

The Maidstone STP 0271(20) project included the construction of a temporary road to allow construction access to repair a large slope failure on a cutbank of the Connecticut River that was threatening Route 102 in the town of Maidstone, Vermont (Figure 1). The temporary access road (Figure 2) was constructed during May 2013 and in part followed the pathway of an existing woods road that was located between VT Route 102 and the Connecticut River. The former access road was approximately 20 feet wide and included a disturbance width of between 30 and 40 feet. Following construction, the wetland was restored by removing the geotextile and road gravels down to the original grades. The site was seeded with wetland native seed mix in wetland areas and upland native seed mix in non-wetland areas adjacent to the wetland and then mulched. Straw mulch was applied to avoid the introduction of weeds and invasive species. Per the Maidstone Plan, the seeds for two uncommon species were harvested and stored for planting following construction. These uncommon species include Wiegand's wild-rye (*Elymus wiegandii*) and rough avens (*Geum laciniatum*). Marc Lapin, Ecologist with Ecosystem Conservation Science, sowed the seeds on June 23, 2013. The stabilized construction entrance was removed and planted with native trees and shrubs. The silt fence, located adjacent to the oxbow, was taken out during fall 2013 to allow flooding of the restored wetland. During the fall dormancy period, live dogwood and willow stakes were installed in the riprap in the wetland buffer.

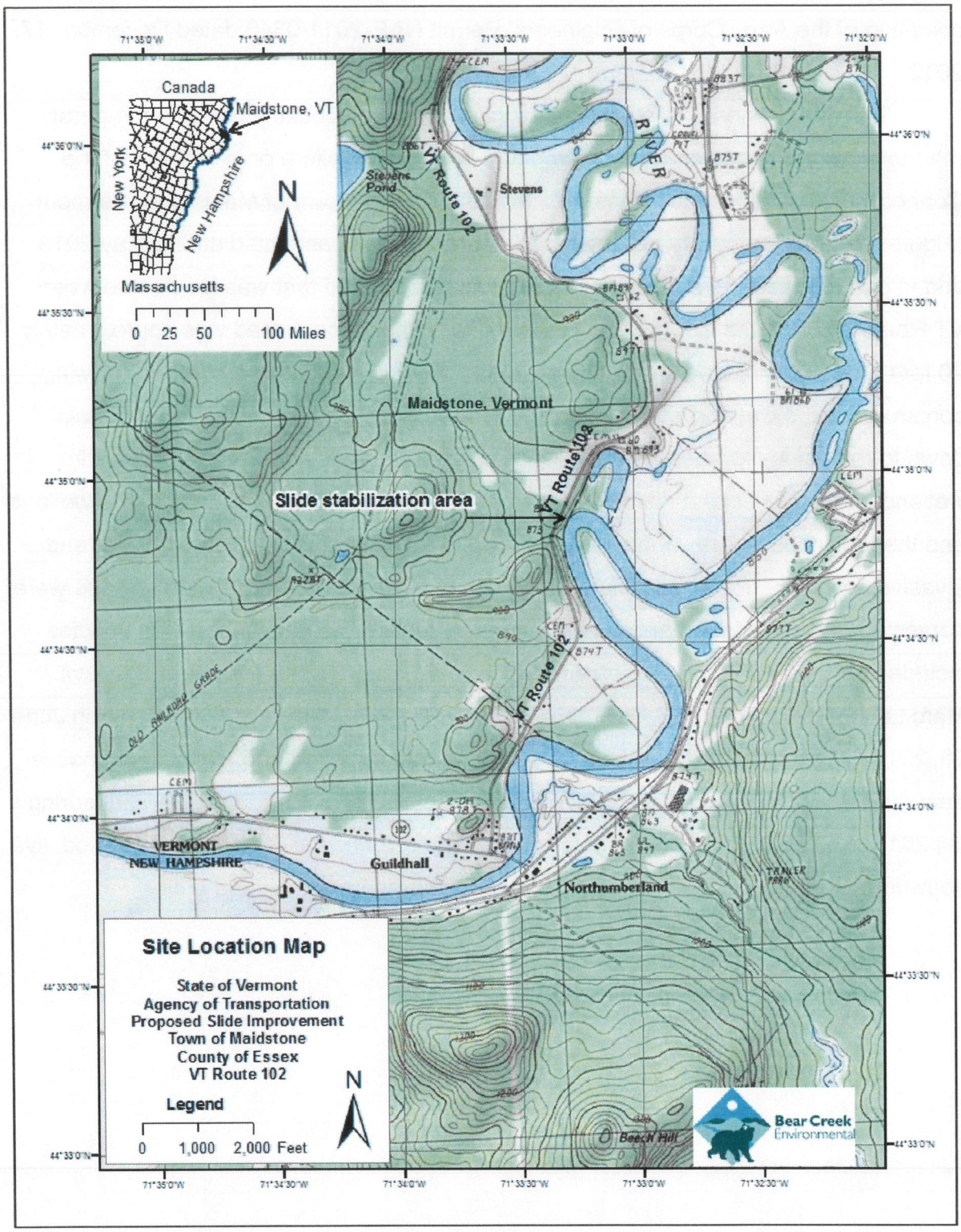

Figure 1. Site Location Map for Maidstone STP 0271(20) Project

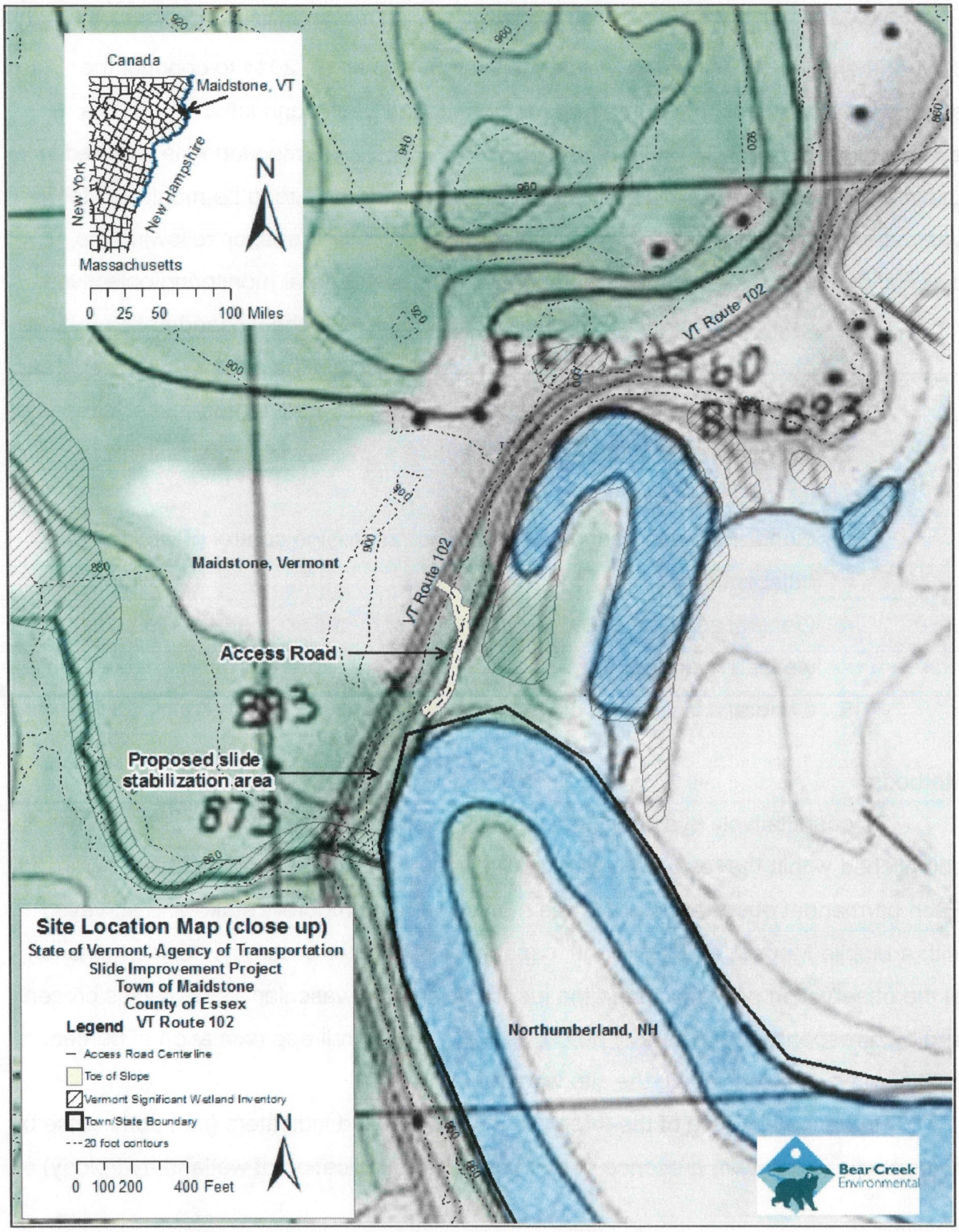

Figure 2. Location of Former Temporary Access Road

Marc Lapin of Ecosystem Conservation Science and Mary Nealon of Bear Creek Environmental, LLC visited the Maidstone site on August 19, 2014 to conduct the second year of monitoring. First-year monitoring had been conducted 11 months earlier, on September 27, 2013, and a summary of the 2013 monitoring is included in Lapin and Nealon (2013).[2] The accepted plan calls for the site to be monitored for five years during the growing season, beginning the first growing season following the completion of the restoration activities. There are five general monitoring objectives:

1. Evaluation of the overall vegetative success in the wetland noting relative abundance of hydrophytic plant species within the restored wetland areas with a goal of 80 percent vegetative cover by native (non-invasive) species
2. Assessment of the presence/absence of invasive species within the restored wetland areas
3. General assessment of site stability and erosion control of wetland and adjacent area
4. General assessment of the presence of hydric soils and corresponding wetland hydrology
5. General assessment of wetland function

Methods

To quantitatively evaluate plant species composition two 5 x 5 m plots were established within the restored wetland area where the access road had been removed. Each permanent observation point was marked with a temporary stake and surveyed with a Mobile Mapper 100, GPS unit, capable of sub-meter accuracy. Documentation at the observation points included the identification of all vascular plant species present and a corresponding estimate of percent cover. An overall approximation of percent cover of invasive species on the site was made.

Presence/absence of the three recognized wetland indicators (i.e., dominance by hydrophytic vegetation, presence of hydric soils, and indication of wetland hydrology)

[2] Lapin, M, and M. Nealon, 2013. Maidstone Slide – STP 0271(20) Year 1 Report: Wetland and Invasive Species Monitoring and Control. Bear Creek Environmental Biological Services Team, Montpelier, VT.

were assessed within the restored wetland areas. Wetland function was evaluated using the U.S. Army Corps of Engineers New England District Highway Methodology Workbook (USACE 1999) as a general guide.

Re-Vegetation of the Restored Access Road

After one growing season following removal of the road, the wetland area disturbed by the construction of the temporary access road had been revegetated with good success; the successful revegatation continued through the second growing season, although there were changes in both species composition and plant abundances. At the end of the first growing season over 85% of the area had plant cover, with 0% cover of invasive exotic shrubs. By late summer of the second growing season, plant cover was nearly 100%. The wet channels that had been bare in 2013 were still not fully vegetated in 2014, but the tall leaves of rushes, sedges and grasses arched over them and created ground cover even where root systems had not re-established.

Several invasive exotic shrubs were observed near the upland edge of the restored roadway; these were individuals that had been growing prior to the clearing of the area and had either persisted intact or had resprouted from stumps. There was no regeneration of invasive exotic shrubs by seed within the restored roadway. There was, however, a population of approximately a dozen wild parsnip (*Pastinaca sativa*) in the mid-section of the restoration area. In Year 1 the non-native herbaceous plants creeping yellow-loosestrife (*Lysimachia nummularia*) and brittle-stemmed hemp-nettle (*Galeopsis tetrahit*)[3] comprised 20 to 30% of the plant cover in some parts of the restored roadway; by Year 2 these populations had diminished and in no parts of the restoration zone comprised more than several percent coverage. These exotic herbs

[3] mis-identified as wild basil (*Clinipodium vulgare*) in 2013

are not listed as invasive species or noxious weeds in Vermont[4] or New Hampshire, although creeping yellow-loosestrife is on the New Hampshire Invasive Species Committee's watch list.[5] Except for wild parsnip and great burdock (*Arctium lappa*) all non-native species had less coverage in Year 2 than in Year 1. Reed canary grass (*Phalaris arundinacea*) had less overall coverage, but had increased in cover in the wetter-zone plot.

The two 5 x 5 m plots (Figure 3) that were established to document vegetation and soils in a very wet portion of the restored roadway (Table 1) and a dry portion of the restored roadway (Table 2) are useful for describing both the species composition in the different moisture zones of the restoration area and the changes that have occurred in the two years of growth. As noted in Year 1 monitoring, each plot had different dominant species but shared many of the common species. This trend continued into Year 2, thus it is worth repeating how useful it was to use a diverse native seed mix that allowed for differential germination and establishment based on microsite conditions. Plant cover exceeded 100% due to the layering of plants with different heights and growth forms, such as taller and shorter graminoids and forbs interlayered with creepers beneath.

The drier plot, representing the portion of the restored wetland that is closer to the river, continued to be dominated by grass, and positive identification of the most common species as red fescue (*Festuca rubra*) was possible with the flowering and fruiting seen in August 2014. Smooth goldenrod *(Solidago gigantea*) roughly doubled its cover in Year 2, and the stout grass eastern riverbank wild-rye (*Elymus riparius*) was seen to cover one-quarter of the plot. Both the fescue and the wild-rye were part of the seed mix used in the restoration. Shrub cover increased in this drier zone, with black

[4] http://www.vtinvasives.org/plants/plant-quarantine-rule
[5] http://agriculture.nh.gov/divisions/plant_industry/documents/ invasive-watch-list.pdf; http://www.gencourt.state.nh.us/rules/state_agencies/agr3800.html

elderberry among the top five species in coverage. Forty species were within the plot in 2014, whereas 41 were observed in 2013.

The wet portion of the restoration zone is the more northern section that abuts the steeply sloping part of the restored roadway's descent from Route 102. A rush, determined to be Pylae's soft rush (*Juncus pylei*) (a very similar species to common soft rush (*Juncus effusus*)) maintained dominance and increased slightly to cover about two-thirds of the area. Common fox sedge (*Carex vulpinoidea*) had nearly equal coverage to the rush in the very dense, layered herbaceous vegetation. Both the sedge and the rush were part of the seed mix utilized in the wetland. The only other species with greater than 1% coverage was common arrowhead (*Sagittaria latifolia*). In 2013 common fox sedge had not been recorded; it is possible that it was present and, as small individuals, was well hidden among the dense tangle of rush, or perhaps it did not germinate until year 2. The wet plot in the restored roadway had slightly lower species diversity than the drier plot; we saw an increase from 35 to 38 species in the two years. Species richness actually increased more than those numbers indicate, as five species that were in the plot in 2013 were recorded near to the plot but not within it in 2014. Similarly, species richness increased in the drier portion of the restoration, with six species near the plot that had been recorded within the plot the previous year. In addition to the plants recorded in the plots in the two years of monitoring, we found nine species within the restoration area that did not occur in either plot; two of those were non-native herbaceous species (Table 3). In Year 2 only four of the 38 seed plants present in the wet-site plot were not flowering or fruiting at the time of sampling; in the drier plot of the 35 seed plants, ten were not flowering or fruiting and three of those were shrubs, which generally take longer to reach reproductive age.

In her wetland delineation, Gustafson[6] documented black ash (*Fraxinus nigra*) and silver maple (*Acer saccharinum*) as tree stratum dominants. In 2013, approximately six silver maple seedlings and no black ash were observed in the 5 x 5 m Plot 1 (wetter zone) sample. Sampling in 2014 revealed only one silver maple seedling in the plot and again no black ash. Neither species was observed in Plot 2 in either year. In the shrub stratum Gustafson recorded black ash, choke cherry (*Prunus virginiana*) and highbush-cranberry (*Viburnum trilobum*). Of these three species, only choke cherry was observed in the restored roadway; as one would expect it was in the drier area (Plot 2 and the southern part of the site) and not within the wettest part of the restored area. Choke cherry was seen both years of sampling and had increased coverage from 1% to 2%. Although not recorded by Gustafson as one of the pre-disturbance wetland's shrub stratum dominants, black elderberry, at 5% cover, was recorded as the most abundant woody species in the drier plot. Woody species were virtually absent from the wetter area; the very rare, tiny silver maple seedlings and some canes of common blackberry were the only woodies within the wet portion of the restoration.

In the entirety of the restored wetland area, we observed 96 species over two years of monitoring. Sixty-four species were recorded in the Year 2 plot sampling, with an additional four species present but not within either plot. Sixteen non-native species are included within the two-year total of 96, but only seven of those were present by Year 2. All species recorded by Gustafson in her pre-construction wetland delineation documentation of dominant species were present in the restoration area. None of those species were dominant after the second growing season of the restoration, but one would not expect such a rapid recovery to natural composition or structure of the vegetation after a disturbance as disruptive as construction of a temporary roadway.

[6] Gustafson, S. 2011. Memo to John Lepore, VT Agency of Transportation. Re: Maidstone Slide Wetlands Evaluation, December 31, 2011. Shelley Gustafson Environmental, Ferrisburgh, VT.

No strong pattern was seen with regard to species observed in the plots in year 1 but not in year 2. Some of the species change seen in the two plots can be considered to be a natural sorting out of plants in response to preferred microhabitats. Also apparent is that some species that did not reappear in one or both plots in the second year are more typically open-ground colonizers of bare mineral or muck soil; these include nodding beggar-ticks, common evening-primrose, smartweeds, common barnyard grass, foxtail barley and foxtail grass. More competitive persistent plants would be expected to establish in greater coverage in year 2 and overtake such early colonizers, and that is what we have seen here. Another group includes those that are typically members of more densely vegetated wetland communities; we might expect some of these to reappear later in the restoration succession. These include small-spiked false nettle, Virginia virgin's-bower, American hog-peanut and spinulose wood and northern lady ferns. Species present in Year 2 that were not recorded the first year are overwhelmingly native species characteristic of mid- and later-successional wetlands, and there was an approximately equal number of those gained as lost in the second year. It will certainly be interesting to see the changes in species composition as succession proceeds. Data from two years indicates a trajectory toward a diverse assemblage of native herbs, but strong dominance by red fescue and smooth goldenrod in the drier zone and Pylae's soft rush and common fox sedge in the wetter zone certainly suggests that an alternative trajectory is possible.

Photo documentation of the vegetation is included as Appendix 1.

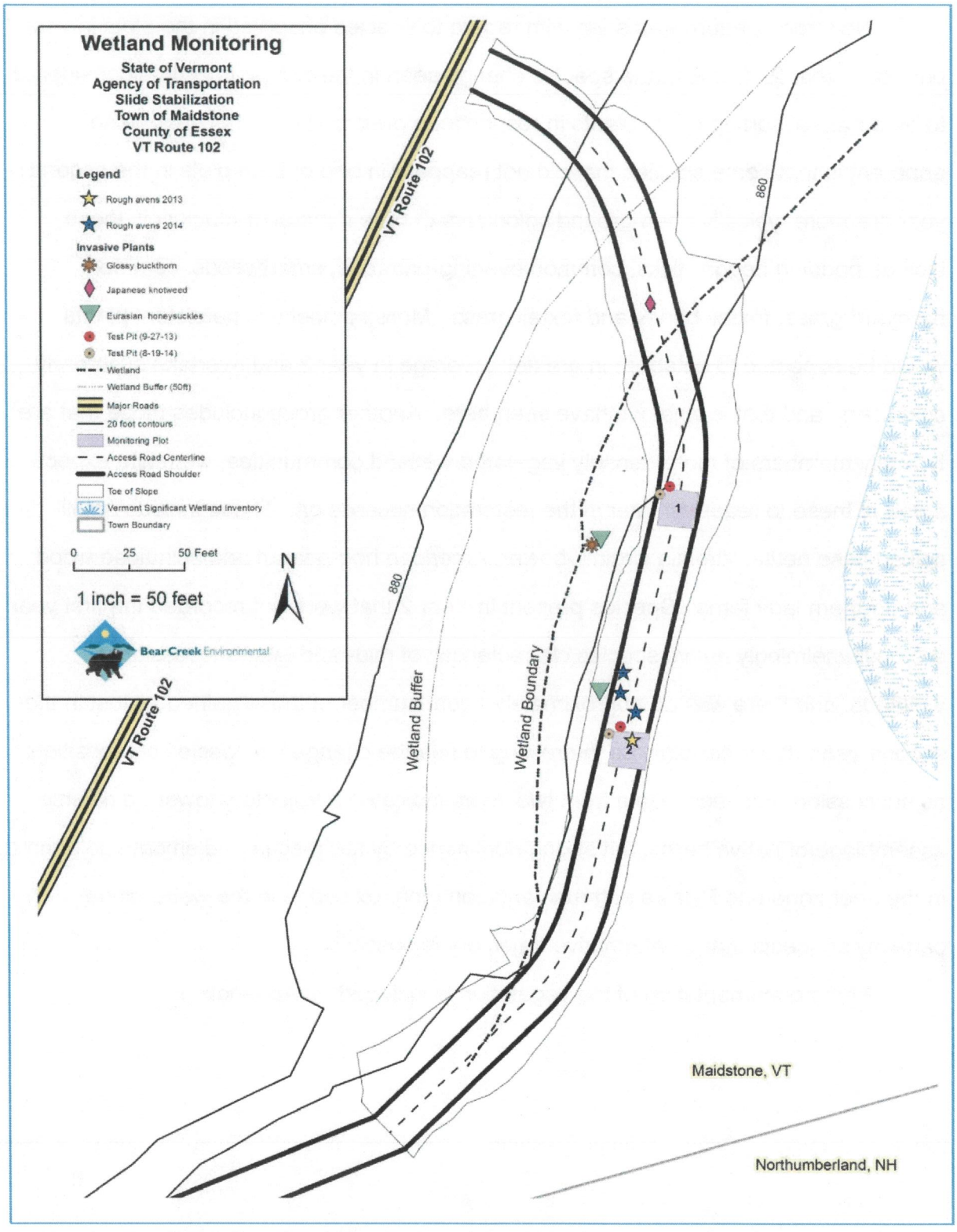

Figure 3. Wetland Monitoring Plots (September 27, 2013 and August 19, 2014)

Table 1. Plant Cover in Plot 1 (wettest area of restored roadway) in First (2013) and Second (2014) Monitoring Years

Scientific Name	Common Name	2014 Cover/ Abundance	2013 Cover/ Abundance	Year 2 Notes
***Juncus pylaei*‡**	Pylae's Soft Rush	65%	60%	fruiting
Carex vulpinoidea	Common Fox Sedge	60%		fruiting
Sagittaria latifolia	Common Arrowhead	15%	r	flowering
Alisma triviale	Northern Water-Plantain	o	2%	fruiting
Carex lurida	Sallow Sedge	o	1%	fruiting
Carex scoparia	Pointed Broom Sedge	o		fruiting
Impatiens capensis	Spotted Touch-Me-Not	o	u	flowering
Lysimachia nummularia†	Creeping Yellow-Loosestrife	o	o	
Mimulus ringens	Allegheny Monkey-Flower	o		flowering
Persicaria sagittata	Arrow-Leaved Tearthumb	o	c	flowering
Scirpus atrovirens	Dark-Green Bulrush	o		flowering
Scirpus cyperinus	Common Woolsedge	o	r	flowering
Verbena hastata	Blue Vervain	o		flowering
Bromus ciliatus	Fringed Brome	u		fruiting

Abundance ranking used if cover <1%

c=common, >10 plants, usually scattered widely through plot

o=occasional, 6-10 plants

u=uncommon, 3-5 plants

r=rare, 1-2 plants

Bold denotes species included in wetland seed mix; underline denotes species included in upland seed mix

‡ Assumed to be *J. effusus* in Year 1; determined to be *J. pylaei* in Year 2; advertised as *J. effusus* in seed mix; both are native species

† Non-native

Table 1. Plant Cover in Plot 1 (wettest area of restored roadway) in First (2013) and Second (2014) Monitoring Years

Scientific Name	Common Name	2014 Cover/ Abundance	2013 Cover/ Abundance	Year 2 Notes
Eutrochium maculatum	Spotted Joe-Pye Weed	u		flowering
Galium asprellum	Rough Bedstraw	u	r	fruiting
Penthorum sedoides	Ditch-Stonecrop	u		fruiting
Scutellaria galericulata	Hooded Skullcap	u		flowering
Typha latifolia	Broad-Leaved Cat-Tail	u	r	fruiting
Acer saccharinum	Silver Maple	r	r	single individual
Amphicarpaea bracteata	American Hog-Peanut	r		
Calamagrostis canadensis	Canada Reed Grass	r	o	flowering
Dichanthelium clandestinum	Deer-Tongue Rosette-Panicgrass	r		flowering
Dulichium arundinaceum	Three-Way Sedge	r		flowering
Epilobium ciliatum	Fringed Willow-Herb	r	o	flowering
Eupatorium perfoliatum	Boneset Thoroughwort	r		flowering
Galeopsis tetrahit†	Brittle-Stemmed Hemp-Nettle	r	1%	flowering
Galium palustre	Marsh Bedstraw	r	r	fruiting
Glyceria grandis	American Manna Grass	r		fruiting

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Table 1. Plant Cover in Plot 1 (wettest area of restored roadway) in First (2013) and Second (2014) Monitoring Years

Scientific Name	Common Name	2014 Cover/ Abundance	2013 Cover/ Abundance	Year 2 Notes
Leersia oryzoides	Rice Cut Grass	r		fruiting
Oenothera biennis	Common Evening-Primrose	r		flowering
Onoclea sensibilis	Sensitive Fern	r	r	
Osmundastrum cinnamomeum	Cinnamon Fern	r	r	
Phalaris arundinacea†	Reed Canary Grass	r		fruiting
Potentilla norvegica	Norwegian cinquefoil	r		flowering
Solidago gigantea	Smooth Goldenrod	r	o	flowering
Solidago rugosa	Common Wrinkle-Leaved	r	r	flowering
Symphyotrichum puniceum	Purple-Stemmed American-Aster	r	r	
Antennaria sp.	Pussy-toes		r	
Athyrium filix-femina	Northern Lady Fern		o	near plot
Bidens cernua	Nodding Beggar-Ticks		2%	
Boehmeria cylindrica	Small-Spiked False Nettle		r	
Brassicaceae†	Mustard		r	
Clematis virginiana	Virginia Virgin's-Bower		r	near plot

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Bold denotes species included in wetland seed mix; underline denotes species included in upland seed mix

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Table 1. Plant Cover in Plot 1 (wettest area of restored roadway) in First (2013) and Second (2014) Monitoring Years

Scientific Name	Common Name	2014 Cover/ Abundance	2013 Cover/ Abundance	Year 2 Notes
Echinochloa crus-galli†	Common Barnyard Grass		u	
Eleocharis sp.	Spike-rush		r	
Fragaria virginiana	Common Strawberry		r	
Geum laciniatum (year 2 i.d. to	Rough Avens		single plant	near plot, fruiting
Juncus cf. *brevicaudatus*	Short-tailed Rush		r	
Persicaria arifolia	Halberd-Leaved Smartweed		r	
Rubus allegheniensis	Common Blackberry		r	near plot
Rubus idaeus	Red Raspberry		r	
Rumex crispus†	Curly Dock		r	near plot, fruiting
Taxa Richness		38	35	

Abundance ranking used if cover <1%

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† Non-native

Table 2. Plant Cover in Plot 2 (dry area of restored roadway) in First (2013) and Second (2014) Monitoring Years

Scientific Name	Common Name	2014 Cover/	2013 Cover/	Year 2 Notes
Festuca rubra	Red Fescue	60%	60%	dense beneath other vegetation
Solidago gigantea	Smooth Goldenrod	40%	20%	flowering
Elymus riparius	Eastern Riverbank Wild-	25%		fruiting
Arctium lappa†	Great Burdock	10%	1%	
Sambucus nigra	Black Elderberry	5%	1%	flowering
Athyrium filix-femina	Northern Lady Fern	2%	1%	
Prunus virginiana	Choke Cherry	2%	1%	
Clematis virginiana	Virginia Virgin's-Bower	c	1%	flowering
Boehmeria cylindrica	Small-Spiked False Nettle	o	r	fruiting
Impatiens capensis	Spotted Touch-Me-Not	o	1%	flowering
Lysimachia nummularia†	Creeping Yellow-	o	10%	
Scutellaria lateriflora	Mad Dog Skullcap	o		flowering
Thalictrum pubescens	Tall Meadow-Rue	o	r	
Agrimonia gryposepala	Common Agrimony	u	o	fruiting
Equisetum hyemale	Tall Scouring-Rush	u	o	
Leersia oryzoides	Rice Cut Grass	u	15%	flowering

Abundance ranking used if cover <1%

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Bold denotes species included in wetland seed mix; underline denotes species included in upland seed mix

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† Non-native

Table 2. Plant Cover in Plot 2 (dry area of restored roadway) in First (2013) and Second (2014) Monitoring Years

Scientific Name	Common Name	2014 Cover/	2013 Cover/	Year 2 Notes
Oxalis stricta	Common Yellow Wood	u	c	flowering
Phalaris arundinacea†	Reed Canary Grass	u	1%	fruiting
Solidago rugosa	Common Wrinkle-Leaved	u		flowering
Verbena hastata	Blue Vervain	u		flowering
Arisaema triphyllum	Jack-In-The-Pulpit	r		
Bromus ciliatus	Fringed Brome	r		flowering
Chelone glabra	White Turtlehead	r		
Dichanthelium clandestinum	Deer-Tongue Rosette-	r		fruiting
Dryopteris cristata	Crested Wood Fern	r		
Epilobium ciliatum	Fringed Willow-Herb	r	r	flowering
Eupatorium perfoliatum	Boneset Thoroughwort	r		flowering
Eurybia divaricata	White Wood-Aster	r		flowering
Galium palustre	Marsh Bedstraw	r	r	fruiting
Geum laciniatum	Rough Avens	r	single plant	fruiting
Leersia virginica	White Cut Grass	r		fruiting
Matteuccia struthiopteris	Ostrich Fern	r	r	
Muhlenbergia cf. *frondosa*	Wire-Stemmed Muhly	r		

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Table 2. Plant Cover in Plot 2 (dry area of restored roadway) in First (2013) and Second (2014) Monitoring Years

Scientific Name	Common Name	2014 Cover/	2013 Cover/	Year 2 Notes
Onoclea sensibilis	Sensitive Fern	r	u	
Pastinaca sativa†	Wild Parsnip	r	r	hand-pulled from plot
Rhus typhina	Staghorn Sumac	r		
Rubus hispidus	Bristly Blackberry	r		
Solanum dulcamara†	Climbing Nightshade	r	u	flowering
Symphyotrichum lateriflorum	Calico American-Aster	r	r	flowering
Symphyotrichum puniceum	Purple-Stemmed	r		
Agrostis gigantea	Redtop Bentgrass		o	
Amphicarpaea bracteata	American Hog-Peanut		r	near plot
Asclepias incarnata	Swamp Milkweed			near plot, flowering
Bidens cernua	Nodding Beggar-Ticks		1%	
Calamagrostis canadensis	Canada Reed Grass		5%	
Carex cf. *lacustris*	Lakeside Sedge		r	
Galeopsis tetrahit†	Brittle-Stemmed Hemp-		20%	
Dryopteris carthusiana	Spinulose Wood Fern		c	
Eutrochium maculatum	Spotted Joe-Pye Weed		r	
Galium asprellum	Rough Bedstraw		r	near plot, fruiting

Abundance ranking used if cover <1%

c=common, >10 plants, usually scattered widely through plot

o=occasional, 6-10 plants

u=uncommon, 3-5 plants

r=rare, 1-2 plants

Bold denotes species included in wetland seed mix; underline denotes species included in upland seed mix

‡ Assumed to be *J. effusus* in Year 1; determined to be *J. pylaei* in Year 2; advertised as *J. effusus* in seed mix; both are native species

† Non-native

Table 2. Plant Cover in Plot 2 (dry area of restored roadway) in First (2013) and Second (2014) Monitoring Years

Scientific Name	Common Name	2014 Cover/	2013 Cover/	Year 2 Notes
Hordeum jubatum	Foxtail Barley		1%	
Juglans cinerea	Butternut			near plot
Oenothera biennis	Common Evening-			near plot, flowering
Persicaria hydropiper	Water-Pepper Smartweed		r	
Persicaria maculosa†	Lady's-Thumb Smartweed		r	
Plantago cf. *major*†	Common Plantain		c	
Rumex crispus†	Curly Dock		r	near plot, fruiting
Setaria sp. †	Foxtail Grass		2%	
Solanum nigrum†	European Black		r	
Symphyotrichum cordifolium	Heart-Leaved American-		r	
Taxa Richness		**40**	**41**	

Abundance ranking used if cover <1%

c=common, >10 plants, usually scattered widely through plot

o=occasional, 6-10 plants

u=uncommon, 3-5 plants

r=rare, 1-2 plants

Bold denotes species included in wetland seed mix; underline denotes species included in upland seed mix

‡ Assumed to be *J. effusus* in Year 1; determined to be *J. pylaei* in Year 2; advertised as *J. effusus* in seed mix; both are native species

† Non-native

Table 3.

Plants in Restored Roadway Outside of Sample Plots, Year 2

Scientific Name	Common Name	Non-Native
Asclepias incarnata	Swamp Milkweed	
Fraxinus americana	White Ash	
Fraxinus nigra	Black Ash	
Juglans cinerea	Butternut	
Lycopus uniflora	Northern Water-Horehound	
Rubus allegheniensis	Common Blackberry	
Rumex crispus	Curly Dock	*
Sium suave	Water-Parsnip	
Tussilago farfara	Coltsfoot	*

Invasive Species Observations

Year 2 monitoring once again revealed that the invasive exotic shrubs common in the adjacent upland, glossy buckthorn (*Rhamnus frangula*) and Eurasian honeysuckles (*Lonicera tatarica*, and/or *L. morrowii*), had not seeded into the restoration area. We did however find a few of these shrubs adjacent to the restoration (Figure 3) and these were treated by a licensed pesticide applicator in early October 2014 using a glyphosate-based herbicide.

Non-native species observed in the restored area but not considered "noxious weeds" by either Vermont or New Hampshire included creeping yellow-loosestrife (*Lysimachia nummularia*), reed canary grass (*Phalaris arundinacea*) and wild parsnip (*Pastinaca sativa*). New to monitoring in Year 2 were the numerous wild parsnip in reproductive status (both flowering and with immature fruits). First-year rosettes of this field pest had been recorded in 2013 in the drier section of the restoration, and this pattern of distribution was seen in 2014 also. All dozen or so plants that we observed were hand-pulled, bagged in plastic, removed from the site, and disposed of in a landfill.

Reed canary grass was recorded as rare in the wetter plot and uncommon in the drier plot; the population in all parts of the restoration was fruiting. These findings

represent a spread of the non-native grass in the wetter zone and a decrease in its abundance in the drier zone. The decrease may be a result of the doubling of smooth goldenrod from 20% to 40% in the drier area. Control and continued monitoring of reed canary grass are recommended, for it is aggressive and creates a dense thatch which has been seen to dominate moist and wet open areas and inhibit development of a diverse assemblage of native species.[7] Of particular concern would be the preclusion of shrub and tree regeneration in the restoration area, a phenomenon noted in floodplain wetland restoration areas in the Champlain Valley. To aid establishment of a native community of trees, shrubs and herbs, it would be prudent to begin control of reed canary grass in 2015 rather than wait to see if it expands. Researchers and managers have had some success in control with the use of herbicides, mechanical cutting (prior to seed maturation) and burning.[8] We suggest mechanical control during the 2015 restoration monitoring; we recommend a low-cost strategy of cutting and bagging seed heads prior to fruit maturation and then cutting the stems down to ground level. A technical bulletin from the State of Washington Department of Ecology is the best concise summary of control information we have located and includes a number of important references; it is attached as Appendix 2.

The other "non-noxious" non-native herb common to wetlands, creeping yellow-loosestrife, decreased considerably, from 10% cover to <1% occasional, in the drier portion of the site and remained stable at <1% occasional in the wetter area. The very dense coverage of taller herbs (red fescue, smooth goldenrod, and eastern riverbank wild-rye) probably created unfavorable conditions for creeping yellow-loosestrife in the drier area.

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[7] Lapin, M., K. Doyle, J. Graves, and M. Droege. 2004. Clayplain and floodplain forest restoration plan, Hubbardton River and Lower Poultney River Watershed, Vermont and New York. Prepared for The Nature Conservancy, Southern Lake Champlain Valley Program, West Haven, Vermont, and Ruesink, A. 2005. Quesnel and Laroque field restoration plan, with updates by Emily Seifert, spring 2009. Prepared for The Nature Conservancy, Montpelier, VT.

[8] State of Washington Department of Ecology. Non-native invasive freshwater plants: Reed canarygrass (*Phalaris arundinacea*) – Technical Information. http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua011.html. Accessed November 24, 2014.

Invasive Species Recommended Control

After monitoring was completed we recommended chemical control of glossy buckthorn and Eurasian honeysuckles that were in the wetland adjacent to the restoration area and Japanese knotweed that was present along the stabilized slope and the wetland buffer of the former access road (Figure 3). Chemical treatment of glossy buckthorn and Eurasian honeysuckles was completed by Vegetation Control Services on October 2, 2014. The Japanese knotweed plants we observed on the stabilized slope and in the wetland buffer of the former access road on August 19, 2014 were not conspicuous on October 2, 2014, and therefore, could not be treated with the herbicide. Chemical treatment of Japanese knotweed is recommended for spring or summer 2014. Although Japanese knotweed was not observed within the restored wetland, control of the knotweed in outlying areas is vital for preventing the spread into the wetland. Control of wild parsnip in the restored wetland was conducted by hand-pulling by Mary Nealon on August 19, 2014.

In the Invasive Species Management, Planting and Monitoring Plan dated December 13, 2012, we recommended five years of monitoring. Initial findings are favorable, but it is still prudent to conduct an additional three years of monitoring to determine if continued invasive species control is recommended in order to achieve the vegetative success goal of 80% cover by native non-invasive species. We expect that within the next three years the invasive shrubs and wild parsnip will be relatively easy to control. If reed canary grass is seen to expand and overtake native vegetation, adaptive management should be practiced and alternatives for controlling it should be evaluated and discussed.

Uncommon Species

Two uncommon species, rough avens (*Geum laciniatum*) and Wiegand's wild-rye (*Elymus wiegandii*), were known from the roadway site prior to construction. Seeds of both species were collected in October 2012, stored in cool, dry conditions, and dispersed within the restoration area on June 23, 2013.

Year 2 monitoring verified establishment and fruiting of rough avens in the restoration area (Figure 3). The first-year rosettes observed in 2013 had attained reproductive status in their second year of growth and positive identification was possible. One individual was growing within the drier plot and another individual was in the area closely adjacent to the wetter plot. Throughout the restoration area we observed approximately eight fruiting rough avens; the majority of the population was in the area between our two sample plots. Close to the river, where the bulk of the original population had been located, does not appear to be suitable habitat, as it has been engineered with fill as a lower-slope area to help support the reconstructed slope and cannot be considered part of the wetland restoration. Nonetheless, judging from Year 2 observations of the population size, vigor and reproductive status of rough avens in the restoration area, the collection, storage and dispersal of the seeds of this uncommon species have apparently been successful since these conservation actions seem to have aided in the re-establishment of a population that would otherwise have been nearly or fully decimated in this part of the floodplain forest.

The other uncommon species whose seeds were collected, stored and dispersed does not appear to have re-established within the project area. No Wiegand's wild-rye was observed in the wetland restoration in the two years of monitoring. This uncommon grass frequently occupies only a very narrow band (about 5 meters) close to the river, and that definitely is the pattern of distribution of Wiegand's wild-rye at this Maidstone Bends floodplain forest site. Since the restoration area does not actually extend fully to the river due to the engineering of the slope for stability, the preferred habitat has not been restored. Fortunately, the population atop the riverbank in the floodplain forest adjacent to the project area was not disturbed and remains sizable and vigorous. No accurate count was made of the entire local Wiegand's wild-rye population, but from casual observation in 2014 we estimate that there are 100-200 culms extending from the re-engineered terminus of the access road upstream to where optimal habitat ends at a gravel bar. The population is denser close to the project area (within 100 meters) where it still occupies suitable habitat that has not been filled for slope stabilization. Plants within roughly 25 meters of the project area may have established from the hand-

dispersed seed, but it is not possible to know. None of the Wiegand's wild-rye seed dispersed farther from the river in the restoration area appears to have resulted in establishment of plants.

Soils in the Restored Access Road Site

Restoration of soils based on observation of the total land surface and description from four, small, hand-dug soil pits (one pit each year adjacent to each plot) (Figure 3) showed that the site has been restored to hydric soils. Soil disturbance from the construction and removal of the temporary access road has altered the soils to minor extents where removal of the roadway overburden was incomplete (close to the slope that permitted truck access from Route 102) and where reshaping of the land created scattered mounds that did not exist prior to construction (drier/southern portion of the restoration). The engineered lower slope that extends southward into what was formerly floodplain forest is no longer hydric soil. The wetter portion of the restoration area features a soil with muck over fine sand to fine sandy loam; it is not in a zone of regular alluvial deposition and therefore a muck O horizon is able to develop. The drier portion of the restoration is characterized by a very fine sandy loam alluvial soil; the absence of a well-decomposed O horizon suggests recurring deposition of alluvium.

So that we could observe soils not disturbed by the digging of soil pits the previous year, the 2014 soil pits were dug on the west side of each plot's northwest corner. (In 2013 pits were dug on the north side of the northwest corners.)

Plot 1 is the wetter plot, and the soil pit dug in Year 1 monitoring showed remnants of overburden from construction of the access road. The Year 2 pit did not display any overburden or roadbed stone and instead showed a very natural wetland soil profile. We did not dig around in other areas because we did not want to cause undue disturbance to vegetation in the restoration area, but our observations of the surface soil in various locations of the wetter portion of the site indicate that the Year 2

pit is more characteristic of the wet portion of the restored wetland. The pit described in the first year of monitoring seems to describe a small area at and near the base of the slope that descends from Route 102. The more natural and apparently more widespread soil showed a 6-7 cm well decomposed muck over a 10-cm mucky fine sand A horizon (Table 5). The underlying B horizon had a fine sand texture with common, prominent, rust-colored mottles. The water table at the mid-August time of sampling was at 7-8 cm beneath the soil surface, just below the muck layer, and continued slumping of the wet sand precluded digging beneath roughly 30 cm.

The soil pit beside Plot 2 once again revealed an intact alluvial soil profile (Table 6). As with the 2013 soil description, the sampled pit was located in a spot that appeared to characterize the majority of the dry area, rather than the small mounded microsites that may not have been representative of the natural condition.

Table 4. Plot 1 Soil Description, 2014 pit

Depth (cm)	Horizon	Description
0 - 7	O	black (10YR 2/1) muck with a small percentage of fine sand; abundant very fine roots
7-17	A	very dark grayish brown (2.5Y 3/2) mucky fine sand; common to uncommon very fine roots
17-?	B	grayish brown (2.5Y 5/2) to light gray (2.5Y 7/2) fine sand; common, prominent mottles, dark yellowish brown (10YR 4/6) to yellowish brown (10YR 5/6)
?	C	not reached due to high water table

Table 5. Plot 2 Soil Description, 2014 pit

Depth (cm)	Horizon	Description
0-6	A	dark grayish brown very fine sandy loam; granular; abundant very fine roots, common medium roots, uncommon coarse roots
6-28	B_1	dark olive brown (2.5Y 3/3) very fine sandy loam; subangular blocky; few very fine and fine roots; common medium and coarse roots
28-100+	B_2	olive brown (2.5Y 4/3) very fine sandy loam; occasional fine and very fine roots, uncommon medium roots

Site Stability

Our second year of monitoring supports our initial finding that wetland site stability has been well restored. Pre-construction, the site was fully forested and had no bare soil. At the end of Year 1 the site had at least 85% vegetation cover; 15% or less of the site was covered by either open water or straw mulch. Late in the growing season of Year 2 the site had over 90% vegetation cover; less than 5% of the site featured open water. No erosion was noted in either 1) the restored area, 2) the adjacent portion of floodplain forest that was disturbed by tree and shrub removal but was not part of the temporary access road, or 3) the engineered slope section that was a combination of wetland buffer and some floodplain forest (identified as "Area 4 – Riprap in Wetland Buffer" in the Planting Plan). The second and third areas are the parts of the disturbed wetland that experience the highest energy from floodwaters. The area where the only construction disturbance was tree and shrub removal featured re-sprouting trees and shrubs and dense herbaceous floodplain vegetation. The wetland buffer riprapped area continued to be well stabilized by the coir matting, herbaceous vegetation that established post-construction from the native seed mix, the shrub

plantings, and volunteer "weeds" (including brittle-stemmed hemp-nettle, common agrimony and curly dock). Survivorship of the planted red-osier dogwood and native shrub willow live stakes was very high. In general, the willow appeared more vigorous than the dogwood. There were very few individuals that appear to have outright died, rather, those that were less vigorous had shorter and fewer live branches or had one to several short low sprouts beneath a desiccated upper portion. Survivorship should be re-evaluated in 2015, which would be the second full growing season for the planted shrubs.

Wetland Functions

After Year 1 monitoring we saw no indications that the project had removed the wetland's ability to perform its previously documented functions. Year 2 monitoring does not change that assessment. Thus, after two growing seasons we found that diminishment of the functional capacity for water storage, surface and ground water protection, and erosion control were minor and continued to be related to 1) the structural changes to vegetation, and 2) the limited areas of soil compaction and mounding in the project area. Additionally, diminishment of wildlife habitat functionality was also minor and was related to changes in vegetation composition and structure; since very few seedlings of trees were found in the restored area, we expect recovery to forest habitat to be relatively slow. The increase in cover of the shrub black elderberry and the sprouting of white and black ash stumps in the restoration area bode well for recovery within a decade to some woody vegetation, if not closed-canopy forest. Edge effects along the restored roadway continue to be of concern, especially in relation to the potential increase in density of invasive shrubs glossy buckthorn and Eurasian honeysuckles, if control measures are not continued when necessary.

Our observations still support our Year 1 statement that if the restoration proceeds as expected and tree and shrub cover are re-established, full habitat functionality should be restored, except perhaps for sensitive soil biota/microbiota that do not find the somewhat altered soil to be suitable habitat. However, the return of tree

cover may be slower than would ideally occur and may take decades. Only time will tell. Plant cover has increased over the two years of monitoring, and the very strongly native species-dominated herbaceous plant assemblages in both the drier and wetter parts of the restoration are not structurally inconsistent with herbaceous wetland communities that are naturally part of the large wetland complex within which the project site occurs. Thus, all previously documented wetland functions continue to operate at levels similar to those observed prior to construction, although due to slight changes in microtopography, soil compaction, and shape of the land there have been slight alterations to water storage and surface and ground water protection. Due to changes in vegetation composition and structure, there have been somewhat larger alterations to the restoration area's wildlife habitat functionality. Because the restored wetland is both a small portion of a large wetland complex and is on its upland margin, these alterations have not substantially changed the functionality of the wetland complex.

APPENDIX 1.

Photographic Documentation

Figure 4. Vegetation of Plot 1 in second year of restoration. The prominent plants are common arrowhead, Pylae's soft rush and common fox sedge. Also apparent are broad-leaved cat-tail and a single plant of spotted joe-pye weed.

Figure 5. Vegetation of Plot 1 in second year of restoration. Pylae's soft rush, common woolsedge, common wrinkle-leaved goldenrod and one leaf of cinnamon fern are seen. Slope rise to Route 102 is in background.

Figure 6. Vegetation of Plot 2 second year of restoration. Eastern riverbank wild-rye and smooth goldenrod are dominants along with the shorter red fescue (not showing in the photo). Tall meadow-rue seen in lower left. Intact floodplain forest to the east is in background.

Figure 7. Vegetation of Plot 2 second year of restoration. Black elderberry, red fescue tall meadow-rue, eastern riverbank wild-rye and common yellow wood sorrel are apparent.

Figure 8. Rough avens north of plot 2. Year 2 monitoring verified establishment and fruiting of rough avens in the restoration area.

Figure 9. Soil of Plot 1 showing (from left to right) muck O horizon held together with abundant very fine roots, mucky fine sand A horizon and mottled grayish brown to gray fine sand subsoil. High water table is evident.

Figure 10. Invasive glossy buckthorn adjacent to former access road.

Figure 11. Japanese knotweed observed on August 19, 2014 in wetland buffer on former access road.

Figure 12. Japanese knotweed on stabilized slope. One of approximately 20 knotweed plants less than 1 meter high. Plants were observed on August 19, 2014, but were not conspicuous in early October 2014.

Figure 13. Willow Whip in wetland buffer. Survivorship of the planted red-osier dogwood and native shrub willow live stakes was very high.

APPENDIX 2.

Reed Canary Grass Technical Information Sheet, State of Washington Department of Ecology

Non-native Invasive Freshwater Plants

Reed Canarygrass (*Phalaris arundinacea*)

Technical Information

Description

A highly variable species, reed canarygrass (*Phalaris arundinacea*L.) is a rhizomatous perennial grass that can reach three to six feet in height. The sturdy, often hollow stems can be up to 1/2 inch in diameter, with some reddish coloration near the top. The leaf blades are flat and hairless, 1/4 to 3/4 of an inch wide. The flowers are borne in panicles on culms high above the leaves. The panicles are generally three to six inches in length. The species flowers in June and July (Weinmann et al. 1984; Hitchcock et al. 1969).

Economic Importance

Detrimental - Reed canarygrass forms dense, highly productive single species stands that pose a major threat to many wetland ecosystems. The species grows so vigorously that it is able to inhibit and eliminate competing species (Apfelbaum and Sams 1987). In addition, areas that have existed as reed canarygrass monocultures for extended periods may have seed banks that are devoid of native species (Apfelbaum and Sams 1987). Unlike native wetland vegetation, dense stands of reed canarygrass have little value for wildlife. Few species eat the grass, and the stems grow too densely to provide adequate cover for small mammals and waterfowl (Maia 1994). The species is considered a serious weed along irrigation banks and ditches because infestations can increase siltation (Marten and Heath 1973). When in flower, the species produces abundant pollen and chaff, which aggravate hay fever and allergies (Weinmann et al. 1984). Although reed canarygrass is planted as a forage crop in some areas, the species poses a significant threat to the state's wetlands. Reed canarygrass is extremely aggressive and often forms persistent, monocultures in wetlands and riparian areas. Infestations threaten the diversity of these areas, since the plant chokes out native plants and grows too densely to provide adequate cover for small mammals and waterfowl. The grass can also lead to increased siltation along drainage ditches and streams. Once established, reed canarygrass is difficult to control because it spreads rapidly by rhizomes.

Beneficial - Frequently cultivated as a forage species, reed canarygrass is an important component of lowland hay from Montana to Wisconsin (Hitchcock 1950). In some areas, the grass has been used for erosion control. The variegated-leaved variety picta L. is sometimes grown as an ornamental under the common name "ribbon grass" or "gardener's garters" (Hitchcock 1950; Hitchcock et al. 1969).

Geographic Distribution

Reed canarygrass is a circumboreal species (Larson 1993). While possibly native to North America, European cultivars have been widely introduced for use as hay and forage on the continent; there are no easy traits known for differentiating between the native plants and European cultivars (White et al. 1993). The species is rather common throughout most of southern Alaska and Canada, as well

as all but the southeastern portion of the U.S. (Hitchcock et al. 1969).

Habitat

A wetland plant, this species typically occurs in soils that are saturated or nearly saturated for most of the growing season, but where standing water does not persist for extended periods. However, established stands can tolerate extended periods of inundation. Ideal conditions typically occur in roadside ditches, rights-of-way, river dikes and levees, shallow marshes, and meadows (Weinmann et al. 1984).

Growth, Development, and Reproduction

Reed canarygrass is a perennial species. It spreads by seeds or by creeping rhizomes. The species will also produce roots and shoots from the nodes of freshly cut, well-jointed culms (Marten and Heath 1973). It flowers from June through August in Washington.

Response to Herbicides

Glyphosate, Amitrol, Dalapon, and Paraquat have all been tried with some success. Maximum control depends on the timing of application (Apfelbaum and Sams 1987). These herbicides provide control for up to two years at the most. After this period, reed canarygrass recolonizes a treated area from adjacent stands or from seed bank recruitment (White et al. 1993). However, only glyphosate (Rodeo®) is licensed for use in aquatic systems in Washington. Rodeo® application, followed in two to three weeks by prescribed burning has also been effective. The use of fire helps to ensure mortality by killing resprouts and germinants (Apfelbaum 1993).

Response to Cultural Methods

Studies in the Midwest indicate that prescribed burning is effective in areas with an existing component of native plants, either above ground or in the soil seed bank. To be effective, burns should be conducted in the late spring, early to mid-summer, or early to mid-fall. Early spring burning stimulates the production of shoots (Apfelbaum 1993).

Response to Mechanical Methods

Heavy equipment has been used unsuccessfully in reed canarygrass removal. Rapid regrowth occurs from rhizomes and seeds that remain in the soil even after mechanical removal . Clipping back plants at ground level and covering them with opaque black plastic tarps can reduce but not eliminate populations (Apfelbaum and Sams 1987). However, this method is not always effective because reed canarygrass shoots can grow up through most materials, and seasonal inundation may displace covering materials (Gillespie and Murn 1992). Mowing may be a valuable control method, since it removes seed heads before seed maturation and exposes the ground to light, which promotes the growth of native species. Studies in Wisconsin indicated that twice-yearly mowings (in early to mid-June and early October) led to increased numbers of native species in comparison to reed canarygrass-infested plots that were not mowed (Gillespie and Murn 1992).

See also Freshwater Emergent Integrated Pest Management Plan for management methods.

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