Project Work Plan
03-07/319 Connecticut River Watershed Restoration Phase III

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prepared by

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Introduction

State agencies and watershed groups have identified streambank erosion as a significant source of non-point pollution (sediment) to a 20-mile reach of the Connecticut River known as the Turners Falls Power Pool. The severe bank erosion impacts important freshwater and anadromous fisheries habitat and results in the loss of prime agricultural land, which impacts the livelihood of local farmers. Eroding river banks also mean the loss of riparian buffer habitat used by rare species of dragonflies, Bald Eagles, migratory birds and other wildlife.

The purpose of this project is to continue the successful bioengineering riverbank stabilization work and the vegetation and habitat monitoring begun as part of two previous s.319 projects undertaken in the Pool (Phase I: 96-03/319 and Phase II: 00-04/319). To date, bioengineering techniques have been used to stabilize a total of over 9,800 linear feet of riverbank in the Turners Falls Power Pool. These treatments are an environmentally sensitive alternative to conventional armoring (rip-rap) of the riverbank to halt erosion and the resulting sedimentation. Given the size of the Connecticut River and the magnitude of the erosion, the bank repairs in the Turners Falls Pool need to be strong enough to withstand mean annual flows of approximately 17,000 cfs as well as flood events, boat waves, pool fluctuations, and other natural and anthropogenic sources of stress on the banks. The long-term success of these treatments will stem the loss of prime agricultural lands, reduce sedimentation, improve water quality, provide enhanced wildlife habitat, and protect archaeological resources which may otherwise be lost to erosion. Success of these treatments will also mean that bioengineering bank stabilization techniques are a viable solution for reducing bank erosion in large riverine systems like the Connecticut and are preferable to traditional bank armoring techniques like rip-rap and gabions.

The vegetation monitoring protocols developed for the Phase III site (known as the Urgiel Downstream site) and for the four sites completed under previous phases of this project are based on those used to evaluate the success of bioengineering treatments at Hearthstone Quarry Brook in Chicopee, Massachusetts.[1] The habitat monitoring protocols to be used during this project are based on those developed by the Franklin Regional Council of Governments during s.319 project 96-03/319.

[1] The Bioengineering Group, Inc. and Valley Environmental Services, Inc., Quality Assurance Project Plan (QAPP) for the Demonstration of Urban Streambed Stabilization and Wetlands Function and Wildlife Habitat Improvement Using Soil Bioengineering Treatments at Hearthstone Quarry Brook, Chicopee, Massachusetts, s.319 Project 96-04, August 13, 1996.

Summary of Bioengineering Site Designs

Phase I Sites

Three sites were restored under Phase I: Wickey, Shearer and Crooker. Construction at the Crooker site was partially funded by money from s.319 grant 96-03/319. Although s.319 funding was used for the construction of only one site, the final project report evaluated the design and construction of all three sites. Vegetation and habitat monitoring were also performed at the Wickey and Shearer sites. The three bioengineering treatment types used on the Phase I sites included:

- **Hard Toe:** Sand or gravel fill was placed in the undercut/scour zone and then covered with rock rip-rap. Coir fascines were placed in vertical layers above the rock toe and cabled in place. The area above the coir fascines was protected by burlap or coir fabric and then planted with live stakes of woody species.

- **Breakwater**: This treatment was designed to be built at the mean water level and includes a rock toe and coir roll or fascine at the water's edge. A flat area was created behind the toe and a pre-vegetated mattress was staked in place. The specified plants were designed to create an emergent wetland community. A gradual slope leads to the top of the bank. The upper slope was protected with coir fabric or burlap and seeded or planted with live stakes.

- **Bank Reconstruction**: Sand or gravel was used to fill the undercut/scour zone. A rock toe was constructed and coir fascines were placed above the toe. Fabric-wrapped geogrid lifts were placed in layers above the coir fascines to construct the new bank. Dormant live brush was placed in-between the layers.

Phase II

The construction of one site, known as the Urgiel Upstream site, was partially funded by the Phase II grant (00-04/319). This grant also funded vegetation monitoring for the three Phase I sites and the Urgiel Upstream site. The bioengineering design for this site was significantly different from the design techniques used for the Phase I sites. The Urgiel Upstream design used four bank treatment types:

- **Top of Slope** – seed with native seed mix and plant Red Oak, Red Maple and Sycamore trees, 4"-5"dbh, and Gray Birch, Quaking Aspen, Pin Oak, White Ash and Cottonwood trees, 4 to 5 feet tall.
- **Upper Bank** – seed with native seed mix and plant 1 gallon pot-sized woody vegetation, including: Arrow-wood, Staghorn Sumac, Gray Dogwood, Shadblow, American Hazelnut, Black Chokecherry and Nannyberry.
- **Lower Bank** – seed with native seed mix and plant 1 gallon pot-sized woody vegetation, including: Speckled Alder and Silky Dogwood.
- **Stone Toe** – plant tubelings (rooted cuttings) of Pussy Willow, Purple-osier willow, and Sandbar willow.

The Urgiel design incorporated several new techniques that had not been previously used in the Power Pool, including:

- Planting willow tubelings in the stone toe to "soften" the appearance of the stone;
- Reducing the size of the rocks used in the stone toe to 4 to 6-inch diameter stone;
- Installing an erosion control blanket that would biodegrade more quickly; and
- Simplifying bank reconstruction and revegetation by grading the cleared bank to a 1.5:1 slope and using hand techniques and installation to plant native herbaceous and woody vegetation. Geogrid lifts, brush mattresses and brush fascines used on the Phase I sites were not used at Urgiel.

Phase III

The current grant will partially fund the construction of one site, known as the Urgiel Downstream site. The site is approximately 980 linear feet in length and the total area to be stabilized and planted is 32,000 square feet. The bioengineering design for this site is similar to the one used at the Phase II site (Urgiel Upstream). The design has four bank treatment types, like Urgiel Upstream, with the only difference being the type of trees to be planted on the top of slope and a slightly different treatment of the stone toe, with the willows being planted on the river side of the stone toe. Appendix A includes two maps for the site: *Existing Conditions* and *Bioengineering Treatment – Details and Cross-Sections*, which were prepared by New England Environmental, Inc.

- **Top of Slope** – seed with native seed mix and plant Gray Birch, Quaking Aspen, Pin Oak, and White Ash trees which are 4 to 5 feet tall, spaced 15 feet on center.
- **Upper Bank** – seed with native seed mix and plant 1 gallon pot-sized woody vegetation, including: Arrow-wood, Staghorn Sumac, Gray Dogwood, Shadblow, American Hazelnut, Black Chokecherry and Nannyberry.
- **Lower Bank** – seed with native seed mix and plant 1 gallon pot-sized woody vegetation, including: Speckled Alder and Silky Dogwood.
- **Stone Toe** – plant tubelings (rooted cuttings) of Pussy Willow, Purple-osier willow, and Sandbar willow in front of rip-rap.

Pre-Construction Vegetation Monitoring Methodology for the Urgiel Downstream Site

The purpose of the pre-construction monitoring program for the Urgiel Downstream site is to document the current site conditions so that comparisons can be made between pre- and post- construction site vegetation. The sampling methodology will document existing vegetation in four distinct areas across the site (top of bank, upper slope, lower slope, and bank/water interface, where the stone toe will be installed). These four areas

correspond to the four bank treatment types to be installed at the site. Since the bank will be extensively regraded and revegetated, the establishment of permanent sampling locations does not make sense.

The existing bank face is highly eroded and unstable, making it potentially hazardous for field personnel to work on many sections of the bank. Existing site conditions will be recorded via photodocumentation and visual observations/estimates. These techniques are simple and can be performed from a boat or by walking at the top of the bank or along the bank/water interface, if there are portions of the site that can be accessed safely. Photographs will be taken of the site as a whole (from a boat) and, if the site can be walked, photographic stations will be established using the existing survey stakes at the top of the bank. Photographs will be taken looking upstream, downstream, towards the top of bank, and towards the bank/water interface. Vegetation will be visually assessed. The existing survey stakes at the site, which are located at 100-foot intervals, may be used to establish visual "transects" and "blocks" of vegetation across the four areas of the site (top of slope; upper slope; lower slope; and toe). The survey stakes are located on the map of existing conditions so the locations of the "transects" and "blocks" could be approximated on the map. Notes will be made regarding the overall type and vigor of existing vegetation, including percent cover and the presence of invasive, non-native species.

Table 1.1
Pre-Construction Vegetation Monitoring Methodology
for the Urgiel Downstream Site

Tasks	Method	Frequency	Data	Comments
Establish vegetation monitoring locations for Urgiel site.	If the site can be accessed safely, staff will walk the top of bank, along the bank/water interface, and portions of the bank to assess vegetation at the site. If site access is a problem, the assessment will be conducted from a boat.	Late summer/early fall 2005		Existing survey stakes may be used to establish "transects" and "blocks" of vegetation to be assessed. These "blocks" of the site can be located on the survey map of Existing Site Conditions prepared by New England Environmental, Inc. and compared to the topography and bank profiles shown on the map.
Conduct monitoring of woody and herbaceous species at the Urgiel site.	Vegetation will be visually assessed. Estimates of the overall type and vigor of existing vegetation, including percent cover and the presence of invasive, non-native species.	Late summer/early fall 2005	A written description of existing site conditions based on visual estimates and observations.	Height and vigor of woody species will be evaluated.
Conduct analysis of vegetation monitoring data for Urgiel site	Describe existing, pre-construction site conditions.	Late fall/winter 2005 - 2006	Written description of existing vegetation, including type and areal distribution.	Written descriptions will be tied to site pictures. Existing vegetation will be compared to the list of **Native Riparian Species** prepared by Russ Cohen of the MA Riverways Program (www.mass.gov/dfwele/river/rivnativesp.htm). The species on this list have value as food for wildlife (see Appendix C).

Table 1.1
Pre-Construction Vegetation Monitoring Methodology
for the Urgiel Downstream Site

Tasks	Method	Frequency	Data	Comments
Establish photomonitoring stations at Urgiel site	The photomonitoring stations will be established using the 100 foot survey stakes located at the top of the bank.	Late summer/early fall 2005		
Conduct photo-monitoring	Take photos at stations described above, looking upstream, downstream, and vertically up and down the bank. If photos are to be taken from a boat, photograph the bank (bank/water interface to top of bank), upstream, and downstream from each reference point.	Late summer/early fall 2005	Photographs of existing site conditions, including "local" shots at specific locations on the site and areal shots of the entire site.	Qualitative documentation of pre-construction site conditions.

Post-Construction Vegetation Monitoring Protocols

The long-term goals for the bioengineering projects, including the Urgiel Downstream site, are as follows:

- Reduce erosion in the Turners Falls Power Pool and thereby reduce a source of non-point pollution (sediment) to the Connecticut River;
- Stabilize eroded riverbank;
- Enhance habitat value by reintroducing native plant communities;
- Protect private property and prime agricultural land that abuts the River; and
- Identify successful bioengineering techniques.

The short-term goals of the Urgiel Downstream project include:

- Minimize further disturbance of the site during construction;
- Control sediment loss to the river during construction;
- Maximize construction efficiency by using native and natural materials, and hand techniques and installation, where appropriate;
- Preserve and enhance wildlife habitat; and
- Continue to incorporate "soft" elements into the site design (planting willow tubelings in and around the stone toe and using small rocks in the stone toe).

With these goals in mind, a set of objectives, which define the ideal site outcome, and a set of success criteria, which establish tolerance limits for deviations from the ideal site outcome, were developed and are presented in Table 1.2. To be considered a success, the execution and completion of a project must attain the stated goals and/or the project must fall within the accepted range established by the success criteria.

Table 1.2
Monitoring Goals, Objectives and Success Criteria

Project Goals	Objectives	Indicators	Monitoring Methods	Success Criteria
Reduce erosion as a source of non-point source pollution to the Connecticut River	Reduce erosion from project site	Absence of bare soil and establishment of native bank vegetation	Vegetation sampling	60-80% first year vegetation survival; 80-90% second year vegetation survival; and at least 75% vegetative cover across site except the stone toe
Stabilize eroded riverbank and identify successful bio-engineering techniques	Stabilize eroded riverbank at project sites	Native bank vegetation	Vegetation sampling	60-80% first year vegetation survival; 80-90% second year vegetation survival; and at least 75% vegetative cover across site except the stone toe
Enhance habitat value by reintroducing native plant communities	Plant native woody and herbaceous species at project sites	Native bank vegetation	Vegetation and wildlife habitat sampling	60-80% first year vegetation survival of planted native species
Protect private property, including prime agricultural land	Stabilize eroded riverbank at project sites	Native bank vegetation	Vegetation sampling	60-80% first year vegetation survival; 80-90% second year vegetation survival; at least 75% vegetative cover across site except the stone toe

Post-Construction Vegetation Sampling Methodology – Urgiel Downstream Site

The vegetation sampling methodology developed to evaluate the success of the bioengineering treatments to be installed at the Urgiel Downstream site includes visual estimates of percent survival and percent cover, and stem counts of woody and herbaceous vegetation. The site will be monitored on a quarterly basis following construction and twice (late Spring/early Summer and late Summer/early Fall) per year thereafter. Vigorous growth of the planted vegetation will meet the goals described in Table 1.2. No destructive or invasive sampling techniques will be used. The purpose of the vegetation sampling is to gather information regarding:

- The areal extent and health of planted materials;
- Differences in vegetation performance under different conditions; and
- Difference in species performance.

Survey stakes located at 100 foot intervals along the length of the site will be used to establish the locations of randomly selected sampling transects that run from the stone toe/water interface to the top of the bank where the survey stakes are located. Ten (10) permanent sampling plots will be established along the transects to monitor both woody and herbaceous species. Each plot represents a site condition with homogeneous light conditions (aspect and canopy cover), a distinct position on the bank, and a uniform treatment. Four distinct bank positions are represented by the ten sampling plots, including: two (2) on the top of the bank, three (3) on the upper slope, three (3) on the lower slope, and two (2) on the stone toe. The locations of the sampling plots along the transects will be chosen using a random number system. The total area of the vegetation monitoring plots is approximately 1% of the total area of the site to be restored using bioengineering techniques. Each plot is four (4) square meters in size for a total sampling area of 40 square meters or approximately 430 square feet. The locations of the sampling plots will be permanently established with 3-foot lengths of rebar driven in at each corner of the plot. In the future, if the rebar can't be located by visual inspection, a metal detector can be used to locate the sampling plots.

The numbers of live stems of each species in a plot will be counted and the percent cover for each species will be established by visual assessment. The number of dead stems, if any, will also be counted to determine the percent survival of each planted species. Estimates of percent canopy cover and ground cover species will also be recorded. A data sheet will be prepared for each plot which lists each woody and herbaceous species present in the plot, and the stem count and percent cover for each species. Other notes will be added, as appropriate, including percent total cover and comments regarding height and health of woody species and the presence of invasive species (see Appendix B for an example of a data sheet).

Vegetation Sampling Methodology – Phase II and Phase I Sites

Phase II Site – Urgiel Upstream

The sampling methodology to be used for the Urgiel Upstream site is the same one described for the Urgiel Downstream site except that twelve (12) permanent sampling plots have already been established for this site. These plots will be assessed twice per year, once in the late Summer/early Fall and once in the late Spring/early Summer. Photographs will be taken to document existing site conditions. Photographic stations will be tied to the transects and grids. The downstream, lower corner of each grid will serve as the photographic station. Photographs will be taken looking upstream, downstream, towards the top of bank, and towards the bank/water interface. Photographs will also be taken from the vantage point of a boat in order to capture the whole bank.

The Urgiel Downstream site was previously monitored during October/November 2002 and June 2003 as part of s.319 project 00-04/319. Vegetation monitoring data and analyses are presented in the final report for that project prepared by the Franklin Regional Council of Governments. This current sampling program will build upon and integrate the previous sampling efforts.

Phase I Sites – Wickey, Crooker and Shearer

The sampling methodology to be used for the Phase I sites is one developed by the Franklin Regional Council of Governments during the Phase II s.319 project 00-04/319. These sites were monitored once, during September/October 2002. In 2002, two (2) transects were sampled at each of the Crooker and Shearer sites. No transects were sampled at the Wickey site due to site access problems. Instead, the Wickey site was visually assessed from a boat. Monitoring data for the Wickey and Shearer sites was also collected by the Franklin Regional Council of Governments in 1997 and 1998 as part of s.319 project 96-03/319. A different sampling methodology was used for that effort, one that was more appropriate for recently planted sites. This current sampling program will build upon and integrate the previous sampling efforts.

The purpose of the current round of site monitoring is to assess the overall health and vigor of the established vegetation at the sites and provide some information on the presence of native and invasive species. The vegetation at the Phase I sites has now been established for at least six years.

The methodology for the Phase I sites includes: photodocumentation and sampling along site transects. Photographs will be taken to document existing site conditions. Photographic stations will be tied to the transects. The lower end of each transect (at the bank/water interface) will serve as the photographic station. Photographs will be taken looking upstream, downstream, and towards the top of bank. Photographs will also be taken from the vantage point of a boat in order to capture the whole bank.

Two (2) transects will be sampled at each site. The Phase I sites will be monitored twice per year, once in the late Summer/early Fall and once in the late Spring/early Summer. Different transects will be established for each year of monitoring (2005-2006 and 2006-2007

Transects will be sampled at each Phase I site and stem counts of woody and herbaceous vegetation along transect lines will be recorded and then used to evaluate the success of the bioengineering treatments installed at the Phase I sites. If site access is a problem, as it was with the Wickey site in 2002, visual estimates of the type and health of vegetation will recorded from a boat. These estimates will then be used to assess the existing vegetation. Vigorous growth of the planted vegetation will meet the goals described in Table 1.2. No destructive or invasive sampling techniques will be used. A data sheet will be prepared for each transect which lists the woody and herbaceous species present along the transect, stem counts and other notes, as appropriate, including comments regarding height and health of woody species and the presence of invasive species. See Appendix D for an example of a Phase I data sheet.

Table 1.3
Vegetation Monitoring Methodology

Tasks	Method	Frequency	Data	Comments
Establish monitoring plots for Urgiel Downstream site	Ten (10) $4m^2$ plots randomly located on top of bank, upper slope, lower slope & stone toe.	Spring 2006	Permanent location at site, location on map	The location of transects and plots will be randomly chosen.
Establish photomonitoring stations at Urgiel Downstream site	Locate photo reference point at downstream, lower corner of each plot.	Spring 2006	Permanent location at site, location on map	
Locate existing monitoring plots for Urgiel Upstream site	Twelve (12) existing $4m^2$ plots located on top of bank, upper slope, lower slope & stone toe.	Fall 2005 Spring 2006 Fall 2006 Spring 2007	Permanent location at site, location on map	
Locate existing photomonitoring stations at Urgiel Upstream site	Locate photo reference point at the downstream, lower corner of each plot.	Fall 2005 Spring 2006 Fall 2006 Spring 2007	Permanent location at site, location on map	
Establish monitoring transects for Phase I sites	Two vertical transects per site that run from top of stone toe to top of bank	Fall 2005 Spring 2006 Fall 2006 Spring 2007		The location of transects will be randomly chosen at the start of each sampling round.
Locate photomonitoring stations at Phase I sites	Locate photo reference points at the lower end (bank/water interface) of each transect.	Fall 2005 Spring 2006 Fall 2006 Spring 2007		
Conduct monitoring of woody and herbaceous species at the Urgiel	Stem counts by species, percent cover (total and by species)	1st Year post-construction (quarterly) 2nd Year (Fall 2006;	Data sheets for each plot, percent cover percent survival (totals by species and bank treatment	Height and vigor of woody species and presence of invasive species will be evaluated.

Table 1.3
Vegetation Monitoring Methodology

Tasks	Method	Frequency	Data	Comments
Downstream site.		Spring 2007)	type)	
Conduct monitoring of woody and herbaceous species at the Urgiel Upstream site.	Stem counts by species, percent cover (total and by species)	Fall 2005 Spring 2006 Fall 2006 Spring 2007	Data sheets for each plot, percent cover percent survival (totals by species and bank treatment type)	Height and vigor of woody species and presence of invasive species will be evaluated.
Conduct monitoring of woody and herbaceous species at Phase I sites	Stem counts by species along transects	Fall 2005 Spring 2006 Fall 2006 Spring 2007	Data sheets for each transect	Height and vigor of woody species and presence of invasive species will be evaluated.
Conduct photo-monitoring at the Urgiel Downstream site	Take photos at stations described above. Photograph plot, photograph site upstream and downstream from station	1st Year post-construction (quarterly) 2nd Year (Fall 2006; Spring 2007	Photographs	Qualitative documentation of site conditions.
Conduct photo-monitoring at the Urgiel Upstream site	Take photos at stations described above. Photograph plot, photograph site upstream and downstream from station	Fall 2005 Spring 2006 Fall 2006 Spring 2007	Photographs	Qualitative documentation of site conditions.
Conduct photo-monitoring at the Phase I sites	Take photos at stations described above. Photograph site upstream and downstream from station	Fall 2005 Spring 2006 Fall 2006 Spring 2007	Photographs	Qualitative documentation of site conditions.

Table 1.3
Vegetation Monitoring Methodology

Tasks	Method	Frequency	Data	Comments
Conduct analysis of vegetation monitoring data for Urgiel Downstream and Urgiel Upstream sites	Averages calculated for percent cover by bank treatment type (total and by species). Values by plot calculated for percent cover (total and by species)	Annual, following monitoring	Averages to compare between years, between different plot types & species	Existing vegetation will be compared to the list of **Native Riparian Species** prepared by Russ Cohen of the MA Riverways Program (www.mass.gov/dfwele/river/rivnativesp.htm). The species on this list have value as food for wildlife (see Appendix C).
Conduct analysis of vegetation monitoring data for Phase I sites	Stem counts along transects and estimates of percent cover (total and by species)	Annual, following monitoring	Information on health and vigor of native species and presence of invasive species	Existing vegetation will be compared to the list of **Native Riparian Species** prepared by Russ Cohen of the MA Riverways Program (www.mass.gov/dfwele/river/rivnativesp.htm). The species on this list have value as food for wildlife (see Appendix C).

Wildlife Habitat Monitoring

The wildlife habitat monitoring methodology which will be used to evaluate the bioengineering sites is modeled on one developed by the Franklin Regional Council of Governments as part of s.319 project 96-03/319. This methodology will provide a qualitative assessment of potential habitat types. An inventory of functional habitat would require a much more rigorous sampling methodology and data analysis that is beyond the scope of this project. Instead, the field protocol for this project will use photodocumentation and visual assessment techniques to assess potential habitat at both a "micro" scale (within sampling plots or along transects) and a "macro" scale (the site as a whole). Site data will recorded on the Wildlife Habitat Monitoring data sheets for this project (included as Appendix E). The outcome of the habitat monitoring will be descriptions of habitat types and their areal distribution at the site, and descriptions of the potential habitat linkages between the site and adjacent lands.

Pre-Construction Wildlife Habitat Monitoring of Urgiel Downstream Site

The Notice of Intent for the site, filed with the Gill Conservation Commission on December 22, 2000, includes a completed Wildlife Habitat Evaluation Field Data Form that was prepared by the utility's consultant, New England Environmental, Inc. The purpose of the pre-construction wildlife habitat monitoring program is to update the baseline information presented in the 2000 NOI filed for the site and provide a basis for comparison to post-construction habitat types. If sampling "transects" and "blocks" have been established for the pre-construction vegetation monitoring, staff will inventory the potential wildlife habitat within these sampling areas. Overall potential pre-construction habitat at the site will also be evaluated by walking the top of bank, along the bank/water interface, and the bank itself. If site access is a problem, the pre-construction inventory will be conducted from a boat. Photographs will also be taken to document site conditions. Photographs will be tied to the existing survey stakes at the site, as appropriate.

Post-Construction Wildlife Habitat Monitoring of the Urgiel Downstream Site

The purpose of the post-construction monitoring program for the Urgiel Downstream site is to gather data to compare to pre-construction conditions and develop a database for the site. The sampling protocols for the Urgiel Downstream site will use the sampling grids and transects established for the post-construction vegetation monitoring. Staff will inventory the potential wildlife habitat within these sampling plots. Overall potential post-construction habitat at the site will also be evaluated by walking the top of bank, along the bank/water interface, and the bank itself. Photographs will also be taken to document site conditions. Photographs will be tied to the sampling grids and transects.

Wildlife Habitat Monitoring for the Phase I and II Sites

The protocols for the Phase II site, Urgiel Upstream, will be similar to those to be used for the post-construction monitoring to be conducted at the Urgiel Downstream site. Staff will inventory the potential wildlife habitat within the permanent vegetation sampling plots that exist at the site. Overall potential wildlife habitat at the site will also be evaluated by walking the top of bank, along the bank/water interface, and the bank itself. Photographs will also be taken to document site conditions. Photographs will be tied to the existing vegetation sampling grids and transects or the existing survey stakes at the site, as appropriate.

The habitat monitoring protocols for the Phase I sites will use the vegetation monitoring transects that will be established to inventory habitat on a "micro" scale. The overall potential habitat of the site ("macro scale") will be documented by visual assessment and photodocumentation.

Table 1.4

Wildlife Habitat Monitoring Methodology

Tasks	Method	Frequency	Data	Comments
Conduct pre-construction wildlife habitat monitoring for the Urgiel Downstream site.	If the site can be accessed safely, staff will walk the top of bank, along the bank/water interface, and portions of the bank to inventory potential wildlife habitat. If site access is a problem, the inventory will be conducted from a boat.	Late Summer/Early Fall 2005	Completed field data forms and photographs for the site	If "transects" and "blocks" have been established for vegetation monitoring, habitat will be inventoried in these areas.
Conduct analysis of pre-construction habitat monitoring data for Urgiel Downstream site.	Describe existing, pre-construction site conditions	Late fall/winter 2005 - 2006	Written description of existing potential habitat.	Data gathered will be compared to 2000 data in the NOI. Information from the pre-construction vegetation monitoring which identifies native species that provide food for wildlife will also be incorporated.

Table 1.4

Wildlife Habitat Monitoring Methodology

Tasks	Method	Frequency	Data	Comments
Conduct wildlife habitat monitoring for the Urgiel Upstream site, Urgiel Downstream site, and the Phase I sites.	For the two Urgiel sites, habitat data forms will be completed for the sampling plots. Habitat field data forms will be completed for the transects at the Phase I sites. In addition, field data forms will be used to inventory the entire site.	Fall 2005 Spring 2006 Fall 2006 Spring 2007 (see Comments)	Completed field data forms for the site.	The Urgiel Downstream site will be monitored on a quarterly basis for the first year following construction and then twice per year thereafter.
Conduct analysis of habitat monitoring data for Urgiel Downstream site, Urgiel Upstream site, and Phase I sites.	Describe current site conditions	Fall 2005 Spring 2006 Fall 2006 Spring 2007 (see Comments)	Written description of existing potential habitat.	The Urgiel Downstream site will be monitored on a quarterly basis for the first year following construction and then twice per year thereafter. Data gathered will be compared to 2000 data and pre-construction data gathered as part of this project. Information from the vegetation monitoring which identifies native species that provide food for wildlife will also be incorporated.

APPENDIX A
Existing Conditions Map and
Bioengineering Treatment – Details and Cross-Sections Map

APPENDIX B
Sample Vegetation Monitoring Forms for Phase II and III Sites

Vegetation Monitoring Data
Urgiel Upstream Site
Upper Slope # 41
Percent Total Cover of Entire Plot = 90

Herbaceous Species	Woody Species	Stem Count	Percent Cover
White clover (Trifolium repens)		*	80
White sweet clover (Melilotus albos)		5	4
Rabbit foot clover (Trifolium arvense)		7	1
	Arrowwood (Viburnum dentatum)	2	5
Smooth panicum w/long leaves		2	<1
Perennial rye grass (Lolium perenne)		5	<1
Pink knotweed (Polygonum sp.) (canopy)			<1
Pepper mustard		1	<1
Blue grass (Poa sp.) (underneath clover)		*	40
	Red maple seedling (Acer rubrum)	1	<1
Amaranth (Amaranthus sp.)		1	1

Notes: Arrowwood shrubs were healthy and 2.5 and 3.0 feet in height.

APPENDIX C
Native Riparian Species List

Native Riparian Species

This list of native Massachusetts species was compiled by Russ Cohen at Riverways. These species are suitable for planting in most riparian areas. All the plants on this list have value as food for wildlife and/or humans.

Angelica (*Angelica atropurpurea*)[summer wildflower]

Arrowhead (*Sagittaria latifolia*)[emergent]

Basswood (*Tilia americana*)[tree]

Beach Plum (*Prunus maritima*)[shrub] [grows inland in sandy soil as well as on the coasts]

Bee Balm (*Monarda didyma*)[summer wildflower]

Black Birch (*Betula lenta*) [tree]

Blueberry, Highbush (*Vaccinium corymbosum*)[shrub]

Bugleweed (*Lycopus uniflorus*) [a tuber-bearing wild mint]

Bulrush, Common (*Scirpus validus* and *acutus*)[emergent]

Bulrush, River *(Scirpus fluviatilus)*[emergent]

Bunchberry *(Cornus canadensis*) [ground cover]

Butternut (*Juglans cinerea)[*tree]

Calamus (*Acorus calamus*)[emergent]

Canada Mayflower (*Maianthemum canadense*)[spring wildflower/ground cover]

Carrion Flower *(Smilax herbecea*)[vine]

Cat Brier (*Smilax rotundifolia*)[vine]

Cattail (*Typha latifolia* and *angustifolia*)[emergent]

Cow Parsnip (*Heracleum maximum*)[summer wildflower]

Cranberry (*Vaccinium macrocarpon*)[ground cover]

Elderberry, Black (*Sambucus canadensis*)[shrub]

Evening Primrose (Oenothera biennis) [summer wildflower]

False Solomons' Seal (Smilacina racemosa)

Flowering Raspberry (*Rubus odoratus*)[summer wildflower]

Fox Grape (*Vitis labrusca*)[vine]

Groundnut (*Apios americana*)[summer wildflower/vine]

Hackberry (*Celtis occidentalis*) [tree]

Highbush Cranberry (*Viburnum trilobum*) [shrub]

Hog Peanut (*Amphicarpa bracteata*)[summer wildflower/vine]

Jerusalem Artichoke (*Helianthus tuberosus*)[fall wildflower]

Jewelweed (*Impatiens biflora* or *pallida*)[summer wildflower]

Juneberry (*Amelanchier canadensis*)[tree]

Marsh Marigold *(Caltha palustris*)[spring wildflower]

Meadow Beauty (*Rhexia virginica*)[summer wildflower]

Mountain Ash (*Sorbus americana*)[tree]

Nannyberry (*Viburnum lentago)* [shrub]

Ostrich Fern (*Matteuccia pensylvanica*)[fern]

Partridgeberry *(Michella repens*)[spring wildflower/ground cover]

Pickerelweed (*Pontederia cordata*)[emergent]

Riverside Grape (*Vitis riparia*)[vine]

Rose Mallow (*Hibiscus moscheutos)*[summer wildflower, very showy]

Spicebush *(Lindera benzoin*)[shrub]

Sweet Cicely *(Osmorhiza claytoni*)[spring wildflower]

Sweet Fern (*Comptonia peregrina*) [shrub]

Trout Lily (*Erythronium americanum*)[spring wildflower/ground cover]

Wild Raisin (*Viburnum cassinoides* and *prunifolium)*[shrubs]

Wintergreen (*Gaultheria procumbens*) [ground cover]

The New England Wild Flower Society
180 Hemenway Road
Framingham, MA 01701
(508) 877-7630,
http://www.newfs.org

The New England Wild Flower Society is a reputable source for seeds/seedling plants of many if not most of these species. A good way to find out whether or not a species you're thinking of planting is native to your particular region of the state is to consult ***The Vascular Plants of Massachusetts: A County Checklist***, by Bruce Sorrie and Paul Somers http://www.state.ma.us/dfwele/dfw/nhesp/nhpubs.htm.

State botanist Paul Somers points out that a number of native grasses, sedges and woody species not appearing on Russ' list above are also suitable for planting in riparian areas. Many of these other suitable species are included in a booklet on suggested plantings for Riverfront Areas prepared by Mike Abell of DEP's Northeast Regional Office. This booklet is currently undergoing final review in DEP's Boston office and will eventually be posted on the Web at http://www.state.ma.us/dep/brp/ww/wwpubs.htm.

Date Site Last Updated: August, 2001

For comments or suggestions, contact: Rachel Calabro, Adopt-A-Stream WWW Coordinator at Rachel.Calabro@state.ma.us

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APPENDIX D
Vegetation Monitoring Data Sheet for Phase I Sites

Vegetation Monitoring
Stem Counts
Crooker Site at 11+00 stake #503

Transect Length (meters)	Herbaceous Species	Woody Species	Transect Interval From Top of Slope to Top of Stone Toe (meters)											
			12-11	11-10	10-9	9-8	8-7	7-6	6-5	5-4	4-3	3-2	2-1	1-0
12	White Snakeroot (*Ageratina altissima*)		1											
	Bluegrass (*Poa sp.*)		*	*	*	*	*	*	*	*	*	*	*	*
	Unknown grass		15	8	8		2	4	3	4	18	10	14	
	Deertongue Grass (*Dichanthelium clandestinum*)		3	10	5	22	21	11	15	2	4	3		2
	Virginia Creeper (*Parthenocissus quiquefolia*)			1										
	Fall Panic Grass (*Panicum dichotomiflorum*)			1						2	2	5	13	
	Tall Goldenrod (*Solidago canadensis var. scabra*)								3				4	
	Many headed grass								3				4	8
	Purple Loostrife (*Lythrum salicaria*)										1			5
	Grass-leaved Goldenrod (*Euthamia graminifolia*)													3
	Calico Aster (*Aster lateriflorus*)													2
		Willow - yellow				2	3	3				1	5	2
		Small willow broad leafed								2				
		Silky Dogwood (*Cornus amomum*)										1	2	

Notes: * Present along entire length of transect as a fine understory.
Willow ranged in height from 4.5 to 6 feet; 3/16" to 3/8" d.b.h.
Small willow height was 5 inches.
Silky dogwood were 3 feet in height.

APPENDIX E
Wildlife Habitat Monitoring Data Sheet

CONNECTICUT RIVER WILDLIFE HABITAT MONITORING
FIELD TABLE

Location:_____ **Date:**_____ **Samplers:**_____

Wildlife Habitat Category: **Bank** **Wetland** **Upland** **(circle one)**

Habitat Criteria	*Present*	*Absent*	*Notes*
Forage			
Hard Mast			
Soft Mast			
Edible Buds			
Edible Herbaceous Growth			
Cover			
Tree Stratum			
Shrub/Sapling Stratum			

Habitat Criteria	*Present*	*Absent*	*Notes*
Herbaceous Stratum			
Fallen Snags			
Ledge/Rocks			
Escape Habitat			
Tree Stratum			
Thorny Shrubs			
Other Shrubs & Saplings			
Rock Crevices/Overhangs			

CONNECTICUT RIVER WILDLIFE HABITAT MONITORING
FIELD TABLE

Location:_____ **Date:**_____ **Samplers:**_____

Wildlife Habitat Category: **Bank** **Wetland** **Upland** **(circle one)**

Habitat Criteria	*Present*	*Absent*	*Notes*
Nesting			
Tree Stratum			
Shrub/Sapling Stratum			
Burrows			
Rock Crevices/Overhangs			
Fallen Snags			
Migration/Overwintering			

Habitat Criteria	*Present*	*Absent*	*Notes*
Migratory Routes			
Tree Stratum Dense Overgrowth			
Shrub Stratum Dense Undergrowth			
Fallen Snags			
Thick (4-6 inches) Leaf Layer & Fibric Horizon			
Other Observed Habitat or Habitat Users			

CONNECTICUT RIVER WILDLIFE HABITAT MONITORING
FIELD TABLE

Location:_____ **Date:**_____ **Samplers:**_____

Wildlife Habitat Category: **Bank** **Wetland** **Upland** **(circle one)**

Direct Observations
Mammals: List sightings, tracks, droppings along entire length of bioengineering treatment
Reptiles & Amphibians: List observed species along entire length of bioengineering treatment.

Direct Observations
Birds: List observed species in treatment area.