Feasibility Report for the 2012 Bassett Creek Main Stem Restoration Project

Golden Valley Road to Irving Avenue North

Crystal • Golden Valley • Medicine Lake • Minneapolis
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Bassett Creek Watershed Management Commission

June 2011

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Golden Valley Road to Irving Avenue North

Golden Valley & Minneapolis, Minnesota

Prepared for
Bassett Creek Watershed Management Commission
June 2011

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the Laws of the State of Minnesota.

____
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1.0 Executive Summary

1.1 Background

The Bassett Creek Watershed Management Commission (BCWMC) Watershed Management Plan recognizes the need to restore stream reaches damaged by erosion or affected by sedimentation. Section 7.0 of the BCWMC Plan describes the issue, the Commission's policies relating to channel restoration, and the benefit of stream restoration. In January 2007 the BCWMC's Technical Advisory Committee recommended that the Commission add stream channel restoration projects to the Commission's 10-year Capital Improvements Program (CIP).

This study examines the feasibility of restoring sites along the Main Stem of Bassett Creek from Golden Valley Road (at the north end of the Theodore Wirth Golf Course) in the City of Golden Valley to the Irving Avenue North in North Minneapolis (see **Figure 1**, Location Map).

This feasibility study follows the protocols developed by the U.S. Army Corps of Engineers (USACE) and the BCWMC for projects within the BCWMC Resource Management Plan. Although this reach is not included in the RMP, it otherwise fits with the intent of it due to its proximity and similarity to the other stream projects included in the RMP.

Restoration of sites along this reach is proposed to be included as a group for design and construction in the BCWMC 2012 CIP.

1.2 General Project Description and Estimated Cost

The measures identified for potential implementation in this reach consist of the following:

- removal of trees and vegetation,
- grading reaches of stream bank,
- stabilizing storm sewer outfalls that discharge into the channel,
- establishing new vegetation on areas disturbed by construction,
- installing a variety of stream stabilization measures to address erosion problems, including riprap, biologs, j-vanes, and live stakes,
- performing a drawdown to consolidate sediments and re-establish vegetation.

This study identifies 9 sites for restoration. **Figure 2** and **Table 2** show the locations of the sites and detail the methods chosen. The feasibility level opinion of cost for implementing all of the identified measures for the 2012 Bassett Creek Main Stem restoration project is $856,000. Cost details are included in **Section 4.3**.

Temporary construction easements are not included in the opinion of cost at this time and are expected to have little or no effect on the total cost. Nearly all of the work sites are located entirely on Minneapolis Park and Recreation Board (MPRB) property.

1.3 Recommendations

The stabilization of this reach will provide water quality improvement by 1) repairing actively eroding sites; and 2) preventing erosion at other sites by installing preemptive measures to protect existing stream banks.

It is recommended that the BCWMC CIP include restoration work on this reach of Main Stem of Bassett Creek for 2012 and that the opinion of cost reflect the revised amount identified in this study. It is further recommended that the restoration of this reach of the Bassett Creek Main Stem proceed into the design and construction phase.

2.0 Background and Objectives

The BCWMC Plan recognizes the need to restore stream reaches damaged by erosion or affected by sedimentation. Section 7.0 of the BCWMC Plan describes the issue, the Commission's policies relating to channel restoration, and the benefit of stream restoration in preserving fisheries habitat and minimizing nutrient and sediment loads to the creek and downstream waters. In January 2007 the Bassett Creek Watershed Management Commission's Technical Advisory Committee recommended that the Commission add stream channel restoration projects to the Commission's 10-year Capital Improvements Program (CIP).

This feasibility study follows the protocols developed in 2009 by the U.S. Army Corps of Engineers (USACE) and the BCWMC for projects within the BCWMC Resource Management Plan. Although this reach is not included in the RMP, it otherwise fits with the intent of it due to its proximity and similarity to the other stream projects included in the RMP.

This study examines the feasibility of restoring sites along the Main Stem of Bassett Creek from Golden Valley Road in the City of Golden Valley to the Irving Avenue North in North Minneapolis (see **Figure 1**, Location Map).

The 2005 Minneapolis Park & Recreation Board (MPRB) Erosion Site Survey identified numerous problem areas along the project area of Bassett Creek through Golden Valley and Minneapolis. The problems include degraded vegetative diversity and invasive species, areas of active bank erosion, and deposition of sediments.

The work to restore the channel in this area has been requested by the MPRB, which owns nearly all of the property adjacent to the creek. The MPRB is redeveloping a large portion of adjacent park area in Wirth Regional Park and desires to minimize the disruption to the park and coordinate the restoration work with the park development.

Restoration of sites along this reach are proposed to be included as a group for design and construction in the BCWMC's 2012 CIP.

2.1 Goals and Objectives

The objective of this study is to review the feasibility of implementing measures to stabilize unstable stream banks and re-establish desirable vegetation on this reach of Bassett Creek, and to provide conceptual designs and opinion of costs of measures that could potentially be used at each of the selected erosion sites.

Scope

The MPRB completed an erosion inventory along Bassett Creek in Minneapolis in 2005. This inventory identified 28 individual erosion locations. Barr Engineering (Barr) staff confirmed many of the sites and updated the information including adding several more sites. Many of these individual sites are grouped within the project sites identified in this study. The selected sites were deemed to be the most critical for meeting the BCWMC goals and objectives while providing a cost effective benefit. MPRB staff were also involved with selecting the final sites.

The feasibility study did not include individual sites between the Cedar Lake Road bridge and Irving Avenue North since this area is covered by the Bassett Creek Valley Master Plan (City of Minneapolis, 2007). The master plan calls for extensive grading work in this area of the creek and will require mitigation and/or removal of large quantities of contaminated soils. Because of the high cost and the likelihood of future grading and disturbance, this area was not included in this study.

Stream Stabilization

The goals of the stream stabilization project include:

- Stabilize eroding banks to improve water quality.
- Preserve natural beauty along Bassett Creek and contribute to the natural habitat and species diversification by planting eroded areas with native vegetation.
- Prevent future channel erosion along the creek and the resultant negative water quality impact of such erosion on downstream water bodies.

Considerations

- Restoration must minimize floodplain impacts. Several businesses and residences are located near the creek, so it is critical for the proposed project does not increase flood elevations that impact these properties.
- Maintain existing floodplain storage and cross sectional areas.
- Seek opportunities to enhance vegetation and habitat within the reach.

2.2 Background

2.2.1 Reach Description

This reach of the Bassett Creek Main Stem (**Figure 1**) extends approximately 15,000 feet from Golden Valley Road to the Irving Avenue North. Land use immediately adjacent to the upper 80% of the reach is predominantly golf course and parkland. The land use adjacent to the lower 20% of the reach is mostly industrial.

Barr staff walked the reach in April 2011 and identified a total of eight sites that require stabilization to address bank erosion, scour, and/or bank failure. The MPRB completed an erosion inventory along this reach Bassett Creek in 2005. This inventory identified 28 individual erosion locations. Barr staff confirmed most of the sites and added several more. Many of the 28 individual sites are grouped within the eight project sites identified in this study.

The sites presented here were deemed to be the most critical for meeting the BCWMC goals and objectives while providing a cost effective benefit. Several of the sites identified in the 2005 MPRB inventory and April 2011 walk were not included in the concept designs in this study because of assumed difficulty for site access or construction easements and relative minor issues. Each of the sites not detailed in this study are located on or near railroad property, which has proven to be a challenging obstacle to overcome in the past.

The total length of identified bank erosion is approximately 3,100 feet. Photos of each of the erosion sites are found in **Appendix A**. The bank failures along this reach appear to be caused by a combination of natural stream erosion processes and problems associated with changing watershed hydrology. Despite cities' best efforts to incorporate best management practices (BMPs) to minimize the impacts of increased runoff, development fundamentally changes the hydrology of the watershed. BMPs reduce the impacts of urban development on streams receiving stormwater runoff, but physical changes and increased rates of erosion occur.

As explained in **Section 2.1**, sites between the Cedar Lake Road bridge and Irving Avenue North are not included due to contaminated soils and the likelihood of future grading and disturbance.

2.2.2 Past Documents and Activities Addressing this Reach

MPRB Erosion Site Inventory (2005)

In 2005 the MPRB completed an erosion inventory and assessment on the Bassett Creek Main Stem as it flows through MPRB land. This inventory identified 28 individual erosion locations.

MPRB staff completed the inventory by walking the length of Bassett Creek and identifying, locating, and documenting sites of significant bank erosion and sediment deposition, as well as the presence of obstructions, storm sewer outlet structures, and other utilities within the stream channel. Documentation included location of the site on aerial photographs, notes on the details of each site, and a digital photograph of each site.

The inventory includes estimates of the extent of erosion measured as a percent of the entire bank. Each site was classified as minor (less than 25%), moderate (25 – 50%), or severe (more than 50%). Typically, the causes of erosion were related to the following:

- heavy foot traffic resulting in surface runoff across exposed slopes, steep slopes, or shaded slopes,
- storm sewer outfalls discharging above the normal water level of the creek,
- and incising of the stream channel and cut bank formation due to elevated flow rates.

The MPRB Erosion Site Inventory is included here as **Appendix E**.

Bassett Creek Valley Master Plan (2006) and the Bassett Creek Valley Stream and Habitat Restoration Implementation Plan (2007)

Completed in 2006 and adopted by the City of Minneapolis in 2007, the Bassett Creek Valley (BCV) Master Plan outlines a land use vision, presents street and façade design guidelines, and tests several redevelopment alternatives against realities of infrastructure capacities, market conditions, and financing strategies. It proposes development of more than 3,000 housing units, 2.5 million square feet of commercial space, and the establishment of 45 acres of open space. In addition, the restoration of Bassett Creek is envisioned as the amenity to allow the valley's urban fabric to successfully emerge. The vision for the Creek is bounded on the west by Cedar Lake Road and extends to the Bassett Creek Tunnel.

The BCV Master Plan suggests the following open space features:

- Enhancing and realigning Bassett Creek into a more natural streambed
- Creating water features and rainwater gardens adjacent to the creek which will add to the open space atmosphere while accommodating stormwater infiltration and storage
- Preserving dramatic views of downtown Minneapolis for area residents
- Building a continuous trail connecting the Luce Line Trail to the Van White Memorial Trail. The Luce Line Trail would also be extended south through Bryn Mawr Meadows to connect with the Cedar Lake Trail
- Building trails along the north side of Bassett Creek as well as a footbridge connecting those trails to the regional trail

The questions of how to incorporate a passive park with sustainable landscape features, reconstruct a meandering stream corridor, provide for stormwater management that also acts as a public amenity, and encourage native habitat development into the open space design were further pursued in the BCV Stream and Habitat Restoration Implementation Plan (City of Minneapolis, 2007). The Implementation Plan specified the following for the preferred design:

- the re-use of sections of the existing stream alignment with improved stream banks and floodway in areas where existing steep banks would require extensive excavation for realignment;
- locating stream meanders at the Commons low points and away from areas with the highest concentrations of known soil contamination;
- development of active use areas, stormwater management features, and enhanced connections to adjacent neighborhoods;
- improved physical and visual access to the creek;
- creation of internal trail loops, two bridge crossings and regional trail connections south of the creek; and
- restoration of extensive areas of prairie and tree canopy south of the creek.

The Commons area containing the stream channel has been a commercial and industrial area with restricted access and a documented history of widespread and variable environmental contamination.

The redevelopment of this area into open space with public access will require remediation of the site to meet more stringent criteria in order to be protective of human health and the environment.

The estimated cost to accomplish the goals and results of the above Implementation Plan are well beyond the scope and funding available for this BCWMC 2012 Main Stem Restoration Project. Further, the implementation preference is for future large scale re-alignment of the existing stream channel in this area which could negate smaller scale improvements. For these reasons the area downstream of the Cedar Lake Road bridge was not considered for site work in this study.

BCWMC Main Stem Watershed Management Plan (2000)

As part of the Bassett Creek Main Stem Watershed Management Plan (2000), the BCWMC estimated the sediment and phosphorus loading to Bassett Creek from channel erosion. Three erosion scenarios were evaluated for increased loadings resulting from three levels of channel erosion - minor, moderate, and severe. The most likely scenario for Bassett Creek was between the moderate and severe scenarios with approximately ten percent of the stream channel suffering from erosion. Similar scenarios were used to estimate the additional loading of phosphorus to Bassett Creek.

The study results indicated that moderate channel erosion could contribute an additional 1,000,000 pounds of suspended sediments annually, an increase from approximately 500,000 pounds to 1,500,000 pounds, and 50 pounds of phosphorus annually, an increase from approximately 2,650 pounds to 2,700 pounds to the Main Stem of Bassett Creek. The study results also showed that stabilizing the Main Stem of Bassett Creek could reduce total phosphorus (TP) loads by an estimated 96 pounds per year and total suspended solids (TSS) loads by an estimated 200,000 pounds per year.

BCWMC Watershed Management Plan (2004)

The BCWMC Watershed Management Plan (2004) recognized this need to restore stream reaches damaged by erosion or affected by sedimentation. The BCWMC established a fund to cover the costs of channel stabilization projects. However, the fund as authorized was insufficient to cover the costs of all of the identified projects. In January 2007 the BCWMC's Technical Advisory Committee recommended that the Commission add stream channel restoration projects to the Commission's ten-year CIP. The BCWMC then went through a process to identify potential channel restoration projects by stream reach, prepared cost estimates for the restoration of the reach, prioritized the restoration projects, and added the larger projects to the CIP. These restoration projects included the Main Stem of Bassett Creek, the North Branch of Bassett Creek, the Sweeney Lake Branch of Bassett Creek, and Plymouth Creek. These reaches of the creek have experienced increased stream bank erosion, streambed aggradation, or scour. These erosion and aggradation processes are a combination of natural processes, and artificial processes due to increased runoff volumes and higher peak discharges in these reaches of the creek that occur with urban development in the watershed. The sediment load from the erosion and scour increases phosphorus loads to downstream water bodies, decreases the clarity of water in the stream, destroys aquatic habitat, and reduces the discharge capacity of the channel. The BCWMC added several channel restoration projects to their long range CIP in May 2007.

BCWMC Resource Management Plan (2009)

The BCWMC completed a Resource Management Plan (RMP) in July 2009 for water quality improvement projects within the Bassett Creek watershed scheduled for design and construction between 2010 and 2016. The goal of the RMP was to streamline the permitting process with the U.S. Army Corps of Engineers (USACE) for all of the projects. Although this reach is not included in the RMP it otherwise fits with the intent due to its proximity and similarity to the other stream projects included in the RMP. Per discussion with the USACE, this feasibility study follows the protocols developed by the USACE and the BCWMC for projects within the BCWMC RMP.

Table 1 presents completed and future restoration projects included in the BCWMC CIP, along with their estimated start dates and costs.

Table 1 BCWMC Channel Restoration Projects

Creek Project	Target Project Start	Estimated Project Cost[1]
Sweeney Lake Branch	2008 (complete)	$386,000
Plymouth Creek, Reach 1	2010 (underway)	$965,000
Bassett Creek Main Stem, Reach 2; Crystal border to Regent Ave.	2010 (underway)	$636,000
Bassett Creek Main Stem, Reach 1; Duluth St. to Crystal Border	2011	$580,200
North Branch	2011	$834,900
Bassett Creek Main Stem 2012; Golden Valley Road to Irving Ave. No.	2012 (proposed)	$600,000
Plymouth Creek, Reach 2 (PC-2)	2015	$559,000

[1] Costs as estimated in revised 2011 CIP

3.0 Site Characteristics

3.1 Bassett Creek Watershed

The watershed area tributary to this reach of Bassett Creek is approximately 25,000 acres and includes approximately the entire Bassett Creek watershed. The upstream watershed drains all or portions of Plymouth, Minnetonka, Medicine Lake, New Hope, St. Louis Park, Crystal, Golden Valley, and Minneapolis. Existing land use includes approximately forty percent single-family residential; twenty-eight percent commercial/industrial; seven percent highway; seven percent parks and undeveloped land; four percent multi-family residential; and water surface area over the remaining land area.

3.2 Stream Characteristics

This reach of the Bassett Creek Main Stem (**Figure 1**) extends for approximately 15,000 feet from Golden Valley Road to Irving Avenue North. The stream is relatively shallow in most places except for occasional deep pools. Portions of this reach were converted into large in-stream ponds, many of which date to the 1930's. Many of these in-stream ponds are located within Theodore Wirth Park and have zonal deposition of sediment to the point that vegetated islands are now present in some of the ponds. The riparian vegetation in this reach varies considerably, depending on adjacent land use. Much of the reach contains unmanaged woody vegetation. Some banks within park areas are largely free of woody vegetation and the banks are mostly grasses dominated by reed canary grass. Some banks within the parks and the golf course have turf grass to the top of the bank.

Barr staff walked the reach to further investigate the scale and severity of the erosion problems for this feasibility study. Barr staff reviewed the previously documented erosion sites and identified additional sites.

3.3 Site Access

Access to most of the sites in this reach will be relatively easy since most of the sites are on public property with relatively few obstacles or infrastructure blocking access.

3.4 Wetlands

The wetlands associated with the study area in the Main Stem of Bassett Creek were delineated in accordance to the USACE Wetland Delineation Manual and Midwest Regional Supplement (2008). The delineation and assessment was necessary to meet the requirements of a Section 404 Permit and the Wetland Conservation Act. The assessment also included the use of the Minnesota Routine Assessment Method (MNRAM 3.4), which is a comprehensive ranking system designed to help qualitatively assess functions and values associated with Minnesota wetlands for the purpose of managing local wetland resources.

Seven wetlands totaling approximately 9.42 acres were identified and field delineated. These are floodplain forest, wet meadow, shallow marsh, and shrub-carr riparian wetlands, which border the Main Stem for the extent of the study area. In addition, MNRAM functional wetland assessments were also performed. The wetlands generally scored low to moderate for vegetative diversity and high for recreation. Low functional ratings are mainly due to the urbanized setting, limited upland buffers, and stream bank erosion.

A full summary of the wetland delineation and MNRAM results, including figures and field data sheets, is in **Appendix B**.

3.5 Cultural and Historical Resources

A reconnaissance survey of Sites 1 through 9 (see **Figure 2**) was completed during late April and early May of 2011 to determine if any sites may require further investigation for cultural or historical importance. A records/literature search had previously been conducted at the Minnesota Historical Society. The field survey was completed by comparing historical aerial photographs to current conditions and by walking the relevant reaches to observe conditions on the ground. Results indicated that only Site 1 has enough archeological potential to justify further archaeological review before any construction disturbance to the area. However, because Sites 2 to 9 are located within Theodore Wirth Park, which currently is being nominated to the National Register of Historic Places as part of the Grand Rounds National Scenic Byway, any landscaping done as part of the restoration effort should be reviewed by the State Historic Preservation Office. The same may apply to the historically significant Fruen Mill complex which has not yet been assessed for National Register of Historic Places potential. The full report of the archeological reconnaissance survey is included as **Appendix C**.

3.6 Phase I Environmental Assessment

A Phase I Environmental Site Assessment (Phase I) was completed for the project area in June 2011. To encompass the surrounding properties most likely to have the potential to affect soil within the project area, the Phase I study area consisted of the 1.5-mile stretch of creek plus all properties within 200 feet in any direction of the centerline. This collective grouping of properties is referred to as “the Property” for the purposes of the Phase I. Parcel or parcel segments/groupings identified during the Phase I process as having known contamination or the potential for contamination were identified as “Potential Environmental Sites.” The locations and rationale for each potential environmental site determination can be found in the Phase I, which is included as **Appendix D** of this report.

During preparation of the Phase I, it was determined that 9 segments of the creek were being considered as proposed restoration sites. These sites and their anticipated construction limits (within 50 feet of the creek bank) represent a relatively small portion of the property reviewed for the Phase I. The project-specific use of the Phase I was to use the results to identify areas with the presence or likely presence of contamination (i.e., potential environmental sites) that could require special soils management or corrective action during creek restoration.

No potential environmental sites were identified by the Phase I for Proposed Restoration Sites 2 though 9. The east bank of Proposed Restoration Site 1 is part of a potential environmental contamination site and owned by a private entity. At the time of this study permission for access to sample for contaminants at this location could not be obtained. If the east bank of Site 1 proceeds to the construction phase it is recommended that a Phase II environmental investigation be conducted to further assess the potential for encountering contamination at these sites.

4.0 Potential Improvements

4.1 Description of Potential Improvements

As described in **Section 1.2**, the project along the 2012 Bassett Creek Main Stem Restoration Project reach consists of a variety of stream stabilization measures to address erosion problems. **Figure 2** shows the identified stabilization sites and **Table 2** lists the potential stabilization measures for each site. There are several stream restoration techniques that can be used, although not all of them would be practicable or applicable to the stream erosion problems on Bassett Creek. The techniques discussed below and included in the conceptual design are among commonly used techniques. Those included in the concept design were selected for their functionality and the expectation that most contractors have had experience with installation of the technique. The final design will determine the most appropriate measures to use at each individual site to meet the objectives of all parties involved. The final design could include techniques not included in these concept designs.

Riprap

Riprap (also called stone toe protection) is used to protect the toe of the stream bank. In-stream riprap typically consists of cobble-sized rock (six inches to 12 inches in diameter). The riprap is keyed in to the streambed and extends up the bank to approximately the bankfull level elevation. The bankfull level is the elevation of the water in the channel during a 1.5-year return frequency runoff event. In some cases, this level may be below the top of the stream bank. Riprap is typically used in conjunction with planting of the upper banks to provide full bank protection. Riprap is especially effective in heavily shaded areas, where it is difficult to establish vegetation. **Figure 3** illustrates this practice.

Root Wads

Root wads are constructed from root balls with sections of their tree trunks attached. Removed trees will be salvaged for their use as root wads. The tree trunks are buried into the bottom of the stream bank, with the root wad end sticking out into the stream. Supporting footer logs and boulders are often used to stabilize the root wads. **Figure 4** illustrates this practice.

Biologs

Biologs are natural fiber rolls made from coir fiber that are laid along the toe of the stream bank slope to stabilize the toe of the stream bank. Biologs 10 – 22 inches in diameter are typically used. Because they are made of natural fiber, vegetation can grow on the biologs. When needed, grading of the stream bank slope above the biolog is used to create a more stable slope (2:1 to 3:1). **Figure 5** illustrates this practice.

J-Vanes

J-vanes (also called rock vanes) are constructed of boulders embedded into the creek bottom. The vanes are embedded in the stream bank and are oriented upstream to direct the flow away from that bank. J-vanes typically occupy no more than one-third of the channel width. **Figure 6** illustrates this practice.

Live Stakes

Live stakes are dormant stem cuttings, typically willow and dogwood species. They are collected and installed during the dormant season (late fall to early spring) and grow new roots and leaves, quickly and cheaply establishing woody vegetation on a stream bank. The willows and dogwoods grow into stands that provide long lasting bank protection. **Figure 7** illustrates this practice.

Live Fascines

Live fascines also use dormant willow and dogwood cuttings installed during the dormant season. In this case, the cuttings are bundled together and planted in a row parallel to the stream flow. They can be effective in reducing sheet erosion along a slope because a portion of the fascine extends above the ground surface. **Figure 8** illustrates this practice.

Site Grading

In many places, the eroding bank will be graded to a 3:1 slope. This provides a stable slope that will not naturally slough and it provides a surface that is flat enough on which vegetation can be planted or seeded.

Vegetation Re-establishment via Drawdown at the Highway 55 Weir (Site 3)

Water level drawdown can be used to manage wetland vegetation by stimulating germination and growth on the exposed sediments. Consolidation of sediment can also occur during the drawdown, lowering the elevation of depositional material. Two important factors that determine plant responses to moist-soil manipulations are the timing of the drawdown and the composition of seeds in the soil at a site. Both of these factors determine the species composition of moist-soil plants that pioneer on exposed mudflats. Most soils contain ample seeds to produce dense stands of desirable moist-soil plants native to a locality.

There are two general types of drawdown, slow or fast, which usually produce different results. In a slow drawdown, the impounded area is gradually drained during a period of two weeks or more.

Early in the season (late May – June) a slow drawdown produces a more diverse vegetative cover than a fast drawdown. A fast drawdown can occur within a few days and produce similar conditions over the entire impounded area simultaneously. A fast drawdown normally produces excellent and extensive stands of similar vegetation, but the rapid de-watering forces wetland wildlife from the area almost immediately. Fast drawdown late in the season may produce less desirable vegetation than those early in the season.

This technique could benefit the large 17 acre flat water area upstream of State Highway 55, where a concrete weir controls the water level. This pool contains areas of variable sediment deposition, poor vegetation establishment, and marginal habitat. A drawdown could be a relatively inexpensive method to consolidate and lower the depositional features, and re-establish vegetation in shallow areas.

It is recommended that water levels in this pool be drawn down in one step to approximately one foot below the weir crest. Once the water level has been lowered the level should be maintained until fall. If it is acceptable, the lower level can remain until the following spring runoff period.

Maintenance

Maintenance of newly planted vegetation against poor survival rates by individual plants, and encroachment by invasive species is crucial to the success of stabilization projects. The cost estimates in this study include a 3 year warranty and maintenance for establishment of vegetation as specified in the contract documents. Coordination between the BCWMC and the MPRB to ensure long term maintenance after the warranty period will be needed. The MPRB will need to assist in the long term maintenance of the streambank stabilization measures, particularly providing maintenance of the vegetation, since poor vegetation management practices are a common cause of bank failures.

Table 2Potential Stabilization Measures at Each Site.

Site #	Station	Potential Stream Stabilization Practices[1]	Photos[2]
1 west	60+50	Install riprap for toe protection. Grade bank to a 2:1 slope. Move trail higher on the hillside, above the riprap. Install shade tolerant shrubs. Remove 35 trees.	1, 2
1 east	60+50	Remove 5000 square feet of concrete pavement, remove collapsed stone wall, excavate floodplain to widen stream, vegetate with live stakes, shrubs and trees	2
2	80+50	Grade bank to a 3:1 slope. Remove 25 trees. Install biolog and live stakes for toe protection. Plant native shrubs and grasses for additional vegetation.	3, 4
3	85+00	12" drawdown of pond for sediment consolidation and vegetation re-growth.	
4	116+00	Grade bank to a 3:1 slope. Install two j-vanes for bank projection. Install biolog for additional toe protection. Remove three trees. Seed bank with native grasses and shrubs.	5
5	129+50	Install three root wads. Grade bank to a 2:1 slope. Install biolog and live stakes. Remove one tree. Plant shade tolerant shrubs and grasses.	6
6	139+00	Grade bank to 2:1 slope. Install three j-vanes Install biolog for toe protection. Plant shrubs and trees. Remove 10 trees.	7, 8
7	160+50	Grade bank to 3:1 slope Install four root wads for toe protection. Install biolog and live stakes. Remove two trees. Seed bank with native vegetation and cease mowing to top of bank.	9, 10
8	158+50	Install four root wads. Grade banks to 3:1 slopes Install live stakes. Remove six trees. Plant native grasses and shrubs	11, 12
9	163+25	Install two j vanes. Install biologs and live stakes. Remove one tree.	13

[1] All sites will be planted or seeded with native grasses, shrubs, and trees. The final design phase will determine which practices will be used at each site and may or may not use the practices specified in this table.

[2] Photos are located in Appendix A

4.2 Project Impacts

4.2.1 Easement Acquisition

Nearly all of the work sites are located entirely on MPRB property. Temporary construction easements are not included in the opinion of cost and are not expected to have significant effect on the total cost along MPRB property. Site 3 is adjacent to railroad land and temporary access may need to be arranged to reach the site. Easement and flagging costs adjacent to railroad property has not been evaluated.

4.2.2 Permits Required for Project

The proposed project will require 1) a Clean Water Act Section 404 permit from the USCAE, or Letter of Permission under a General Permit, and Section 401 certification from the Minnesota Pollution Control Agency (MPCA), 2) compliance with the Minnesota Wetland Conservation Act, and 3) a Public Waters Work Permit from the Minnesota Department of Natural Resources (MNDNR). The proposed project should also follow the MPCA's guidance document for managing dredged materials, if applicable.

Section 404 Permit

The USACE regulates the placement of fill into wetlands, if the wetlands are hydrologically connected to a Waters of the United States, under Section 404 of the Clean Water Act (CWA). In addition, the USACE may regulate all proposed wetland alterations if any wetland fill is proposed. The MPCA may be involved in any wetland mitigation requirements as part of the CWA Section 401 water quality certification process for the 404 Permit.

The BCWMC developed its Resource Management Plan (RMP), which was submitted to the USACE in April 2009 (revised in July 2009), with the goal of completing a conceptual level USACE permitting process for projects proposed. This feasibility study follows the protocols developed for projects within the BCWMC RMP.

The USACE 404 permit requires a Section 106 review for historic and cultural resources. The results of the archeological reconnaissance study are included as **Appendix C**. If more detailed information is requested by the State Historic Preservation Office (SHPO), then a Phase I Archaeological Survey may need to be completed. A Phase I Archaeological Survey can be completed in 45 days or less during the frost-free period. The USACE staff anticipates that the 404 permit review and approval process could require 120 days to complete.

Minnesota Wetland Conservation Act

The Wetland Conservation Act (WCA) regulates the filling and draining of wetlands and excavation within Type 3, 4, and 5 wetlands. In addition, the WCA may regulate all types of wetland alteration if any wetland fill is proposed. The WCA is administered by local government units (LGU), which include cities, counties, watershed management organizations, soil and water conservation districts, and townships. Golden Valley is the LGU for the part of the proposed project site within the City of Golden Valley and Minneapolis is the LGU for the project sites within the City of Minneapolis. The Minnesota Board of Water and Soil Resources (BWSR) oversees administration of the WCA statewide.

The proposed project will only involve grading existing stream banks and other stream bank work. This type of work can generally be considered self mitigating and will not require wetland mitigation, but all work requires review by the LGU.

Minnesota Pollution Control Agency

Based on the findings of the Phase I, it is not anticipated that environmental impacts, such as contaminated soil and debris, will be encountered during the stream restoration activities. As with all excavation projects, there remains a potential risk for encountering unexpected environmental conditions at the time of construction, particularly given the urban environment surrounding this project. If environmental impacts are encountered during the creek restoration earthwork, contaminated materials will need to be handled and managed appropriately. The response to discovery of contamination typically includes entering the MPCA's voluntary program. In accordance with MPCA's guidance, a construction contingency plan (CCP) could be prepared for the project, which would include initial procedures for handling materials suspected to be impacted, collecting analytical samples, and determining a path forward with MPCA for managing impacted materials.

Public Waters Work Permit

The MNDNR regulates projects constructed below the ordinary high water level of public waters, watercourses, or wetlands, which alter the course, current, or cross section of the water body. Public waters regulated by the MNDNR are identified on published public waters inventory (PWI) maps. Bassett Creek is a public watercourse, so the proposed work will require a MNDNR public waters work permit.

Local Permits

The cities of Golden Valley and Minneapolis require permits for grading work within their jurisdiction. Their requirements should be reviewed in the context of each site's work. The MPRB requires a construction permit for construction work on its property. Most of the work is within the MPRB's property and will likely require a permit.

Table 3 below shows the list of expected permitting agencies for each site. This list is an estimation only and each site should be scoped for permits as the site construction details are developed.

Table 3 Potential Permit Requirements by Work Site.

Site Number	Agencies Who May Require Permits
1	Minneapolis, MPRB, MnDNR, MPCA
2	Golden Valley, MPRB, MnDNR
3	MPRB, MnDNR
4	Golden Valley, MPRB, MnDNR
5	Golden Valley, MPRB, MnDNR
6	Golden Valley, MPRB, MnDNR
7	Golden Valley, MPRB, MnDNR, USACE
8	Golden Valley, MPRB, MnDNR, USACE
9	Golden Valley, MPRB, MnDNR, USACE

4.2.3 Other Project Impacts

Tree Loss

The proposed project includes the removal of approximately 83 trees. All of the trees are located in areas where bank grading or site access will be necessary. A detailed tree inventory should be completed during the final design process. The cost estimates include replacing trees at the rate of 2:1 for each project site.

Water Quality Impacts

The proposed stabilization measures will result in a reduction of the sediment and phosphorus loading to Bassett Creek and all downstream water bodies, including the Mississippi River and Lake Pepin. Using the BCWMC Main Stem Watershed Management Plan (2000) analyses discussed in **Section 2.2.2**, and proportioning removal by reach length, stabilizing this reach is estimated to reduce TP loads by 60 pounds per year and TSS loads by 105,000 pounds per year.

4.3 Opinion of Cost

The feasibility level opinion of project cost for the 2012 Bassett Creek Main Stem Restoration Project is **$856,000** for design and construction. The opinion of cost uses the following assumptions:

- An additional 50% of construction costs will be needed for final design, permitting, construction observation, and contingency.
- Construction easements will not be needed, but if construction easements are necessary to construct the project, the cost is expected to be included in the contingency.
- The opinion of cost includes the costs of testing stream bank material for hazardous compounds that would require treatment of the dredged materials per MPCA regulations. For cost estimating purposes, it is assumed that 50% of the soil to be taken off site will require treatment and will require special disposal.
- Additional work will be required to determine if cultural and/or historical resources are present at any project site.
- Removed trees will be replaced at the rate of 2:1.
- The construction contract(s) will include a 3-year maintenance and warranty for new vegetation.

The drawdown segment of the opinion of project cost assumes that a gravity siphon would be used to bring the upstream water level 12 inches below the weir crest. Monitoring would be performed to determine vegetation establishment progress and some control of invasive species would be performed. The feasibility level opinion of cost detail for the drawdown is shown below and the total presented on **Table 3**.

Table 4 Pond Drawdown Opinion of Cost

DRAWDOWN TASKS	OPINION OF COST
Mobilization	$5,000
Survey and install water level gage and siphon with screening	$30,000
Invasive species control	$20,000
Planning, engineering, design, monitoring, and reporting	$35,000
TOTAL	**$90,000**

While environmental impacts are not anticipated at the currently proposed restoration sites, a construction contingency plan (CCP) is recommended to outline initial environmental responses if unanticipated contamination is encountered. The cost for preparing the CCP is estimated to be approximately $2,000, which would include both the preparation of the plan and outlining its provisions to client staff and contractors.

The cost for implementing a CCP will depend on the magnitude, nature, and extent of any potential impacts that are encountered. To develop a cost allowance in the absence of identified environmental impacts, the following preliminary estimate has been developed. During the project, it is arbitrarily assumed that about 100 cubic yards (roughly five-percent) of the total amount of excavated materials for the project will encounter contaminated soil or debris and require offsite disposal at a landfill. The estimate includes costs for analytical testing, transportation and disposal of impacted materials to a local Resource Conservation and Recovery Act (RCRA) Subtitle D Landfill, backfilling of clean soil, and coordination of the work with the MPCA, contractor, and the owner. Additional assumptions are shown on the estimate. In the event that no impacted materials are encountered during the project, the CCP would not be implemented and related costs would not be incurred. Based on the above assumptions, current transportation rates, and disposal rates at a nearby landfill, the cost estimate for the implementation of the described scenario is $12,000.

Encountering more serious levels of contamination (e.g., RCRA Subtitle C hazardous wastes, PCBs, etc.) was not included in the above assumptions and cost estimate. Handling, transport, and disposal of soil or materials classified as hazardous waste could require disposal at a specialized out-of-state landfill and be significantly more expensive.

A feasibility-level opinion of cost for the project construction is included in **Table 4. Figure 2** shows the corresponding site numbers and stationing referenced in **Table 4**.

The feasibility level construction opinion of cost provided in this report is made on the basis of Barr's experience and qualifications, and represents our best judgment as experienced and qualified professionals familiar with the project. The opinion of cost is based on project-related information available to Barr at this time and includes a conceptual-level design of the project.

4.4 Funding Sources

The Cities of Golden Valley and Minneapolis propose to use BCWMC capital improvement program (CIP) funds to pay the project costs. BCWMC channel restoration projects are funded through the BCWMC's CIP and are paid for via an ad valorem tax levied by Hennepin County over the entire Bassett Creek watershed.

4.5 Project Schedule

The design for this project is programmed to begin in 2012. The construction work will likely be completed during the winter of 2012 - 2013. For project work to occur in 2012, the BCWMC must hold a public hearing and order the project in time for the BCWMC's submittal of its 2012 ad valorem tax levy request to Hennepin County in September 2011. If project construction is to occur in fall or winter, it is recommended that the project bidding take place in the summer. This will allow contractors to acquire plants and seeds at a reasonable price for the required quantities. In the intervening time, the Cities will gather public input, prepare the final design, and obtain permits.

Table 5. Site Locations, Potential Stream Stabilization Practices, and Overall Opinion of Cost for the 2012 Bassett Creek Main Stem Restoration Project.

Site #	Downstream station [(1)]	Site length (feet)	Proposed stream stabilization practices	Site Total
1 west	60+50	300	Install riprap for toe protection, grade banks to 2:1 slope, move trail above riprap, plant shade-tolerant shrubs, remove 35 trees	$ 85,000
1 east	60+50	300	Remove 5000 square feet of concrete pavement, remove collapsed stone wall, excavate floodplain to widen stream, vegetate with live stakes, shrubs and trees	$ 96,000
2	80+50	300	Grade banks to 3:1 slope, install biolog and live stakes for toe protection, plant native shrubs and grasses, remove 25 trees	$ 81,000
3	85+00	n/a	12" drawdown of pond for sediment consolidation and vegetation re-growth, invasive species control & monitoring	$ 90,000
4	116+00	130	Grade banks to 3:1 slope, install two j-vanes for bank protection, install biolog for additional toe protection, plant native shrubs and grasses, remove three trees	$ 23,000
5	129+50	1500	Grade bank to a 2:1 slope, install three root wads, install biologs and live stakes, plant shade tolerant shrubs and grasses, remove one tree	$ 21,000
6	139+00	500	Grade bank to 2:1 slope, install three j-vanes, install biolog for toe protection, plant shrubs and trees, remove ten trees	$ 45,000
7	160+50	132	Grade bank to 3:1 slope, install four root wads, install biologs and live stakes, replant with native vegetation and cease mowing to top of bank, remove two trees.	$ 19,000
8	158+50	151	Grade bank to 3:1 slope, install four root wads and live stakes, plant native grasses and shrubs, remove six trees.	$ 20,000
9	163+25	100	Install two j-vanes, install biologs and live stakes, and remove one tree.	$ 19,000
			Construction Costs Subtotal	$ 499,000
			Construction Contingency (20%)	$ 100,000
			Design, Permitting, and Administration (30%)	$ 180,000
			Contingency for contaminated soils	$ 12,000
			Additional Cultural and Historical Investigation	$ 10,000
			3-year vegetation warranty and maintenance	$ 55,000
			TOTAL	**$ 856,000**

[(1)] Stream stationing: 0+00 at Bassett Creek Tunnel.

5.0 References

Barr Engineering Co., *Bassett Creek Watershed Management Plan*, Bassett Creek Watershed Management Commission, 2004.

Barr Engineering Co., *Bassett Creek Stream and Habitat Restoration Implementation Plan*, City of Minneapolis, 2007.

Hoisington Koegler Group, Inc., *Bassett Creek Valley Master Plan,* Bassett Creek Valley Redevelopment Oversight Committee, City of Minneapolis, 2007.

Natural Resources Conservations Service – Minnesota, *Shallow Water Management for Shorebirds*, USDA, 2001

US Department of the Interior – Fish and Wildlife, *Management of Seasonally Flooded Impoundments for Wildlife*, Resource Publication 148, 1982.

USACE, *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region,* 2008.

6.0 Figures

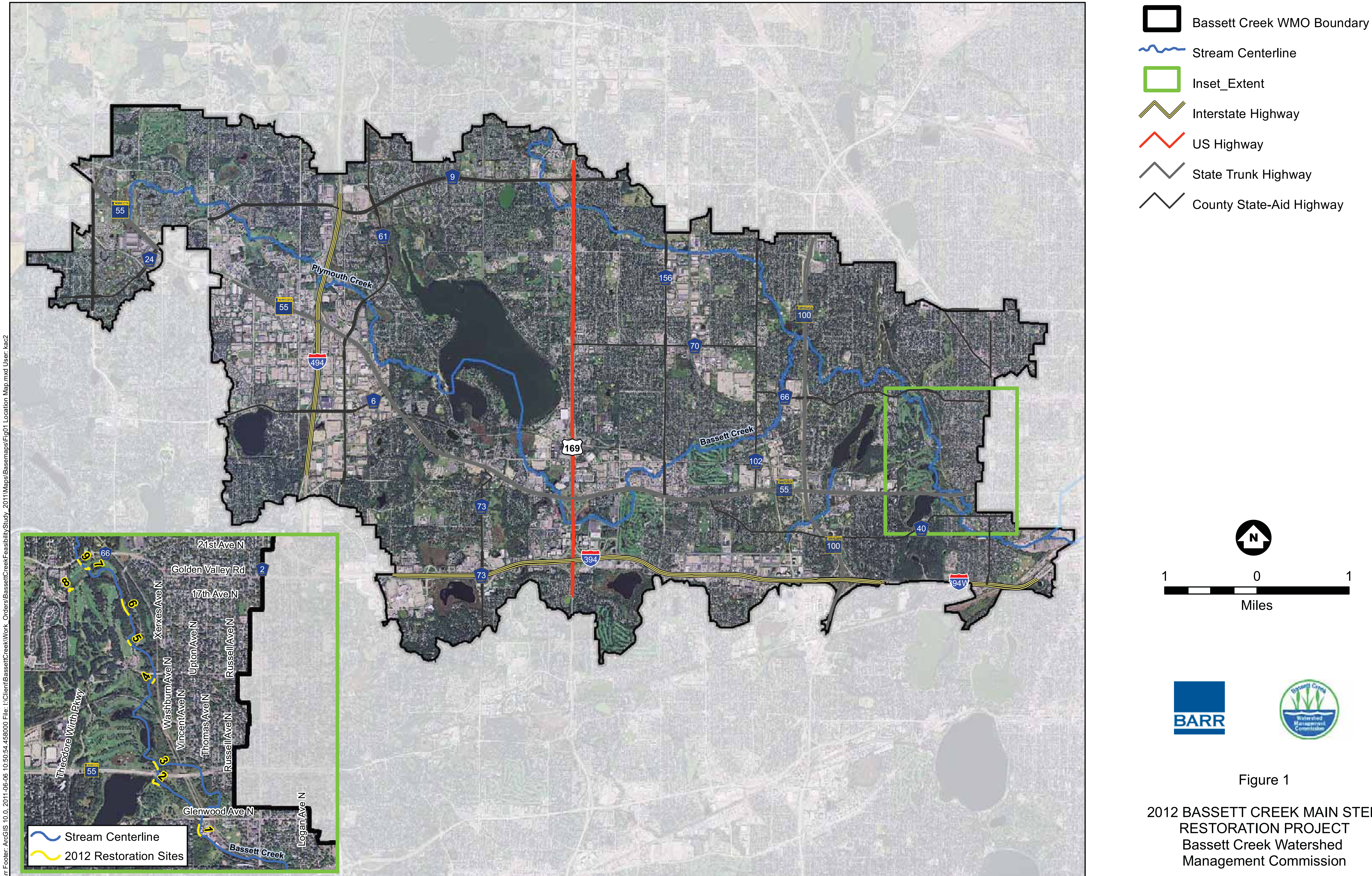


Figure 1

2012 BASSETT CREEK MAIN STEM RESTORATION PROJECT
Bassett Creek Watershed Management Commission

Stationing Centerline

2012 Restoration Sites

Erosion Sites

- Bank Failure
- Bank Scour
- Hill Slope
- Picture
- Grading

600 0 600

Feet

BARR

Figure 2

PROPOSED STABILIZATION PRACTICES
2012 Bassett Creek Main Stem Restoration Project
Bassett Creek Watershed Management Commission

Stream Stabilization Plan

Stone Toe Protection is constructed from cobble-sized rock on the creek edges. It extends to approximately the bankfull level, which will protect the channel banks for flow events that occur every 1 to 2 years or less. The material will extend into the ground to resist scour. Coarse gravel is used to separate the larger rock material from underlying soil. Stone toe protection is typically used in conjunction with revegetation of the upper banks.

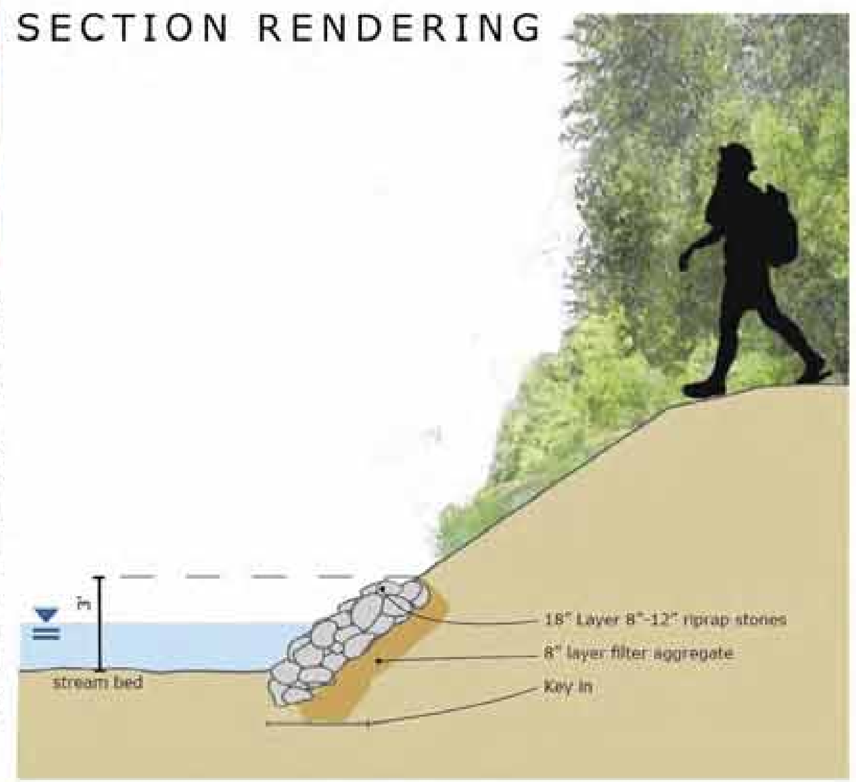
SIMILAR PROJECTS

Stone toe protection has been used extensively in Nine Mile Creek's Lower Valley, in conjunction with deflector dikes, grade control measures and stabilization of large bank failures. Following the 1987 "super storm," the proposed design allowed the stream to continue its course while taking measures to protect areas where water flow was eroding valley walls. The resulting measures have stabilized the stream channel and valley walls while blending seamlessly with the natural environment.

EXISTING CONDITIONS

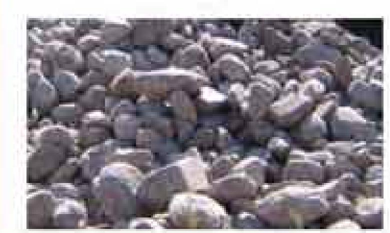
Fluvial bank erosion is caused by water in the stream moving past the streambanks. The shear stress caused by the flow entrains soil particles into the flow, causing the stream bank to erode away. This is the most common type of erosion that occurs in streams. Virtually all streams experience this type of erosion as their flow path evolves over time. However, the rate of fluvial bank erosion can increase when the stream is out of equilibrium with its watershed. Increased flow from a watershed will increase the rate of fluvial bank erosion. In many cases, it appears to be a part of the natural process of stream evolution. In places where the channel is confined by the valley walls, however, fluvial bank erosion can lead to failure of the high banks. It can also undermine storm sewer inlets.

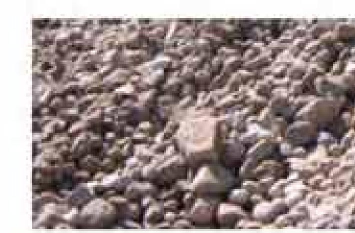
SECTION RENDERING



MATERIALS

Materials will consist of cobble-sized material with coarse gravel filter layer to provide separation from the underlying soil. Natural fieldstone material will be used.





Stone Toe Protection

Bank Protection

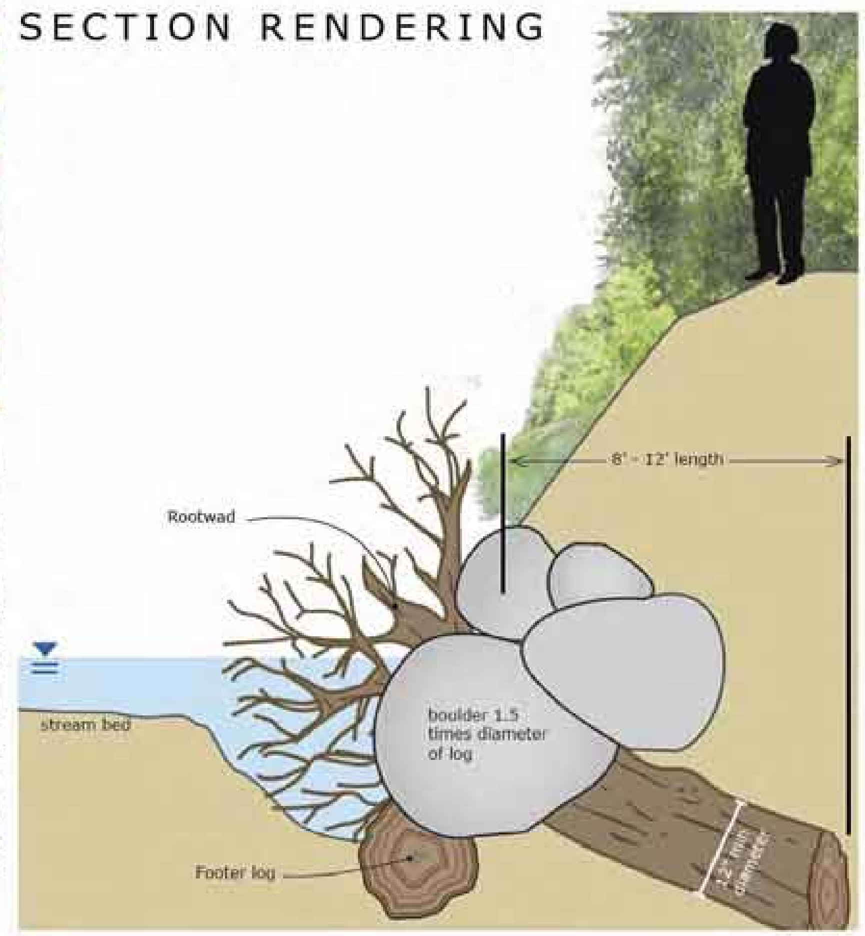
BARR

Figure 3

Stream Stabilization Plan

Root wads are constructed using sections of tree trunks with their root balls attached. The trunks extend into the stream bank leaving only the roots exposed, partially submerged. The root wads are spaced to protect a given length of bank. Footer logs and boulders are often used to help stabilize the root wads. Root wads work well where the water is deep, such as on the outside of bends, and where there is adequate sunlight to allow vegetation to grow around the exposed root wads. As the vegetation becomes established, it becomes difficult to distinguish the root wads from their natural surroundings.

SECTION RENDERING



EXISTING CONDITIONS

Fluvial bank erosion is caused by water in the stream moving past the streambanks. The shear stress caused by the flow entrains soil particles into the flow, causing the stream bank to erode away. This is the most common type of erosion that occurs in streams. Virtually all streams experience this type of erosion as their flow path evolves over time. However, the rate of fluvial bank erosion can increase when the stream is out of equilibrium with its watershed. Increased flow from a watershed will increase the rate of fluvial bank erosion. In many cases, it appears to be a part of the natural process of stream evolution. In places where the channel is confined by the valley walls, however, fluvial bank erosion can lead to failure of the high banks. It can also undermine storm sewer inlets.

SIMILAR PROJECTS

Root wads were used to stabilize two sites on the Rum River in Anoka, Minnesota, where severe bank erosion threatened to destroy adjacent trails. Approximately six root wads were placed at each site under difficult, high-water conditions. The banks were then graded, topsoil was added, and native vegetation was planted. Despite the difficult placement, the root wads have protected the lower bank, allowing the vegetation to become well established.

MATERIALS

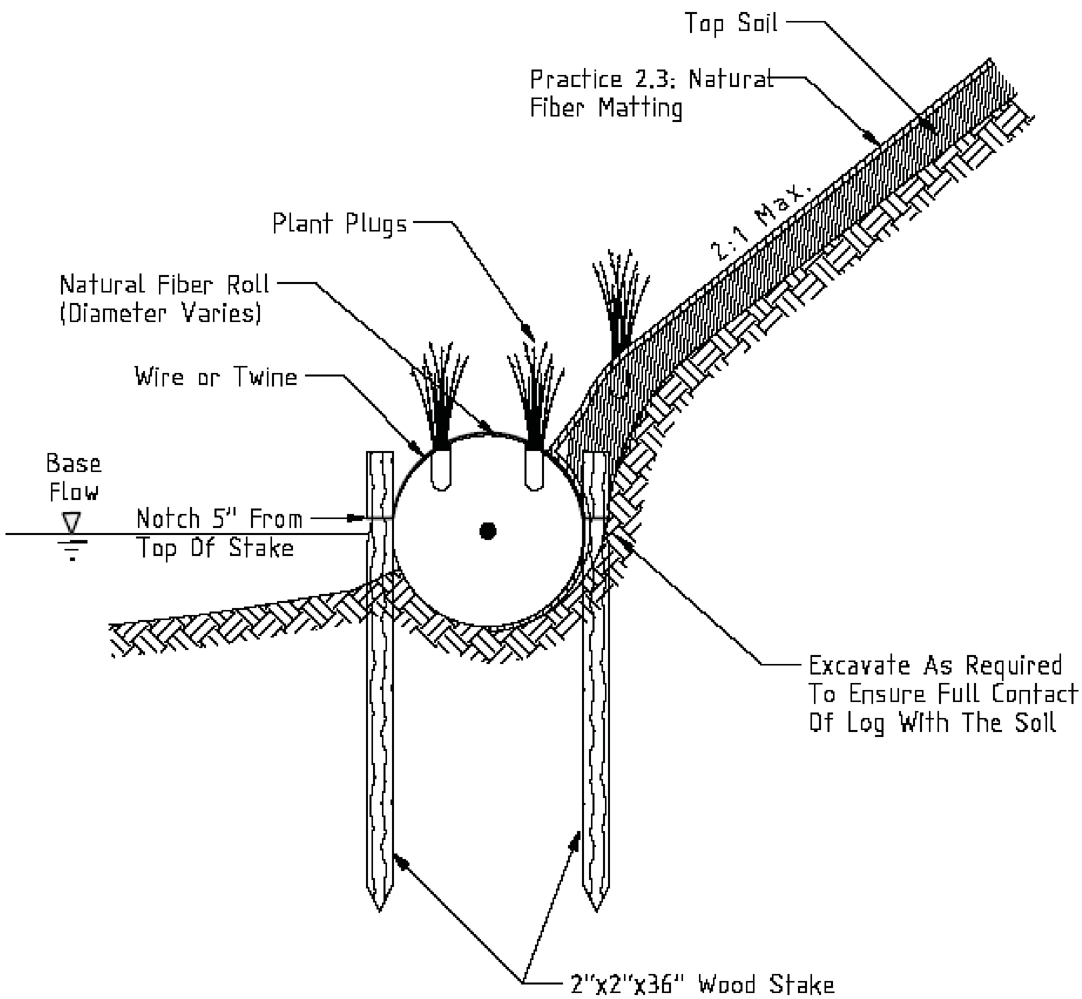
Materials will consist of 12 to 16 foot long tree trunks, minimum 12-inch diameter, with the root ball attached. Materials should be harvested on-site as much as possible. Smaller logs and boulders are also helpful to stabilize and support the root wads.

Root Wads

Bank Protection

BARR

Figure 4



Source:
The Virginia Stream Restoration & Stabilization Best Management Practices Guide

Figure 5
Biologs Bank Protection

Stream Stabilization Plan

Rock vanes are constructed from boulders on the creek bottom. They function by diverting channel flow toward the center and away from the bank. They are typically oriented in the upstream direction and occupy no more than one third of the channel width. Vanes are largely submerged and inconspicuous. The rocks are chosen such that they will be large enough to resist movement during flood flows or by vandalism, with additional smaller rock material to add stability. Rock vanes function in much the same way as root wads in that they push the stream thalweg (zone of highest velocity) away from the outside bend. They also promote sedimentation behind the vane, which adds to the toe protection.

Vanes can also be constructed from both banks, forming an upstream-pointing "V." In this configuration, the vane protects both banks and also provides grade control.

MATERIALS

Materials will consist of various gradations of rock, ranging from large, 3-foot boulders to coarse gravel.

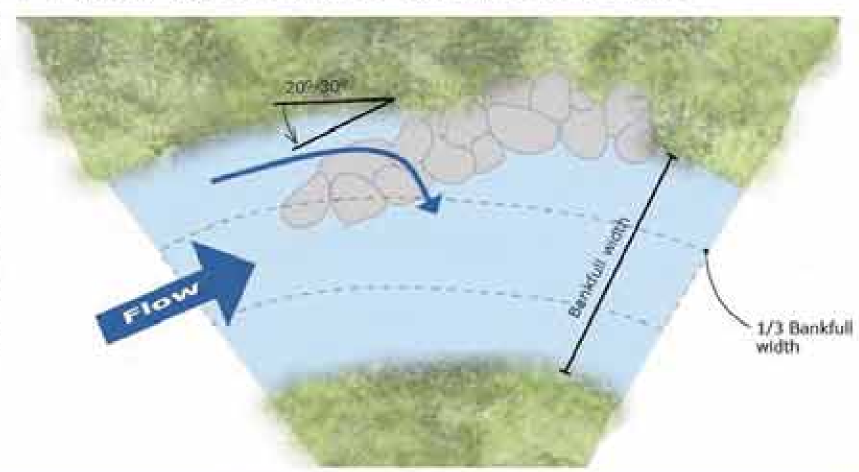
SIMILAR PROJECTS

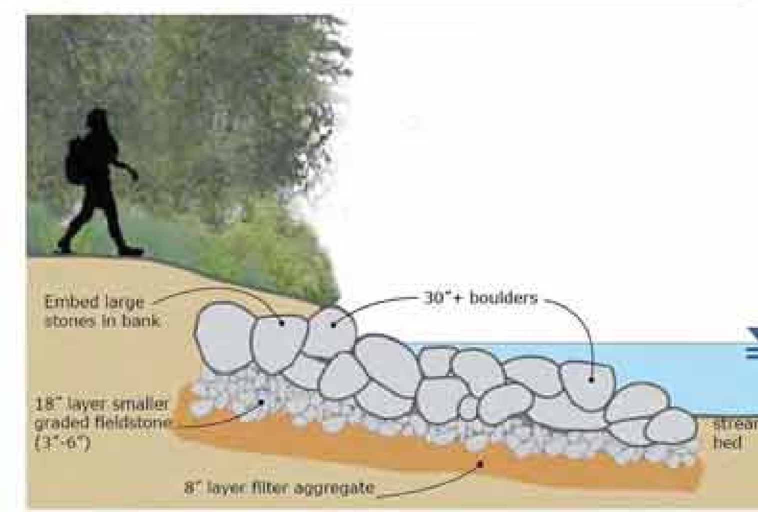
Here is an example of a stabilization project designed for a 1,000-foot long, 20-foot high streambank that was severely eroded. The channel was directed away from the bank toe by installing six rock vanes. The bank was planted with native vegetation and protected with erosion control blanket, while the terrace above the bank was graded to redirect surface runoff to a less vulnerable area. The restored streambank withstood significant flooding during 2001, and has become nicely vegetated (see picture above).

EXISTING CONDITIONS

Fluvial bank erosion is caused by water in the stream moving past the streambanks. The shear stress caused by the flow entrains soil particles into the flow, causing the stream bank to erode away. This is the most common type of erosion that occurs in streams. Virtually all streams experience this type of erosion as their flow path evolves over time. However, the rate of fluvial bank erosion can increase when the stream is out of equilibrium with its watershed. Increased flow from a watershed will increase the rate of fluvial bank erosion. In places where the channel is confined by the valley walls, however, fluvial bank erosion can lead to failure of the high banks. It can also undermine storm sewer inlets.

PLAN/SECTION RENDERING



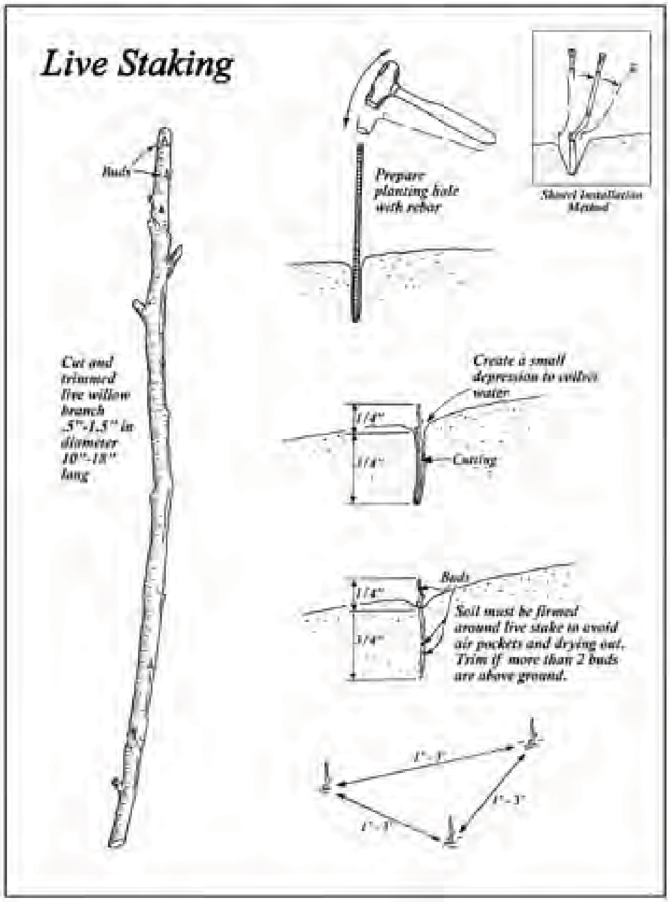


Rock Vanes

Bank Protection

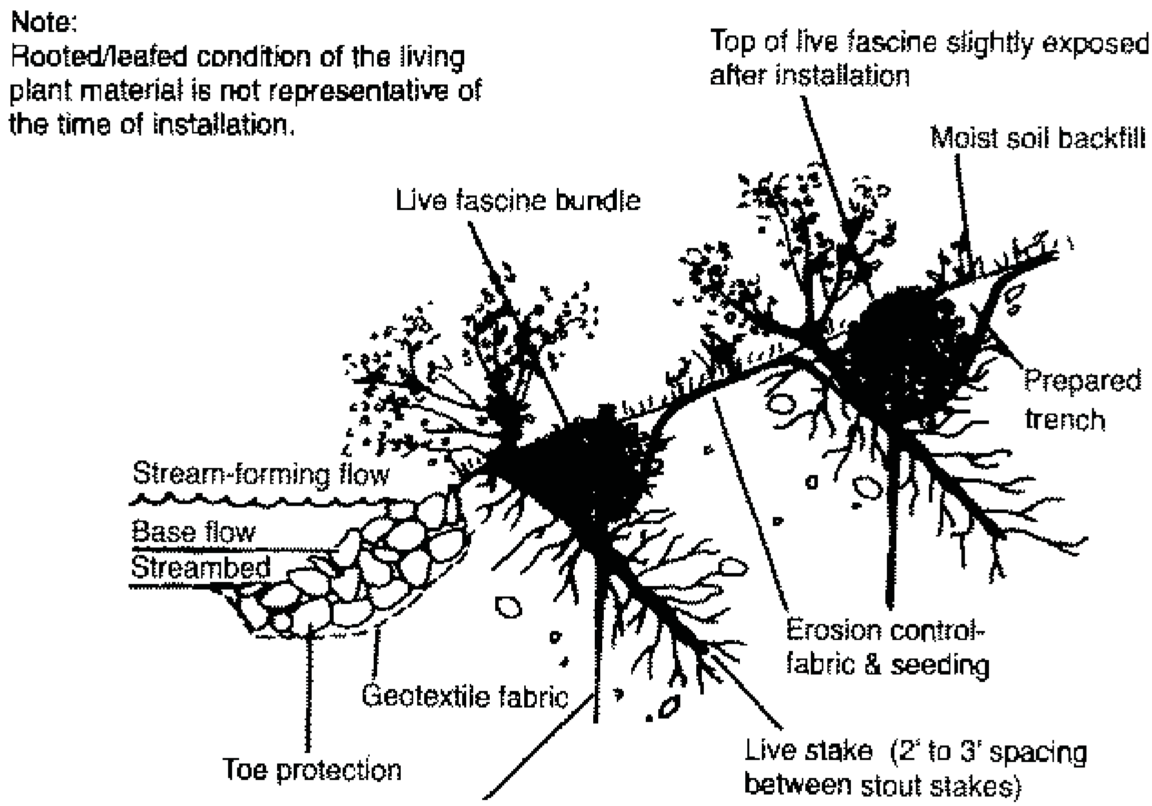
BARR

Figure 6



Source: http://www.sf.adfg.state.ak.us/SARR/restoration/techniques/livestake.cfm

Figure 7
Live Stakes for Bank Protection



Source: http://www.dnr.state.oh.us/water/pubs/fs_st/stfs14/tabid/4169/Default.aspx

Figure 8
Live Fascines for Bank Protection

Appendices

Appendix A

2011 Site Photos

Photo 1. *Site 1*.

Photo 2. *Site 1*.

Photo 3. *Site 2*. Severely eroding bank.

Photo 4. *Site 2*. Severely eroding bank near box culvert entrance

Photo 5. *Site 4*.

Photo 6. *Site 5*.

Photo 7. *Site 6*.

Photo 8. *Site 6*.

Photo 9. *Site 7*.

Photo 10. *Site 7*.

Photo 11. *Site 8.*

Photo 12. *Site 8.*

Photo 13. *Site 9*.

Appendix B

Wetland Delineation

In Separate File

Appendix C

Cultural and Historical Resources

In Separate File

Appendix D

Phase 1 Environmental Assessment

In Separate File

Appendix E

2005 MPRB Erosion Site Survey

In Separate File