Feasibility Report for Bassett Creek Restoration Project

Golden Valley and Crystal, Minnesota

Prepared for
Bassett Creek Watershed Management Commission

August 2009

BARR

Feasibility Report for Bassett Creek Restoration Project

Golden Valley and Crystal, Minnesota

Prepared for Bassett Creek Watershed Management Commission

August 2009

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.

Karen L. Chandler

Karen L. Chandler
Reg. No 19252 Date August 7, 2009

Prepared by
Barr Engineering Company
4700 West 77th Street • Minneapolis, MN 55435-4803
Phone: 952-832-2600 • Fax: 952-832-2601

Feasibility Report for
Bassett Creek Restoration Project

August 2009

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 Summary and Conclusions

1.1 Background

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). The 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. Stream bank erosion and streambed aggradation and scour have occurred as a result of both natural stream processes and increased runoff volumes and higher peak discharges that have occurred with development of the watershed. The resulting 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.

In April 2009, the Commission completed a draft Resource Management Plan (RMP) that included several stream restoration projects. Bassett Creek Reach 2 was one of the stream projects included in the RMP and calls for the restoration of a reach from the Golden Valley-Crystal boundary (approximately 1,600 feet upstream of Highway 100) to Regent Avenue in Golden Valley (see **Figure 1**, Location Map). This reach is included in the Commission's CIP for construction in 2010 – 2011. Table 1 presents the restoration projects included in the RMP, along with their estimated start dates and costs.

Table 1 Channel Restoration Projects added to CIP and included in the RMP

Creek Project	Target Project Start	Estimated Project Cost[1]
Plymouth Creek, Reach 1 (PC-1)	2010	$965,200
Bassett Creek Main Stem, Reach 2	2010	$780,000
Bassett Creek Main Stem, Reach 1	2011	$715,000
North Branch	2013	$660,000
Plymouth Creek, Reach 2 (PC-2)	2015	$559,000

[1] Costs as estimated in revised 2009 CIP

In 2008, the City of Golden Valley completed the Commission's first channel restoration project – the Sweeney Lake Branch, King Hill Area project. This project involved restoration of approximately 600 feet of the upstream end of the Sweeney Lake Branch of Bassett Creek.

1.2 General Project Description and Estimated Cost

Similar to many other urban streams, Bassett Creek Reach 2 suffers from stream bank and streambed erosion, which is caused by increased urban runoff. The potential stabilization measures for this reach consist of the following:

- removal of some trees and vegetation,
- regrading some reaches of stream bank,
- stabilizing some of the storm sewers 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
    - root wads
    - biologs
    - cross vanes
    - j-vanes
    - live stakes
    - live fascines
    - vegetated reinforced soil slope (VRSS)

A more detailed project description is given in Section 4.1 and listed in **Table 2**.

The Reach 2 construction costs are estimated to be $636,100, including $476,200 in Golden Valley and $159,900 in Crystal. A detailed cost estimate is included in **Section 4.3**. Construction easements are not included in the cost estimate at this time, but they are not expected to significantly increase the total cost. The proposed restoration work within the City of Golden Valley is on public property and will not require easement acquisitions to complete construction.

1.3 Recommendations

The Commission's CIP includes restoration of Bassett Creek Reach 2, with project work slated to begin in 2010. 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. This project will also be cost efficient because no permanent easements will be required. The portion of the project in Golden Valley is located on public land and construction access will be relatively easy through the Briarwood Nature Area. The portion of the project within Crystal is located adjacent to 29th Avenue N. The sites in Crystal will only require temporary construction easements and access will be relatively easy even though they are located on private property.

Therefore, it is recommended that the restoration of Bassett Creek Reach 2 proceed into the design and construction phase of the project. It is also recommended that the Bassett Creek CIP be revised to reflect the revised cost estimate.

2.0 Background and Objective

2.1 Background

2.1.1 Reach Description

Bassett Creek Reach 2 (**Figure 1**) extends for 5,100 feet from the Golden Valley-Crystal city boundary (approximately 1,600 feet upstream of Highway 100) to Regent Avenue in the City of Golden Valley. Bassett Creek Reach 2 flows for approximately 1,600 feet through the City of Crystal. The remaining 3,500 feet of the reach is in the City of Golden Valley, including approximately 2,750 feet within the Briarwood Nature Area. Land use immediately adjacent to this reach is predominantly publicly-owned parkland, single family residential homes, and some multi-family residential homes nearby. At least fifteen distinct sites were identified and evaluated along this reach that need some form of stabilization to address bank erosion, scour, and/or bank failure. Of the 15 sites, seven have minor erosion, six have moderate erosion, and two have severe erosion. The total length of bank erosion is approximately 1,320 feet. The bank failures along this reach appear to be caused by a combination of natural stream morphology processes and problems associated with changing watershed hydrology. Even when cities incorporate best management practices (BMPs) to minimize the impacts, development still fundamentally changes the hydrology of the watershed. The BMPs commonly used significantly reduce the impacts of development on the streams receiving stormwater runoff, but changes to the streams and erosion can still occur.

There are also four minor obstructions along this reach that could impede flow during extreme events. Two of the obstructions are trees leaning over the channel; these would be removed during stabilization of one of the erosion sites. The other two obstructions are pedestrian bridges on the recreation trails along the creek. Existing hydraulic models for Bassett Creek indicate that neither of these bridges causes a significant obstruction during the 100-year flood event. There are also nine storm sewer outfalls within the reach. At least two of the outfalls are near meanders. As natural meander migration progresses near these outfalls, the banks around the outfalls may erode; causing the outfalls to lose support and fail, project into the stream in an unsightly manner, and act as an obstruction during high flows. Stabilizing the outfalls and preventing the meander migration from occurring will prevent the need to repair or replace the storm sewer outfalls in the future. The estimated costs in this feasibility study include costs to add protection to the storm sewer outfalls as part of the stream stabilization work.

Implementation of the project will ultimately require close coordination between the BCWMC and the Cities of Crystal and Golden Valley to ensure long term project success. Most importantly, the Cities of Crystal and Golden Valley will need to assist in the maintenance of the designed measures, particularly the vegetation component since poor vegetation management practices are a common cause of bank failures. A major aspect of the vegetation component will be the cities working with the private landowners to ensure that the vegetation establishment and maintenance meets the objectives of stream bank stabilization while considering the landowners' needs.

2.1.2 Past Documents and Activities Addressing this Reach

City Erosion Inventories

The Cities of Golden Valley and Crystal have each completed erosion inventories and assessments on the portions of the Bassett Creek Main Stem that flow through their respective cities. The City of Golden Valley has updated its inventory annually, and the City of Crystal has updated its inventory once every two years.

The inventories were completed by city staff who walked the length of Bassett Creek 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 inventories included an estimate of the extent of erosion as a percent of the entire bank that was eroding was estimated, and each site was classified as minor (less than 25%), moderate (25 – 50%), and severe (more than 50%). Typically, the causes of erosion were related to the following:

- concentrated runoff from parking lots, streets, and ditch drainage
- storm sewer outfalls discharging above the normal water level of the creek
- surface runoff across exposed unvegetated slopes, steep slopes, or shaded slopes
- areas where turf is maintained to the edge of the creek with no vegetative buffer area.

Additionally, the inventories identified problems with utility structures, including

- rusty corrugated metal pipes
- broken or cracked concrete pipes
- pipes pulled apart at the joint
- flared end sections that have been removed
- buried pipe outlets

- significant deposition at the outlet of a structure
- debris blocking a structure
- protruding pipes and outlets located above the normal water levels of the creek

The cities' creek erosion inventories for Reach 2 identified eight erosion sites, including two sites with severe erosion and six with moderate erosion. There were also four obstructions and nine utility structures identified within the reach. When Barr staff walked the reach in 2009, seven additional sites were identified as having minor erosion problems or the potential for erosion problems in the near future. Combining the eight sites identified by the cities and the seven sites added by Barr staff brings to 15 the number of sites along the reach.

BCWMC

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 as to increased loadings resulting from minor, moderate, and severe channel erosion. The most likely condition present in Bassett Creek was between the moderate and severe scenarios with approximately 10 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 (increase from approximately 500,000 pounds to 1,500,000 pounds) and 50 pounds of phosphorus annually (increase from approximately 2,650 pounds to 2,700 pounds) to the Main Stem of Bassett Creek. Stabilizing this reach was estimated to reduce phosphorus loads by 96 pounds per year and suspended solids loads by 200,000 pounds per year.

The BCWMC Watershed Management Plan recognized the 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 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 10 year CIP. The BCWMC then went through a process to identify potential channel restoration projects by stream reach, prepare cost estimates for the restoration of the reach, prioritize the restoration projects, and add the larger projects to the CIP. The 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. Increased runoff volumes and higher peak discharges that occur with development of the watershed in these reaches of the creek have resulted in stream bank erosion and streambed aggradation and scour. The resulting sediment 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 Commission added several of these channel restoration projects to their long range CIP in May of 2007, including Reach 2 of Bassett Creek.

The BCWMC completed a draft Resource Management Plan (RMP) in April 2009 (updated July 2009) for water quality improvement projects within the Bassett Creek watershed scheduled to be completed between 2010 and 2016. The goal of the RMP was to streamline the permitting process with the Army Corps of Engineers (ACOE) for all of the projects. The RMP provided concept designs for stabilizing the stream banks along this reach of Bassett Creek as well as background information about impacts to wetlands, threatened and endangered species, and cultural and historical resources. Reach 2 of Bassett Creek was included in the RMP. Relevant information from the RMP is included in this feasibility study.

The BCWMC Technical Advisory Committee (TAC) met in June of 2009 to discuss erosion problems within the district and the list of stream stabilization projects included in the RMP. The TAC recommended that the first step should be completion of a feasibility study for Reach 2 of Bassett Creek.

2.2 Goals and Objective

Reach 2 of Bassett Creek has erosion problems in at least 15 locations, including at least three storm sewer outfalls that currently or potentially are in danger of being damaged due to stream bank erosion and stream migration. The objective of this study is to review the feasibility of implementing measures to stabilize the stream banks and storm sewer outfalls on Reach 2 of Bassett Creek and to provide conceptual designs and cost estimates of measures that could potentially be used at each of the 15 erosion sites.

Stream Stabilization

The Cities of Golden Valley and Crystal have recognized the importance of addressing stream erosion and sedimentation issues; however, funding limitations have prevented repair of these sites to date. With the availability of funding from the BCWMC, repair of these sites can now proceed.

The Cities of Golden Valley and Crystal have completed periodic erosion inventories along this reach, beginning in 2003. The latest inventory identified eight erosion sites, including two sites with severe erosion. As stated earlier, Barr staff added seven sites with minor erosion or the potential for erosion problems in the near future. One of the sites identified as moderate erosion was reclassified as severe erosion.

The goals of the stream stabilization project are to:

- Stabilize eroding banks to improve water quality.
- Preserve natural beauty in the Briarwood Nature Area and contribute to the natural habitat and species diversification in place by revegetating eroded areas with native vegetation.
- Prevent future channel erosion along the creek to reduce its negative water quality impact on downstream water bodies.

Considerations

- Restoration must minimize floodplain impacts. Only a few homes are near the creek, however it is critical to ensure the proposed project does not increase flood elevations that impact these properties.

3.0 Site Characteristics

3.1 Bassett Creek Watershed

The watershed area to this reach of Bassett Creek is approximately 20,000 acres and represents approximately 80% of the entire watershed within the BCWMC boundary. The watershed to this point along Bassett Creek drains all or portions of Plymouth, Crystal, Minnetonka, Medicine Lake, New Hope, St. Louis Park, and Golden Valley. Existing land use includes approximately 28 percent commercial/industrial; 40 percent single-family residential; four percent multi-family residential; seven percent highway; seven percent parks and undeveloped land; and water surface area over the remaining land area.

3.2 Stream Characteristics

The project area (**Figure 2**) extends for 5,100 feet from upstream of Highway 100 to Regent Avenue in the Cities of Crystal and Golden Valley. The upstream portion of Reach 2 extends 1,600 feet through the City of Crystal. All of the reach in Crystal is on private property. The riparian vegetation in this section is a mix of woody vegetation, non-native grasses, and turf grass. Most of Reach 2 in Golden Valley is within the publicly-owned Briarwood Nature Area, and all of the bank stabilization sites in Golden Valley are on public property. The riparian vegetation along this portion of the reach is a mix of open woodland and grasses.

For this feasibility study, Barr staff walked the reach to further investigate the scale and severity of the erosion problems. Barr staff observed the previously documented erosion sites and identified the additional sites. It is more cost effective to fix minor repairs before they become severe, particularly if a contractor is already mobilized and on-site to complete other repairs.

3.3 Site Access

Access to most of the sites in Golden Valley will be relatively easy due to the presence of the recreation trail system adjacent to the stream. A contractor will easily be able to use the trails to get relatively close to nine of the eleven sites to be stabilized in Golden Valley. The remaining two sites (1 and 2) will have a longer access route from a nearby street, but it will be possible to access those sites with minimal disturbance and vegetation removal. The erosion sites in Crystal are adjacent to or very near 29th Avenue N, which will also make site access relatively easy.

4.0 Potential Improvements

4.1 Description of Potential Improvements

As described in Section 1.2, the project along Reach 2 of Bassett Creek consists of a variety of stream stabilization measures to address erosion problems. **Figure 2** shows the 15 stabilization sites and **Table 2** lists the potential improvements for each site. The following paragraphs describe the potential stream stabilization practices included for this reach. There are dozens of stream restoration techniques that can be used, although not all of them would be practicable or applicable to the problems on Bassett Creek. The techniques discussed below and included in the conceptual design are among the commonly used techniques. They were included in the concept design for their functionality and the expectation that most contractors have had experience with these techniques and understand how to install them. The final design will determine the most appropriate measures to use at each individual site in order to meet the stabilization objectives of all parties involved. The final design may include techniques not in these concept designs.

Riprap

Riprap (also called stone toe protection) is used to protect the toe of the stream bank. In stream systems, 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. The bankfull level is the elevation of the water in the channel during a 1.5-year event. In some cases, this level may be below the top of the stream bank. Riprap is typically used in conjunction with revegetation 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. Approximately 20 of the trees will be salvaged for their use as root wads. The 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. The biologs are typically 10 – 22 inches in diameter. Because they are made of natural fiber, vegetation can grow on the biologs. When needed, grading of the stream bank slope above the biolog will achieve a more stable slope (2:1 to 3:1). **Figure 5** illustrates this practice.

Cross Vanes

Cross vanes (or constructed riffles) are drop structures, which are typically constructed of boulders and rocks to flatten the slope of the channel and reduce the velocity of the flow in the channel. Cross vanes extend across the creek bottom, and are embedded in each bank. Cross vanes direct the main flow to the center of the stream to reduce bank erosion. **Figure 6** 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 7** illustrates this practice.

Vegetated Reinforced Slope Stabilization (VRSS)

VRSS is a bioengineering method that combines rock, geosynthetics, soil, and plants to stabilize steep, eroding banks. VRSS typically involves protecting layers of soil with a blanket or geotextile material creating “soil lifts” (also called “soil pillows”) and vegetating the slope. The vegetation root system provides the long-term slope stabilization. **Figure 8** illustrates this practice.

Pipe Outlet Stabilization

Pipe outlet stabilization measures vary according to specific site circumstances. At most sites, additional rock riprap is needed at the pipe outlet. In other cases, pipe realignment and/or lowering of the pipe may be needed to correct existing problems, prevent future erosion, and prevent pipe failure. **Figure 9** 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 and grow new roots and leaves, quickly and cheaply revegetating a stream bank. The willows and dogwoods grow into thick stands that provide long lasting bank protection. **Figure 10** 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 11** 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.

Table 2 Potential stabilization measures at each site.

Site #	Station	Potential Stream Stabilization Practices[1]	Photos[2]
1	16+00	Install two j-vanes Install three root wads. Grade the bank to a 3:1 slope. Remove 6 trees during grading. Install biologs and live stakes to provide additional toe protection.	1
2	17+75	Install 2 j-vanes and 2 root wads to direct flow away from bank. Grade bank to a 3:1 slope Remove 6 trees during grading. Install biologs and live fascines for toe protection. Install riprap under undercut tree to prevent tree from falling	2
3	21+90	Grade bank to a 3:1 slope Install riprap on 20 feet of bank to protect and stabilize undercut storm sewer Install four root wads. Install biologs and fascines for toe protection. Remove four trees. Install cross vane to redirect flow to center of stream.	3
4	24+00	Install three j-vanes and three root wads Grade bank to a 2:1 slope. Install biolog, live stakes, and fascines. Remove nine trees.	4
5	26+25	Place riprap along 35 feet of channel length to protect bridge Install cross vane to direct flow into center of stream Remove two trees.	5
6	27+25	Install 800 square feet of vegetated reinforced soil stabilization (VRSS) on channel bank. Remove six trees.	6
7	28+25	Install 40 feet of riprap to protect recreation trail. Remove 5 trees.	7
8	29+00	Grade bank to a 3:1 slope. Remove two trees. Install four root wads Install biologs and live stakes.	8
9	31+25	Install three j-vanes. Install four root wads. Install live stakes in the bank.	9
10	32+00	Install three j-vanes. Install four root wads. Install live stakes in the bank.	10

Site #	Station	Potential Stream Stabilization Practices[1]	Photos[2]
11	33+00	Install three j-vanes. Install live stakes in the bank. Install 25 feet of riprap to protect and stabilize undercut storm sewer outlet	11
12	38+50	Grade bank to a 3:1 slope. Install cross vane. Install 50 feet of riprap to provide toe protection and protect private property. Remove 6 trees.	12
13	39+00	Grade portions of the bank to the extent possible without disturbing large trees. Install 50 feet of riprap to prevent migration toward city street. Remove 5 trees.	13
14	40+25	Grade portions of the bank to the extent possible without disturbing large trees. Install 50 feet of riprap to prevent migration toward city street. Install cross vane. Remove 6 trees.	14
15	41+00	Install 2 j-vanes. Install 60 feet of riprap to protect culvert. Remove 8 trees.	15

[1] All sites will be revegetated 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

Construction easements will not be required to complete the stabilization work within the City of Golden Valley because all of the stabilization sites are located on public land owned by the City. The sites within the City of Crystal are located on private property and construction easements will be required. Estimates for the construction easements are not included in this feasibility study and the City of Crystal expects the costs of the temporary easements to complete the stabilization work will be negligible. The sites are adjacent to 29th Avenue N and access to the sites will not require the crossing of significant portions of private property.

4.2.2 Permits Required for Project

The proposed project will require 1) a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (COE) 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.

Section 404 Permit

The COE 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 COE 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 Bassett Creek project has been included in the *Resource Management Plan for Bassett Creek Watershed Management Commission Water Quality Improvement Projects 2010 – 2016* submitted to the COE in April 2009. The goal of the *Resource Management Plan* (RMP) is to complete on a conceptual level the COE permitting process for all of the projects proposed.

The COE 404 permit will require a Section 106 review for historic and cultural resources. 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. Even with the information collected as part of the RMP, the COE 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 and Crystal are the LGU's for the proposed project site. 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 is considered self mitigating and will not require wetland mitigation.

Public Waters Work Permit

The MNDNR regulates projects constructed below the ordinary high water level of public waters or public waters 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 water/water course, so the proposed work will require a MNDNR public waters work permit.

4.2.3 Other Project Impacts

Tree Loss

The proposed project includes the removal of approximately 65 trees. All of the trees are located in areas where bank grading will be necessary. Twenty of the trees can be salvaged for root wads on this project. A detailed tree inventory should be completed during the final design.

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. As discussed in Section 2.1.2, the BCWMC estimated sediment and phosphorus loading to Bassett Creek from channel erosion as part of the *Bassett Creek Main Stem Watershed Management Plan* (2000). Stabilizing this reach was estimated to reduce phosphorus loads by 96 pounds per year and suspended solids loads by 200,000 pounds per year.

4.3 Cost Estimate

The estimated project cost for the Bassett Creek Restoration Project is $636,100 for design and construction. This total includes a $476,200 within Golden Valley and $159,900 in Crystal. The cost estimate assumes a total of 35% of construction costs for final design, permitting, construction observation, and contingency. Construction easements will not be necessary within the City of Golden Valley and the costs of temporary construction easements within the City of Crystal are expected to be negligible. The cost estimate includes the costs of testing stream bank material for hazardous compounds that would require them to be treated as dredged materials per MPCA regulations. It is assumed that hazardous compounds and pollution that will require special disposal of excavated stream bank material are not present at any of these sites. Therefore, the cost of disposing the excavated material as hazardous waste is not included in the cost estimate. A feasibility-level cost estimate for the project construction is included in **Table 3. Figure 2** shows the corresponding site numbers and stationing referenced in **Table 3**.

The opinion of probable construction costs 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 cost opinion 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 Crystal and Golden Valley propose to use BCWMC capital improvement program (CIP) funds to pay for this project. 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

Figure 10 shows the proposed project schedule. The project is slated to begin in 2010. However, because the BCWMC allocated only a small amount of CIP funding for this project in 2010, the bulk of the construction work will be completed in 2011 and could extend into 2012. For project work to occur in 2010, the Commission must hold a public hearing and order the project in time for the Commission's submittal of its 2010 ad valorem tax levy request to Hennepin County by October 1, 2009. 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 plant materials at a reasonable price for the required quantities, the project bidding is recommended to take place in the summer of 2010. In the intervening time, the Cities will gather public input, conduct the environmental review, prepare the final design, and obtain permits.

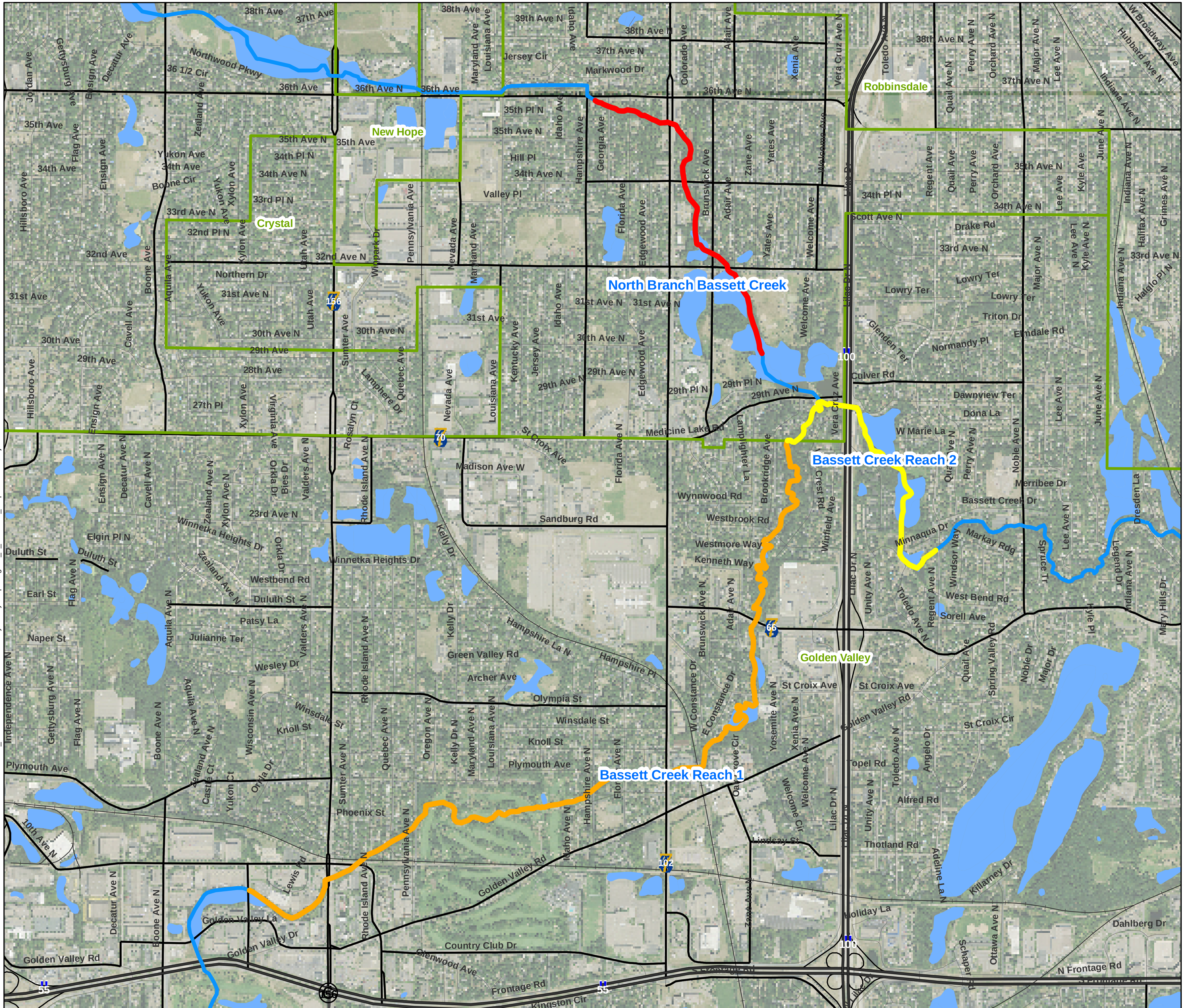
Table 3. Site Locations, Proposed Stream Stabilization Practices, and Overall Cost Estimate for Bassett Creek - Reach 2.

Site #	Downstream station (1)	Site length (feet)	Proposed stream stabilization practices	Site Total (2) (rounded to $100)
1	16+00	150	Grade the bank to a 3:1 slope; 2 j-vanes; 3 root wads; 300' biolog; 150 live stakes; remove 7 trees (5 for salvage)	$ 69,700
2	17+75	150	Grade bank to a 3:1 slope; 2 j-vanes; 2 root wads; 300' biolog; 150' fascines; riprap to stabilize undercut tree; remove 5 trees (2 for salvage)	$ 52,200
3	21+90	100	Grade bank to 3:1 slope; 2 j-vanes; 2 root wads; cross vane; riprap to protect storm sewer; 200' biolog; 100' fascine; remove 6 trees (1 for salvage)	$ 40,200
4	24+00	225	Grade bank to 2:1 slope; 3 j-vanes and 3 root wads; 250' biolog; 150' fasinces; 200 live stakes; remove 9 trees (6 for salvage)	$ 61,600
5	26+25	25	Cross vane; riprap to protect bridge abutment	$ 22,000
6	27+25	125	800 square feet of VRSS; Remove 6 trees (3 for salvage)	$ 68,900
7	28+25	30	30' of riprap to protect trail and bridge; remove 5 trees	$ 20,900
8	29+00	100	Grade bank to a 3:1 slope; 2 j-vanes, 2 root wads; 200' biolog; 100 live stakes; remove one tree for salvage	$ 33,500
9	31+25	70	3 j-vanes; 3 root wads; 50 live stakes	$ 39,000
10	32+00	75	3 j-vanes; 3 root wads; 50 live stakes	$ 39,000
11	33+00	70	3 j-vanes; 50 live stakes; 25' of riprap to protect storm sewer	$ 29,200
12	38+50	50	Grade bank to a 3:1 slope; riprap; cross vane; remove 7 trees (2 for salvage)	$ 41,900
13	39+00	40	Grade bank to extent possible without disturbing large trees; riprap; remove 5 trees	$ 28,900
14	40+25	50	Grade portions of the bank without disturbing largest trees; riprap; cross vane; remove 6 trees	$ 46,200
15	41+00	60	2 j-vanes; riprap to protect culverts; remove 8 trees	$ 42,900
			Subtotal within the City of Golden Valley	**$ 476,200**
			Subtotal within the City of Crystal	**$ 159,900**
			Summation	**$ 636,100**

(1) Stream stationing: 0+00 at Regent Avenue bridge

(2) All sites totals include final design, permitting, construction observation and contingency (35%); restoration seeding and erosion control blanket for disturbed areas; and a 2:1 tree replacement as needed.

Figures



BARR

Figure 1

LOCATION MAP
Bassett Creek Reach 2 Restoration
Bassett Creek Watershed
Management Commission

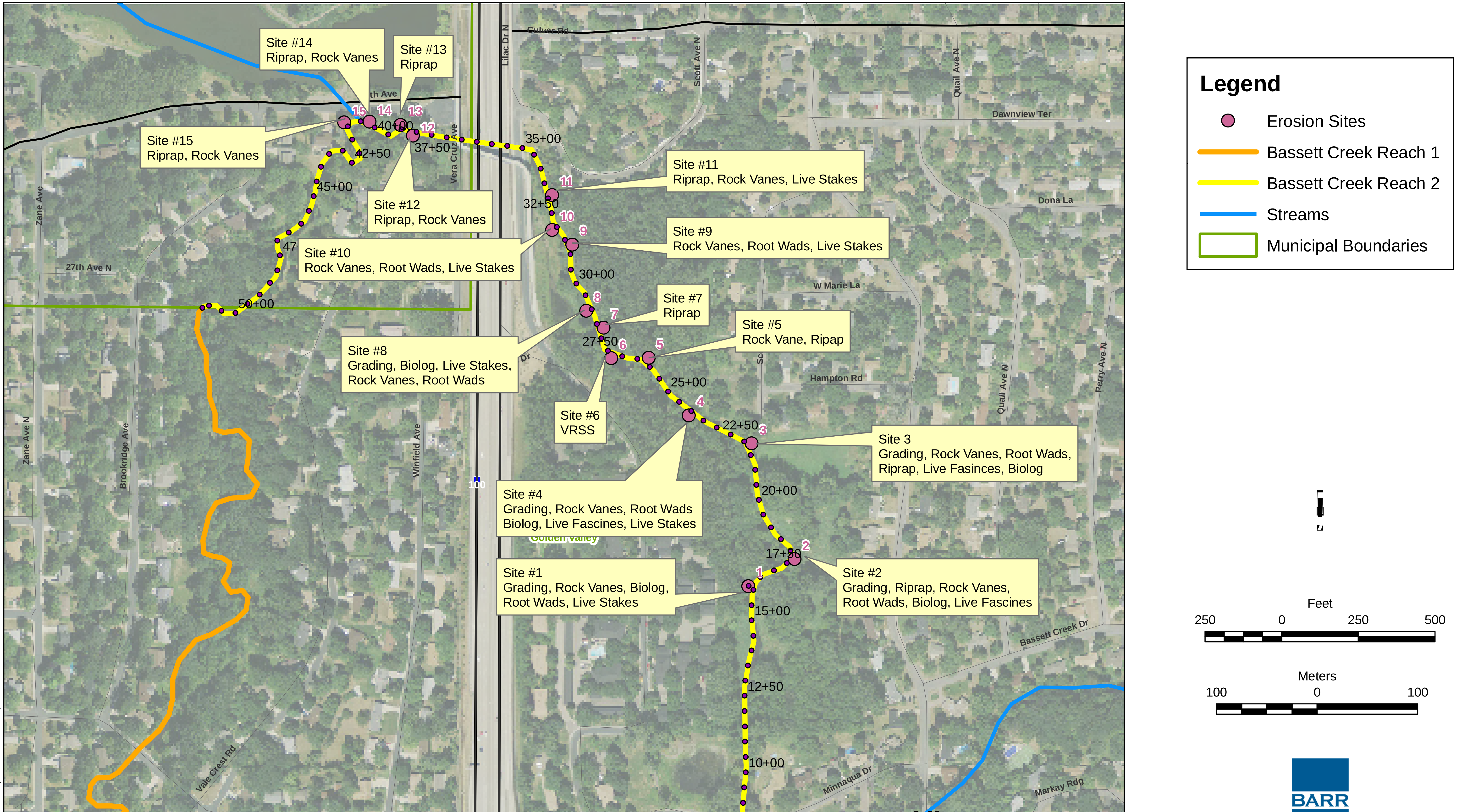


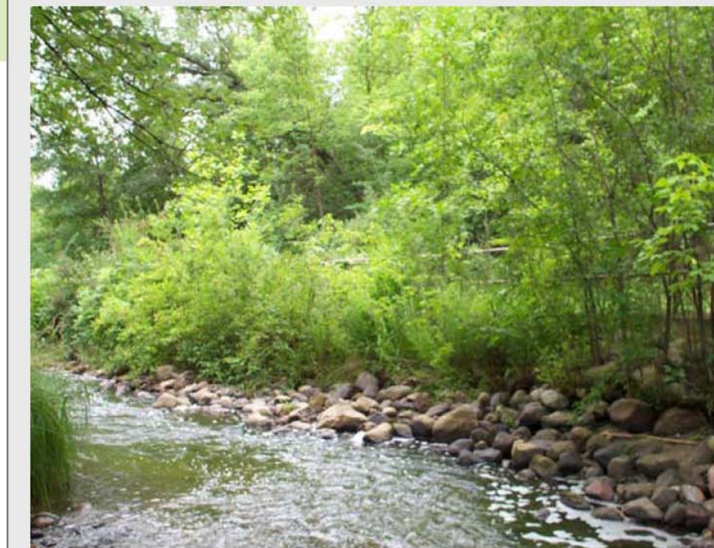
Figure 2

STREAM STABILIZATION SITES
Bassett Creek Reach 2 Restoration
Bassett Creek Watershed
Management Commission

Stream Stabilization Plan

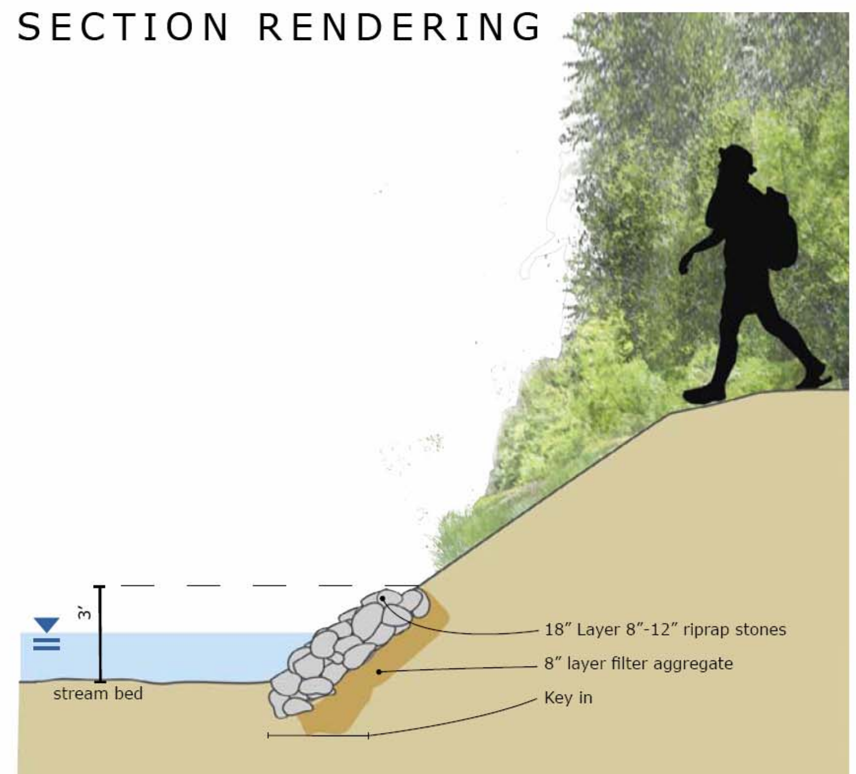
Stone Toe Protection is constructed from cobble-sized rock on the creek edges. It extends to approximately the bankfull level, which will protect the channel banks for flow events that occur every 1 to 2 years or less. The material will extend into the ground to resist scour. Coarse gravel is used to 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.

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.

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.

Stone Toe Protection

Bank Protection

BARR

Figure 3

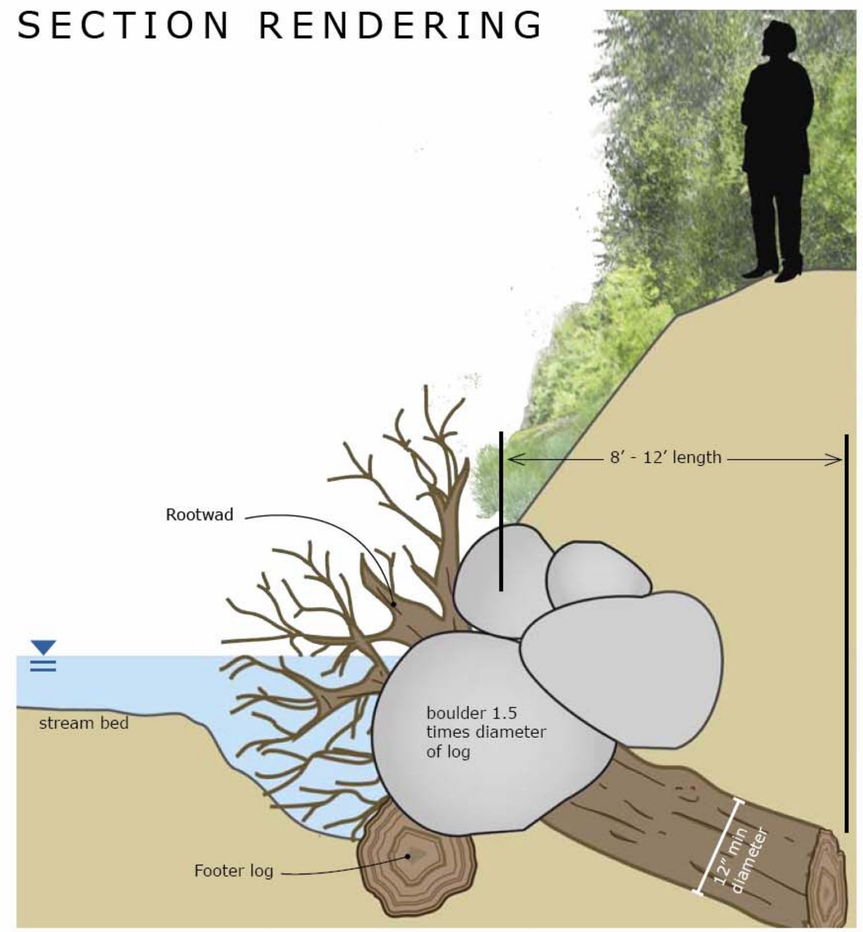
Stream Stabilization Plan

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.

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



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

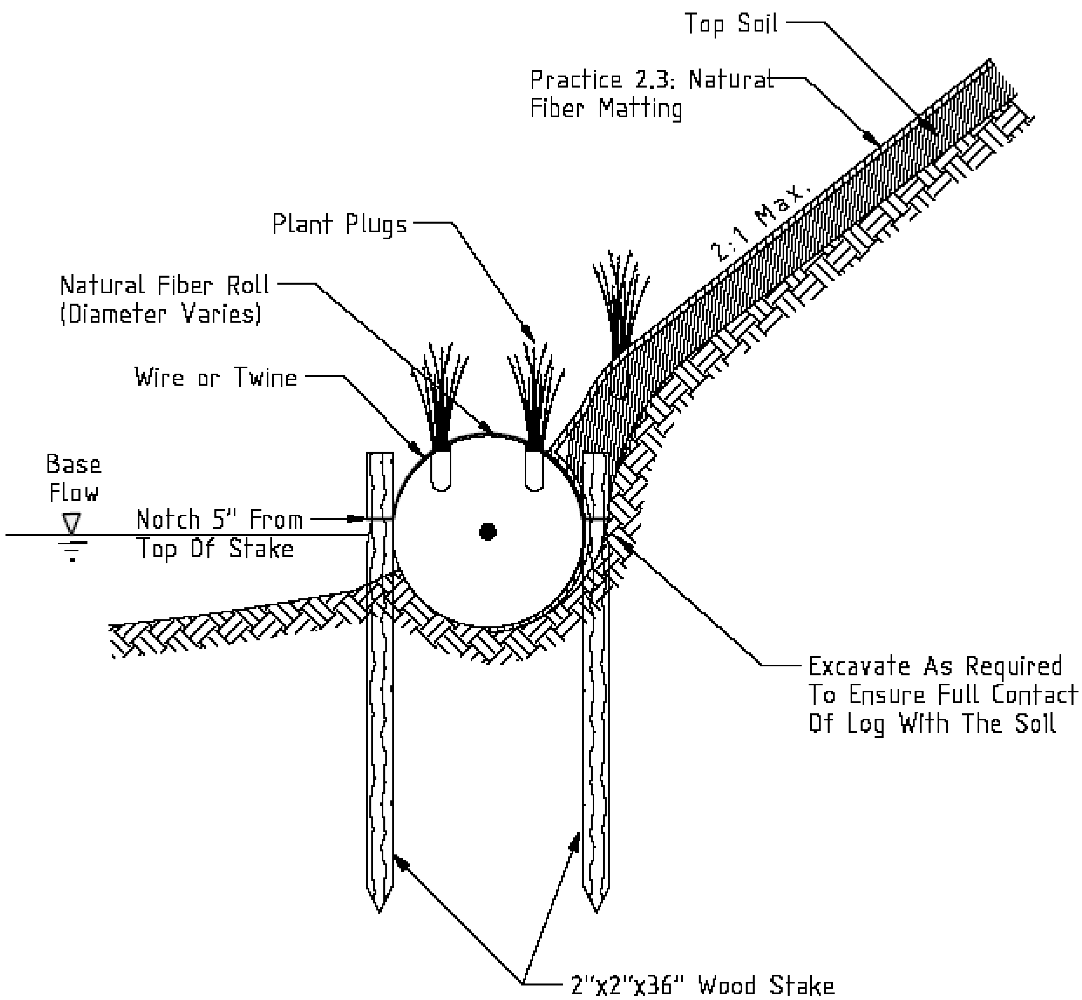
Materials will consist of 12 to 16 foot long tree trunks, minimum 12-inch diameter, with the root ball attached. Materials should be harvested on-site as much as possible. Smaller logs and boulders are also helpful to stabilize and support the root wads.

Root Wads

Bank Protection

BARR

Figure 4



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

Figure 5
Biologs Bank Protection
Bassett Creek Restoration Project
Bassett Creek Watershed Management Commission

Stream Stabilization Plan

Grade control measures are used where channel downcutting has occurred. Various types of weirs are commonly used to provide grade control on streams, particularly in steeper systems. Weirs can be constructed of sheetpile, concrete, or natural materials such as rock. In most cases, natural rock is used to emulate natural riffles. Large boulders would comprise the core of the structure, with smaller rock material placed on the upstream and downstream sides of the boulders to provide a gradual transition to the channel.

The riffles will serve to raise the surface of the water profile, and will reconnect the stream to its floodplain areas. Following the installation of the riffles, pools will be created upstream of the riffles. However, these pools will fill with sediment over time, which will in effect raise the channel bottom to the desired elevation.

MATERIALS

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

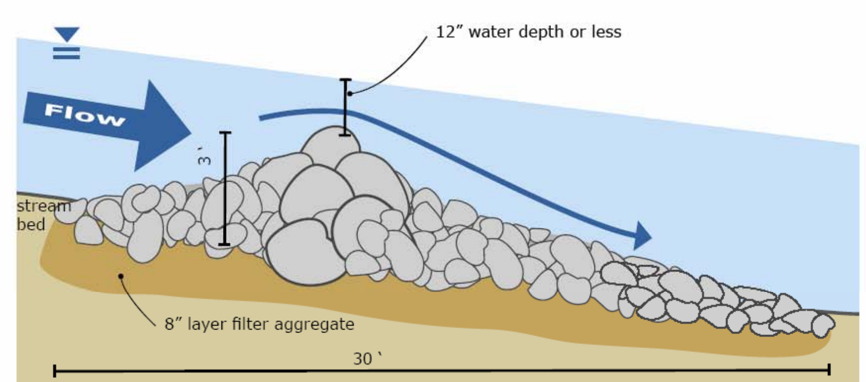
SIMILAR PROJECTS

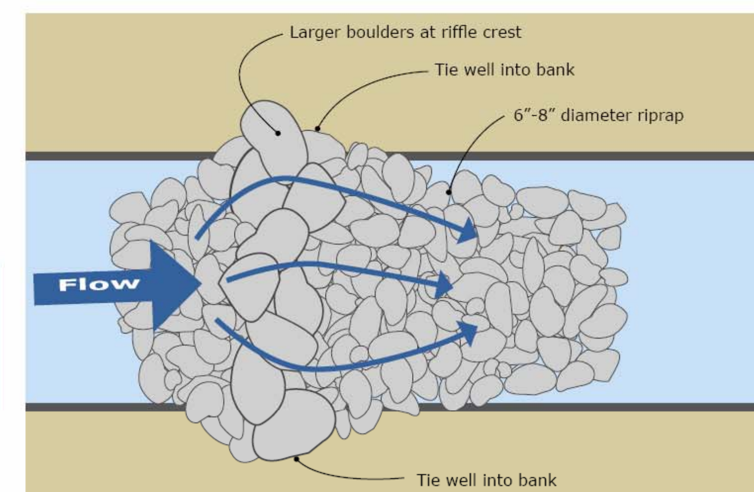
Following the 1987 "super storm," a rapids was constructed on Nine Mile Creek downstream of the 106th Street Bridge. The rapids was one of several grade-control structures that were installed on a three-mile stretch of creek in the lower valley. The proposal allowed the stream to continue its course while taking measures to protect areas where water flow was eroding valley walls. Protection measures included applying porous deflector dikes, burying sheetpile walls parallel to the creek to prevent undercutting of slopes, installing weirs (rock or capped sheetpile) to limit stream-bed degradation, and improving storm-sewer outlets.

EXISTING CONDITIONS

Channel incision occurs when there is an imbalance between the sediment supply and the sediment carrying capacity of the stream. Erosion will occur when the sediment carrying capacity of a stream exceeds the sediment supply. In streams with cohesive banks and steep channel slope, the erosion will first occur primarily on the channel bottom because that is where the erosive forces are the strongest. As the channel deepens, the stream will gradually become wider as the banks eventually fail. The stream will gradually return to equilibrium; however, the process can take many years and significant amounts of erosion will occur during the process.

SECTION/PLAN RENDERING





Constructed Riffle

Grade Control

BARR

Figure 6

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.

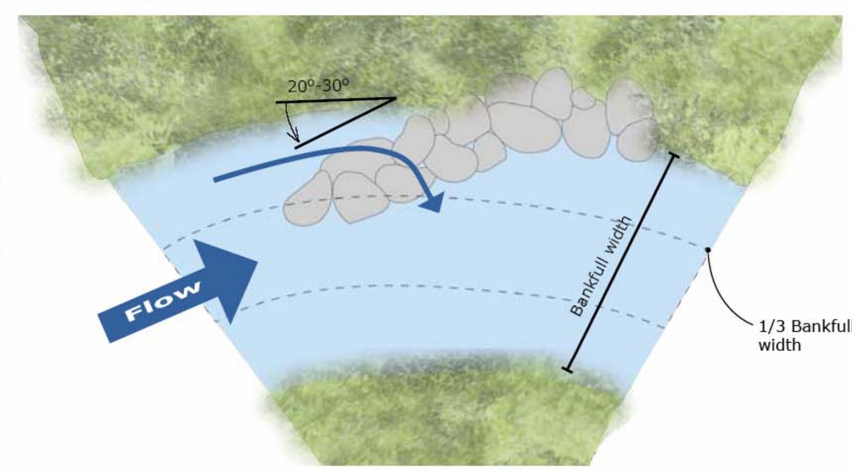
MATERIALS

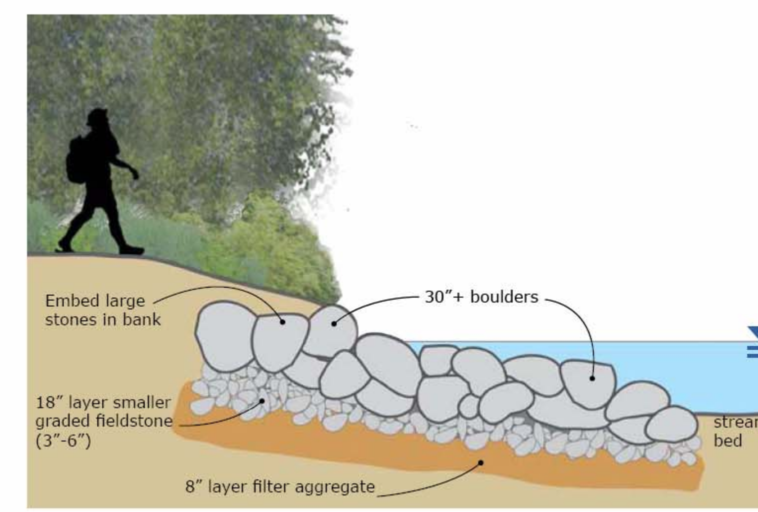
Materials will consist of various gradations of rock, ranging from large, 3-foot boulders to coarse gravel.

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





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).

Rock Vanes

Bank Protection

BARR

Figure 7

Stream Stabilization Plan

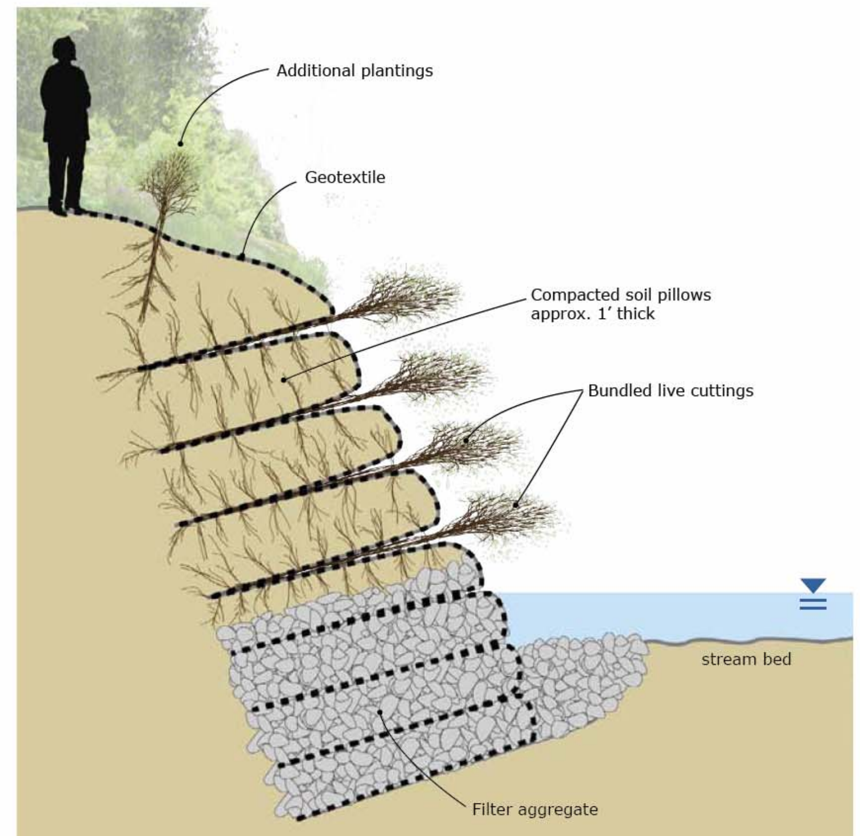
EXISTING CONDITIONS

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.

Soil Pillows are utilized in a bioengineering method known as Vegetated Reinforced Slope Stabilization (VRSS). The method combines rock, geosynthetics, soil and plants to stabilize steep, eroding slopes in a structurally sound manner. VRSS typically involves protecting layers of soils with a blanket or geotextile material (e.g. erosion control blanket) and vegetating the slope by either planting selected species (often willow or dogwood species) between the soil layers or by seeding the soil with desired species before it is covered by the protective material. In either case, with adequate light and moisture, the vegetation grows quickly and provides significant root structure to strengthen the bank. This method tends to be labor intensive and, therefore, relatively expensive.

SECTION RENDERING



In places where the channel is confined by the steep valley walls, however, fluvial bank erosion can lead to failure of the high banks. It can also undermine storm sewer inlets.

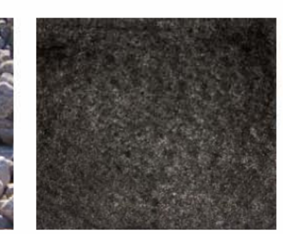
For sites where groundwater seepage is a problem and where it is desirable to maintain steep banks, soil pillows are a feasible solution.

SIMILAR PROJECTS

The Mill Creek Restoration Project utilized soil bioengineering design to stabilize 175 linear feet of severely eroding streambanks within the Caldwell Recreation Park in southeastern Ohio. The work included two 25-foot vegetated reinforced soil slope (VRSS) sections, two 50-foot fill bank sections protected with woven coir and direct woody plantings, and a 12.5-foot tie-in on the upstream and downstream end of streambank work area.

MATERIALS

Materials consist of graded rock for the lower layers of the structure and for internal drainage, if necessary. Geotextile fabric is used to wrap the soil. Plants, such as willow or dogwood, or seed mixture is used for planting in and between the soil pillows.



Soil Pillows

Bank Protection

BARR

Figure 8

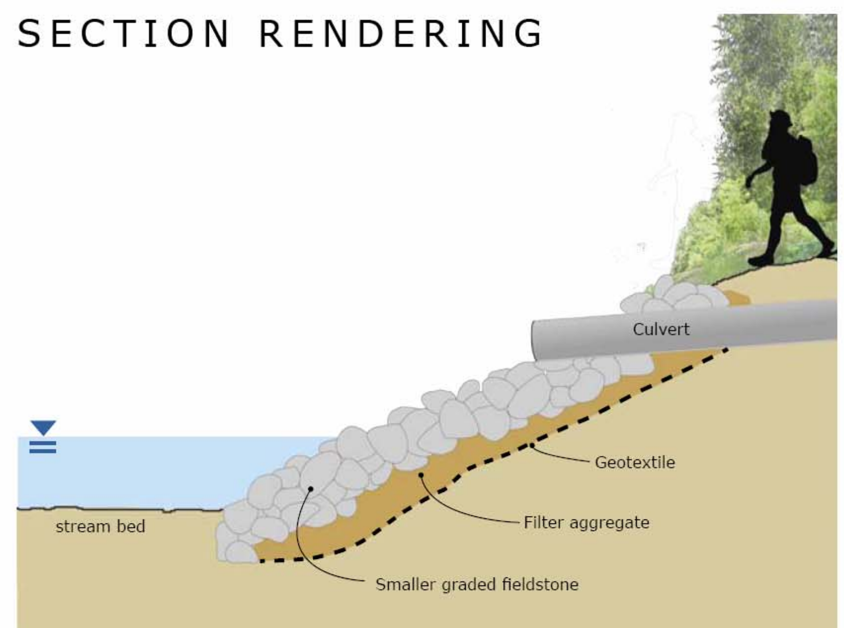
Stream Stabilization Plan

Culvert Stabilization is somewhat unique to each situation, depending on the site circumstances. Most sites require additional rock placement with a granular filter layer (rather than filter fabric). Some cases may require re-alignment and/or lowering of the outlet to better align with the stream channel. Typically, outlets should be aligned in the downstream channel direction so that flow doesn't impinge on the opposite bank. It is usually desireable for the culvert to enter the stream at or just above the normal water level in order to minimze the potential for undercutting.

EXISTING CONDITIONS

Erosion is frequently observed at culvert outlets for a variety of reasons, including insufficient erosion protection at the culvert outlet, streambank erosion, and channel downcutting, which leaves the culvert perched above the channel. Filter fabric is often used at culvert outlets to separate riprap protection from underlying soils, however the fabric provides a slippery surface for the riprap, which commonly slides into the channel.

SECTION RENDERING

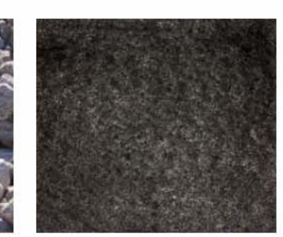


SIMILAR PROJECTS

There are many culvert stabilization designs used on various streams and rivers. Because they are often small projects, the work is often performed by local municipalities or completed as part of a larger project.

MATERIALS

Materials consist of rock materials ranging from graded riprap (either fieldstone, or, for steep slopes, angular) and granular filter material (typically coarse gravel). If necessary, additional pipe, manholes and end sections may be necessary.

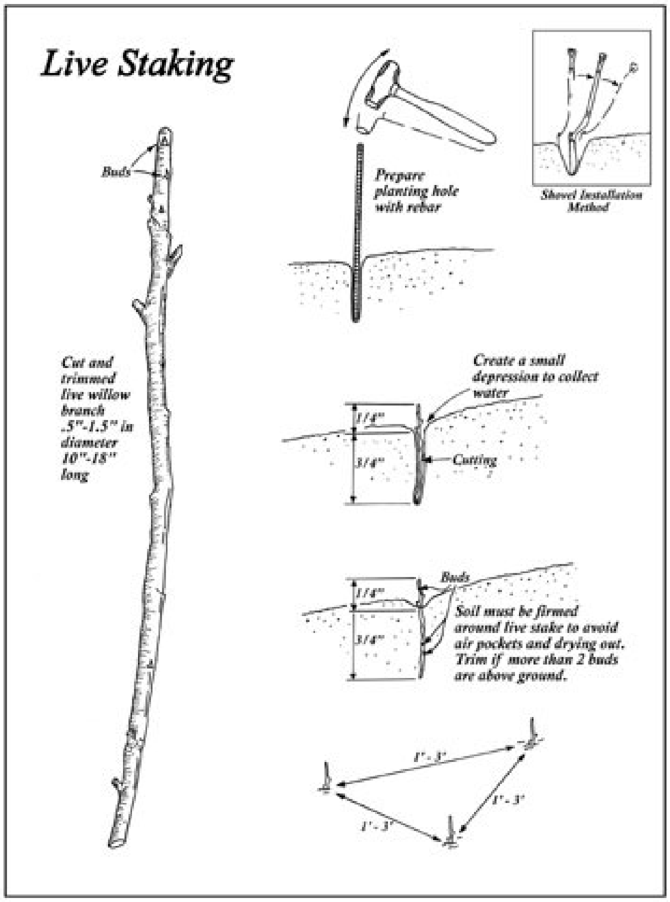




Culvert Stabilization

Bank Protection

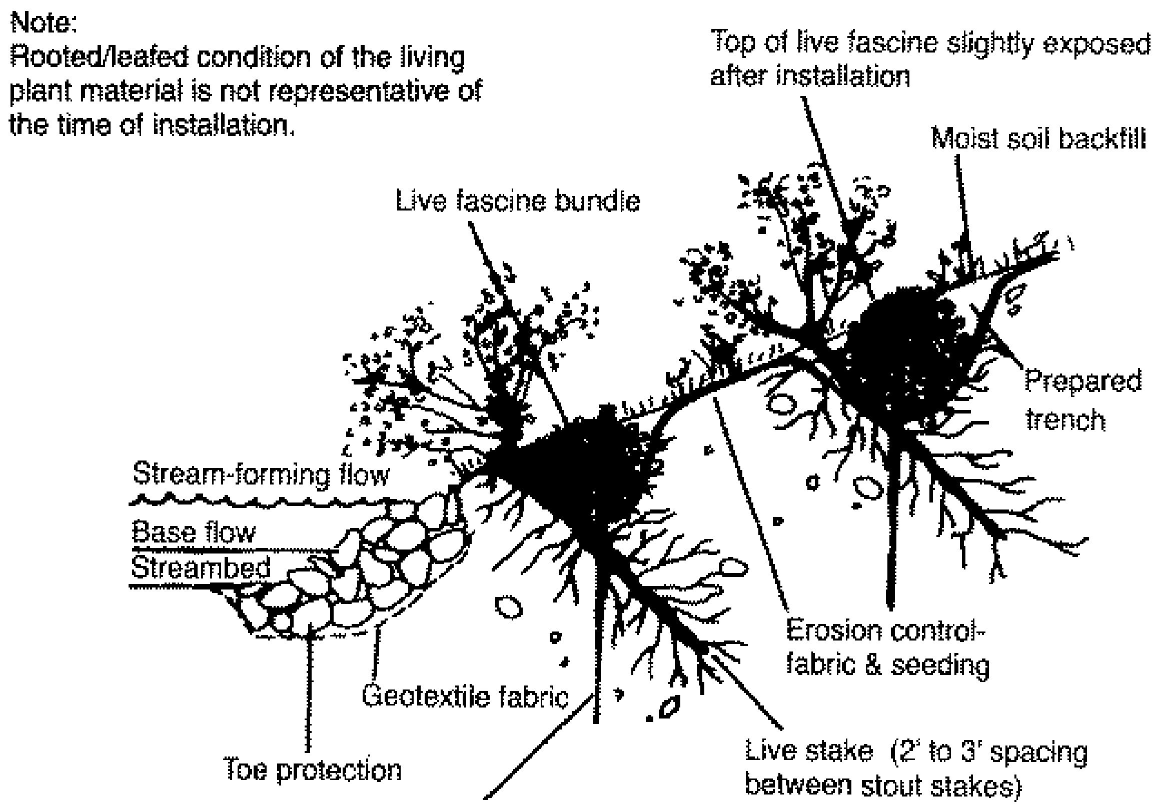
BARR

Figure 9



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

Figure 10
Live Stakes for Bank Protection
Bassett Creek Restoration Project
Bassett Creek Watershed Management Commission



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

Figure 11
Live Fascines for Bank Protection
Bassett Creek Restoration Project
Bassett Creek Watershed Management Commission

	2009						2010												2011											
Project Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Feasibility study to BCWMC & City	■	■																												
BCWMC review of feasibility study		■																												
BCWMC hearing & order project for 2010			■																											
BCWMC submit final 2010 tax levy amount to Hennepin County (Due by Oct. 1st)			■																											
BCWMC submit final 2011 tax levy amount to Hennepin County (Due by Oct. 1st)															■															
City of Golden Valley public input process															■	■	■	■	■	■	■	■								
City of Crystal public input process															■	■	■	■	■	■	■	■								
Project final design																■	■	■	■	■	■	■								
COE and other permits - COE permit may be issued as part of Resource Management Plan																	■	■	■	■	■	■								
BCWMC re-review of project, if needed																						■								
Project bidding and city council approval																							■	■						
Project contracting/notice to proceed																									■					
Project mobilization																										■	■			
Streambank restoration (*project could extend into 2012)																											■	■	■ *	

Figure 12

PROJECT SCHEDULE
Bassett Creek Reach 2 Restoration Project
Bassett Creek Watershed Management Commission

P:\Mpls\23 MN\27\2327051\WorkFiles\2009 Bassett Creek Feasibility Study\Project schedule.xls

Appendices

Appendix A

2009 Site Photos

Photo 1. *Site 1*. Moderate to severe erosion on an outside bank of a meander

Photo 2. *Site 2*. Minor erosion and undercut bank.

Photo 3. *Site 3*. Moderately eroding bank.

Photo 4. *Site 4*. Moderately eroding bank

Photo 5. *Site 5*. Bank at pedestrian bridge on outside bank of a meander.

Photo 6. *Site 6*. Severe erosion on outside bank of a meander.

Photo 7. *Site 7*. Erosion threatening walking trail.

Photo 8. *Site 8*. Moderate erosion.

Photo 9. *Site 9*. Bank is being undercut and will likely fall into stream in the future

Photo 10. *Site 10*. Minor bank undercutting that could lead to future erosion.

Photo 11. *Site 11*. Bank erosion near culvert under Highway 100.

Photo 12. *Site 12*. Severe bank erosion on private property.

Photo 13. *Site 13*. Moderate bank erosion.

Photo 14. *Site 14*. Moderate bank erosion.

Photo 15. *Site 15*. Minor bank erosion.