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Appendices B-F online

City of Golden Valley
7800 Golden Valley Road • Golden Valley, MN 55427

FEASIBILITY Report

February 7, 2014

DRAFT 2015 Bassett Creek Main Stem Restoration Project

City of Golden Valley
Hennepin County, Minnesota

WSB Project No. 2032-06

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DRAFT FEASIBILITY STUDY FOR 2015 BASSETT CREEK MAIN STEM RESTORATION PROJECT

For:

City of Golden Valley

February 12, 2014

Prepared By:

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CERTIFICATION

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.

Todd Hubmer, P.E. Reg. No. 24043

TABLE OF CONTENTS

TABLE OF CONTENTS

1 Introduction

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 Rhode Island Avenue and 10th Avenue to the south side of Duluth Street, located within the City of Golden Valley ***(Figure 1).***

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 (RMP). Although this reach is not included in the RMP, the reach fits with the intent of the RMP due to its proximity and similarity to the other stream projects.

Restoration of sites along this reach is proposed to be included as a group for design and construction in the BCWMC 2015 CIP.

1.2 General Project Description and Estimated Cost

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

- Removal of hazard and invasive trees and vegetation
- Reshaping and stabilization of eroded streambanks
- Installation of a variety of stream stabilization measures and flow diversion methods to address erosion problems, including biologs, rock vanes, boulders, riprap, live stakes, and native vegetation and plantings
- Repair of storm sewer outfalls, and other failing infrastructure along the creek
- Establishing native vegetation, trees, and shrubs along the creek
- Removal of miscellaneous debris from within the creek

This study has been developed to provide two restoration options for the project. These options include a bioengineering approach and a more engineered or hard armoring approach. The options have been developed due to the anticipation of property owners' preferences for limited maintenance of stabilization practices and for the potential of considerable tree removals on private property that will be necessary to complete the project.

This study identifies 29 locations for both restoration options ***(Figure 2 & 3)*** and ***(Table 2a & 2b)*** identify the locations of the sites and provide detail of the selected methods.

The estimated feasibility cost for the implementation for each of the restoration measures for the 2015 Bassett Creek Main Stem Restoration project ranges from $1,319,109 to $1,659,434, as shown on (***Table 3a & 3b)***. These estimated costs are currently greater than the project budget. Once the design options have been finalized and property owners engaged, the maintenance areas will be prioritized according to the following priorities until the budget amount is reached:

1. Stabilization of all stream crossing and storm sewer outfalls
2. Improvements on property currently owned by the City in Areas A and E.
3. Privately owned land in Area D with the most extreme erosion issues where land owners have provided access.
4. Most extreme areas located within golf course property.

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, even though the project it primarily located on private property.

1.3 Recommendations

Stabilization of this reach of the Main Stem of Bassett Creek will provide downstream water quality improvement by restoring actively eroding streambanks, preventing erosion at other sites using preemptive protective measures, improving failing infrastructure, and improving the overall wildlife habitat along the Creek.

It is recommended that the BCWMC CIP include restoration work on this reach of Main Stem of Bassett Creek for 2015. It is further recommended that the restoration of this reach of the Bassett Creek Main Stem proceed into the design and construction phase.

2 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 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 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 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 10th Avenue and Rhode Island Avenue, on the south, and extending north about 9,500 feet to the southerly edge of Duluth Street, just east of Adair Ave ***(Figure 1).***

The 2013 Golden Valley Erosion Site Survey identified numerous problem areas along the project area of Bassett Creek within the City of Golden Valley. The problems include a heavy tree canopy of volunteer trees; degraded vegetative diversity; invasive species of trees, vegetation, and shrubs; areas of active streambank erosion; deposition of sediments; and failing infrastructure.

The work to restore the channel in this area has been requested by the City of Golden Valley, which has very little ownership of or easement rights to the property adjacent to the creek. Restoration of the sites along this reach is proposed to be included as a group for design and construction in the BCWMC's 2015 CIP.

2.1 Goals and Objectives

The objective of this study is to review the feasibility of implementing measures to stabilize stream banks, re-establish desirable vegetation along the reach, and to provide improvements to the existing infrastructure along Bassett Creek. In addition, this study will provide conceptual designs and costs estimated for the measures that could potentially be used at each of the selected erosion sites.

2.1.1 Scope

The City of Golden Valley completed an erosion inventory along Bassett Creek in 2013. This inventory identified 18 areas of streambank erosion, along with several hazard trees, and infrastructure repair locations. WSB and Associates, Inc. (WSB) staff performed a channel survey on August 8, 2013 which confirmed these sites and updated the information, including adding several more sites. Many of these individual sites are grouped within the project areas 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. City of Golden Valley staff were also involved with selecting the final sites.

2.1.2 Streambank Stabilization

The goals of the stream stabilization project include:

- Stabilize eroding banks to improve water quality and to protect property and infrastructure.

- Improve upon the natural beauty and habitat along Bassett Creek by stabilizing eroded areas along the creek and establishing native vegetation and plantings adjacent to the restored areas.

- Prevent future channel erosion along the creek and the resultant negative water quality impact on downstream water bodies.

2.1.3 Considerations

- Restoration activities must minimize floodplain impacts. Several businesses and residences are located near the creek and it is critical for the proposed project to not increase flood elevations that impact these properties.

- Existing floodplain storage and cross sectional areas must be maintained.

- Opportunities to enhance vegetation and habitat within the reach should be sought out.

2.2 Background

2.2.1 Reach Description

This reach of the Bassett Creek Main Stem ***(Figure 1)*** extends approximately 9,500 feet from 10th Avenue and Rhode Island Avenue the south, to the southerly edge of Duluth Street, just east of Adair Avenue. Land use adjacent to this reach is single family and golf course along with some high density residential or commercial.

WSB staff inspected the Creek on August 8, 2013and identified a total of 29 sites that require stabilization to address bank erosion or bank failure, and infrastructure repairs. In addition, there is a considerable amount of debris, fallen trees, gabion baskets, and block walls that need to be removed from the Creek. The City of Golden Valley completed an erosion inventory along this reach of Bassett Creek in 2013. This inventory identified 18 individual erosion locations. WSB staff confirmed most of the sites and added several more. Several of these individual sites are grouped within the 29 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.

The total length of identified bank erosion is approximately 11,000 feet. Photos of each of the erosion sites are found in ***(Appendix B)***. The bank failures along this reach appear to be caused by a combination of natural stream erosion processes, changing watershed hydrology, and a heavy volunteer tree canopy limiting light penetration, limiting stabilizing vegetation growth. 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.

2.2.2 Past Documents and Activities Addressing this Reach

City of Golden Valley Erosion Site Inventory (2013)

In 2013 the City of Golden Valley completed an erosion inventory and assessment on the Bassett Creek Main Stem as it flows through its jurisdiction. This inventory identified 18 individual erosion locations within this portion of Bassett Creek.

City 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 noting the 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:

- Lack of stabilization vegetation, heavy tree canopy
- Steep slopes and direct drainage to the Creek
- Storm sewer outfalls discharging above the normal water level of the creek or having no energy dissipation at the outfall
- Incising of the stream channel and cut bank formation due to elevated flow rates. The City of Golden Valley Erosion Site Inventory is included here as ***(Appendix E).***

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 minor, moderate, and severe channel erosion levels. 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 and 500 pounds of phosphorus annually. This is 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.

Stabilization of this reach of the Main Stem of Bassett Creek is estimated to have a cost per pound of phosphorus removed is estimated at $2,000 per pound.

BCWMC Watershed Management Plan (2004)

The BCWMC Watershed Management Plan (2004) 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 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 10-Year CIP. The BCWMC then identified 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.

The reaches identified have experienced increased stream bank erosion, streambed aggradation, or scour. These erosion and aggradation processes are a combination of natural and artificial processes due to increased runoff volumes and higher peak discharges in these reaches 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 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 (complete)	$965,000
Bassett Creek Main Stem, Reach 2; Crystal border to Regent Ave.	2010 (complete)	$636,000
Bassett Creek Main Stem, Reach 1; Duluth St. to Crystal Border	2011 (complete)	$580,200
North Branch	2011 (complete)	$834,900
Bassett Creek Main Stem 2012; Golden Valley Road to Irving Ave. No.	2012 (ongoing)	$600,000
Plymouth Creek, Reach 2 (PC-2)	2015	$559,000
Bassett Creek Main Stem 2105: 10th Ave to Duluth Street	2015	$1,000,000

[1] Costs as estimated in revised 2011 CIP

3 Site Characteristics

3.1 Bassett Creek Watershed

The watershed area tributary to this reach of Bassett Creek is approximately 25,000 acres and includes a significant portion of the Bassett Creek watershed. The upstream watershed drains all or portions of Plymouth, Minnetonka, Medicine Lake, New Hope, St. Louis Park, Crystal, and Golden Valley. 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 9,500 feet from 10th Avenue and Rhode Island Avenue to the south, and to the southerly edge of Duluth Street, just east of Adair Avenue. The stream is relatively shallow in most places except for occasional deep pools. Portions of this reach were converted into ditches in the 1900s through the 1920s. The riparian vegetation in this reach varies considerably depending on adjacent land use. Much of the reach contains unmanaged woody vegetation. Some banks within golf course 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.

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

3.3 Site Access

Access to the creek and the maintenance sites will be easy, with the most difficult location being south of St. Croix Avenue. However, the creek is surrounded primarily by private property and if access is not granted to the locations by the residents, maintenance in these areas cannot be completed.

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.

Six wetlands totaling approximately 1.54 acres were identified and field delineated. The wetlands border the Main Stem for the extent of the study area are Type 1L, or Seasonally Flooded Basins or Floodplains. In addition, MNRAM functional wetland assessments were also performed. Due to the nature and scope of the proposed 2015 project, it is our opinion that the proposed stream bank restoration activities will require a DNR Work within the Bed of Public Waters permit, and would qualify for a No-Loss determination (under the WCA) and Regional General Permit (Section 404). The DNR's work within the Bed of Public Waters Permit, WCA, and Section 404 regulatory approvals would likely not require wetland replacement plan or wetland mitigation.

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

3.5 Cultural and Historical Resources

A reconnaissance survey of Sites 1 through 29 was completed during in September 2013 to determine if any sites may require further investigation for cultural or historical importance. The survey was completed by reviewing historical aerial photographs, interviewing local residents, and walking the relevant reaches to observe conditions on the ground. The survey found no sites with enough archeological potential that justify further investigation before any construction disturbance to the area. The full report of the archeological reconnaissance survey, including figures, is included in ***Appendix D.***

3.6 Phase I Environmental Assessment

WSB was retained by the City of Golden Valley (the City) to conduct a Phase I Environmental Site Assessment (ESA) of the 2015 Bassett Creek Main Stem Restoration Project which consists of a 1.7 mile reach of Bassett Creek from Rhode Island Ave north to Duluth Street in Golden Valley, Hennepin County, Minnesota (the subject property). The objective of the assessment was to identify Recognized Environmental Conditions (RECs) associated with the property according to ASTM E1527-13 "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessments". See ***Appendix E*** for further the complete report.

The subject property is located in residential, recreational, and commercial parcels within Sections 28, 29, and 32, Township 118 North, and Range 21 West, in Hennepin County, Minnesota. For the purposes of this assessment, the subject property consisted of a 200-foot-radius from the Bassett Creek Main Stem along the 1.7 mile creek reach. A subject property location map is included as ***Figure 1***.

The Phase I ESA is being conducted in support of a proposed creek restoration project that will involve excavation, grading, bank stabilization, and tree removal within the subject property boundary. For ease of discussion, the subject property is divided into five different areas (Areas A-E) as illustrated on ***Figure 1.***

WSB has performed this Phase I ESA in conformance with the scope and limitations of ASTM Practice E1527-13. Exceptions to and deletions from this practice are described in **Section 2.3** of this Phase I ESA. This Phase I ESA has been prepared exclusively for the City of Golden Valley. No additional parties may rely on the contents of this report unless written authorization is obtained from WSB.

This Phase I ESA has revealed no recognized environmental conditions (RECs) associated with the subject property.

Additionally, 15 potential environmental sites were identified during this Phase I ESA and the following environmental items should be noted:

3.6.1 Adjoining and Surrounding Releases

The regulatory database search identified two adjoining properties and five surrounding area properties (located within 500 feet of the subject property) that have documented releases. There is a potential that these releases have impacted the property soil and/or sediment. The majority of these releases have been issued "site closure" by the MPCA indicating the identified contamination, if present, does not appear to pose a threat to public health or the environment under current conditions (note: site closure does not indicate the site is free of contamination) or have been determined to be small in scale and not require additional investigation and/or cleanup. The adjoining property releases are highlighted on the potential environmental sites map included in ***Appendix E***.

4 Potential Improvements

4.1 Description of Potential Improvements

As described in **Section 1.2**, the project along the 2015 Bassett Creek Main Stem Restoration Project reach consists of two options and a variety of stream stabilization measures to address erosion problems. ***Figures 2 & 3*** show the identified stabilization sites and ***Tables 2a & 2b*** list 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.

4.1.1 Slope Shaping

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. **Figure 4** illustrates this practice.

4.1.2 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 12 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.

4.1.3 Biologs with Fieldstone

Biologs are natural fiber rolls made from coir fiber that are laid along the toe of the stream bank slope along with a one foot section of Class II Fieldstone Rip Rap to stabilize the toe of the stream bank. Biologs 12 inches in diameter are typically used. Because they are made of natural fiber, vegetation can grow on the biologs while the Fieldstone Rip Rap provides a slightly greater stabilization characteristic. 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.

4.1.4 Live Fascines

Live fascines 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 6** illustrates this practice.

4.1.5 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 planting or seeding native vegetation on the slope. The vegetation's root systems provide the long-term slope stabilization. **Figure 7** illustrates this practice.

4.1.6 Root Wads

Root wads are constructed from root balls with sections of their tree trunks attached. Removed trees will be salvaged for 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 8** illustrates this practice.

4.1.7 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 inexpensively establishing woody vegetation on a stream bank. The willows and dogwoods grow into stands that provide long lasting bank protection. **Figure 9** illustrates this practice.

4.1.8 Rock Vanes

Rock vanes (also called J 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. Rock vanes typically occupy no more than one-third of the channel width. **Figure 10** illustrates this practice.

4.1.9 Fieldstone Riprap

Fieldstone 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 (6 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 11** illustrates this practice.

4.1.10 Fieldstone Boulder

Boulders are used to protect the toe of the stream bank. In-stream boulders typically consist of rocks (24 to 36 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 12** illustrates this practice.

4.1.11 Maintenance

Maintenance of newly planted vegetation to protect it from poor survival rates of individual plants and encroachment by invasive species is crucial to the success of stabilization projects. The cost estimates in this study include a three year warranty and maintenance for establishment of vegetation as specified in the contract documents.

Table 2a – Potential Stabilization Measures at Each Site.

Potential Bioengineering Stabilization Measures for Each Site			
Site Number	**Station**	**Potential Stream Stabilization Practice[1]**	**Photos[2]**
1	1+50	Remove 30 in Cotton Wood Tree	1
2	0+50- 8+00	Reshape and Stabilize Streambanks with 12 in Biolog and 12 in Live Fascine (1,500 ft) Remove 120 Trees	2
3	4+50	Remove 36 in Cottonwood Tree	-
4	5+75	Remove 42 in Cottonwood Tree	-
5 & 6	8+00 & 9+00	Remove Existing Gabions and Grouted Rip Rap at Culvert Place 30 tons of Class III Fieldstone Rip Rap at Each End of Culvert	3
7	36+50 to 41+50	Reshape and Stabilize Streambanks with 12 in Biolog with 1 ft section of Class II Fieldstone Rip Rap (1,000 ft) Install 6 Root Wads Install 6 Rock Vanes Remove 75 Trees	4
8	43+25	Remove 68 in Cottonwood Tree	-

9	42+50 to 45+50	Reshape and Stabilize Streambanks with 12 in Biolog and a 1 ft Section of Class II Fieldstone Rip Rap (600 ft) Install 5 Root Wads Install 5 Rock Vanes Remove 75 trees	5
10	48+00 to 53+50	Reshape and Stabilize Streambanks with 12 in Biolog and a 1 ft Section of Class II Fieldstone Rip Rap (1100 ft) Install 5 Root Wads Install 5 Rock Vanes Remove 80 Trees	6
11	50+90	Stabilize 12 in FES	7
12	54+75	Remove 66 in Cottonwood Tree	-
13	56+00	Remove (5) 50 in and greater Cottonwood Trees	8
14	54+50 to 58+70	Reshape and Stabilize Streambanks with 12 in Biolog and 1 ft Section of Class II Fieldstone Rip Rap (840 ft) Remove 75 Trees	9
15	58+70 to 59+70	Reshape and Stabilize Streambanks with a 6 ft section of Fieldstone Boulders (840 ft)	10
16	65+20	Reattach FES and Pipe Tie joints Reinstall sheet piling under FES	11
17	62+75	Install 8" Galvanized FES on 8 in CMP	12
18	63+80 to 64+60	Remove block wall (80 ft)	13
19	65+50 to 80+50	Reshape and Stabilize Streambanks with 12 in Biolog and 1 ft Section of Class II Fieldstone Rip Rap (3,600 ft) Install 28 Root Wads Install 25 Rock Vanes Remove 200 Trees	14
20	68+50 to 71+00	Stabilize streambank with VRSS (305 sq yd)	15
21 & 22	76+00 & 77+00	Install Turf Reinforcement Mat on Peninsulas (700 sq yd)	-
23	83+00 to 94+00	Reshape and Stabilize Streambanks with 12 in Biolog and 12 in Live Fascine (2,200 ft) Install 18 Root Wads Install 17 Rock Vanes Remove 175 Trees	16
24	86+50 to 86+70	Remove gabion baskets (20ft)	17
25	87+60	Install FES on 12 in and 24 in RCP pipe	18
26	87+90	Install Galvanized FES on 12 in PVC pipe	19

27	89+25	Install FES on 12 in RCP and PVC pipe	20
28	89+90	Install FES on 12in RCP	21
29	90+80 to 91+00	Remove gabion baskets (20 ft)	-

[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 B.

Table 2a – Potential Stabilization Measures at Each Site.

Potential Engineered (Harder Armoring) Stabilization Measures at Each Site			
Site Number	**Station**	**Potential Stream Stabilization Practice[1]**	**Photos[2]**
1	1+50	Remove 30 in Cotton Wood Tree	1
2	0+50-8+00	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (1,500 ft) Remove 50 trees	2
3	4+50	Remove 36 in Cottonwood Tree	-
4	5+75	Remove 42 in Cottonwood Tree	-
5 & 6	8+00 & 9+00	Remove Existing Gabions and Grouted Rip Rap at Culvert Place 30 tons of Class III Fieldstone Rip Rap at Each End of Culvert	3
7	36+50 to 41+50	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (1,000 ft) Remove 50 Trees	4
8	43+25	Remove 68 in Cottonwood Tree	-
9	42+50 to 45+50	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (600 ft) Remove 30 trees	5
10	48+00 to 53+50	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (1100 ft) Remove 40 Trees	6
11	50+90	Stabilize 12 in FES	7
12	54+75	Remove 66 in Cottonwood Tree	-
13	56+00	Remove (5) 50 in and greater Cottonwood Trees	8
14	54+50 to 58+70	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (840 ft) Remove 20 Trees	9
15	58+70 to 59+70	Reshape and Stabilize Streambanks with a 6 ft section of Fieldstone Boulders (840 ft)	10
16	65+20	Reattach FES and Pipe Tie joints Reinstall sheet piling under FES	11

17	62+75	Install 8" Galvanized FES on 8 in CMP	12
18	63+80 to 64+60	Remove block wall (80 ft)	13
19	65+50 to 80+50	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (3,600 ft) Remove 130 Trees	14
20	68+50 to 71+00	Reshape and Stabilize Streambank with 9 ft Fieldstone Boulder section (250 ft)	15
21 & 22	76+00 & 77+00	Install Turf Reinforcement Mat on Peninsulas (700 sq yd)	-
23	83+00 to 94+00	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (2,200 ft) Remove 80 Trees	16
24	86+50 to 86+70	Remove gabion baskets (20ft)	17
25	87+60	Install FES on 12 in and 24 in RCP pipe	18
26	87+90	Install Galvanized FES on 12 in PVC pipe	19
27	89+25	Install FES on 12 in RCP and PVC pipe	20
28	89+90	Install FES on 12in RCP	21
29	90+80 to 91+00	Remove gabion baskets (20 ft)	-

[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 B

4.2 Project Impacts

4.2.1 Easement Acquisition

Nearly all of the work sites are located on property with very little easements or right-of-way. Temporary construction easements or temporary rights-of-entry are not included in the opinion of cost and are not expected to have significant effect on the total cost.

4.2.2 Permits Required for Project

The proposed project will require:

1. 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), a
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.

4. City of Golden Valley Stormwater Permit
5. City of Golden Valley ROW Permit

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 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 D.*** 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. The City of Golden Valley is the LGU for the proposed project. The Minnesota Board of Water and Soil Resources (BWSR) oversees the 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, the potential risk for encountering unexpected environmental conditions at the time of construction, particularly given the urban environment surrounding this project remains. 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 City of Golden Valley requires permits for grading work within their jurisdiction. Their requirements should be reviewed in the context of each site's work.

4.2.3 Other Project Impacts

Tree Loss

There are considerable tree removals associated with this project. Due to the anticipated tree removals, two restoration options have been developed to mitigate tree loss. Option 1 has a proposed tree removal of approximately 800 trees. Option 2 has a proposed tree removal of approximately 400 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 project costs include tree replacement at each location with replacement ratio based on the type of streambank repair being made.

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 Estimated Project Cost

4.3.1 Estimated Cost

The feasibility level estimated of project cost for the 2015 Bassett Creek Main Stem Restoration Project is **$1,000,000** for design and construction. The opinion of cost uses the following assumptions:

- 40% of project costs will be utilized for final design, permitting, construction observation, and contingency.

- Construction easements will not be needed. If construction easements are necessary to construct the project, the cost is expected to be included in the contingency.

- The estimated cost includes testing stream bank material for hazardous compounds that would require treatment of the dredged materials per MPCA regulations.

- 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 1:8 for the bioengineering approach and 1:4 with the more engineered approach.

- The construction contract(s) will include a three year maintenance and warranty for new vegetation.

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) 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 ***Tables 3a & 3b***. ***Figures 2 & 2*** show the corresponding site numbers and stationing referenced**.**

The feasibility level opinion of cost provided in this report is made on the basis of WSB'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 WSB at this time and includes a conceptual-level design of the project.

4.3.2 Anticipated Project Lifespan

Anticipated lifespan for bioengineering and more engineered restoration practices can very considerably depending on watershed characteristics, existing tree canopy, and the typical maintenance regiment each restoration technique receives.

Within this reach of Bassett Creek it is anticipated that the bioengineering restoration methods would be viable as long as the tree canopy does not become too dense and would reduce sunlight penetration. This timeframe would be consistent with the reestablishment of volunteer and invasive trees shrubs reestablishing themselves along the streambanks, which would likely be about 10 to 15 years. In addition to management of the surrounding forest along the creek, most of this reach is located on private property and it is difficult to anticipate the level of maintenance each resident may provide, which may significantly reduce its lifespan.

More engineered practices restoration practices will have a considerable longer lifespan within this reach due to remain stable with limited sunlight penetration and its reduced maintenance requirements. It is anticipated that the life span of a more engineered stabilization approach would be over 20 years.

4.3.3 30 Year Maintenance Costs

Estimated 30 year costs for each design alternative is difficult to anticipate due to the greater portion of the project being located on private property and the ability to gain access to the restored areas and the amount of additional restoration required on private property. It is estimated that the annual maintenance of the bioengineering practices would be about $5,000 a year for tree clearing, vegetation restoration along the creek, and private property restoration, which comes to approximately $0.50 a foot along this reach 9,400 foot long reach. It is estimated that the annual maintenance of the more engineered practices would be about $1,000 a year for tree clearing, vegetation restoration along the creek, and private property restoration, which comes to approximately $0.10 a foot along this 9,400 foot long reach. Estimated 30 year costs for the bioengineering restoration, at an estimated 3% and 4% annual inflation rate, ranges from $248,005 to $266,657. . Estimated 30 year costs for the more engineered restoration, at an estimated 3% and 4% annual inflation rate, ranges from $128,005 to $146,657.

4.3.4 Analysis of the Benefits and of each Restoration Alternative

Analysis of each of the stabilization and restoration methods provides positives and negatives for each method. Bioengineering practices are more preferable and natural method to restore the creek due to the ability to provide more biodiversity and wildlife habitat along this reach. However, the bioengineering approach does allow for a certain amount of natural streambank erosion and meandering of the creek to occur, which can be problematic within the creeks tight confines on private property. In addition, the bioengineering methods do require routine maintenance over time and due to the proximity of the project on private property, this makes it difficult for the City to provide regular maintenance and it is difficult to depend on local residents to provide the level of maintenance required to keep the bioengineering method viable.

The more engineered approach does not provide as much biodiversity, it does not allow for as much natural erosion and meandering to occur by provide a more stable channel, which may be requested by the adjacent residents. In addition, the more engineered approach does not require the routine maintenance of vegetation management and tree clearing, thus reducing the overall maintenance. Additionally, steps can also be added to the more engineered method to provide additional vegetation and habitat on the upper slopes that can be a little more shade tolerant and lower maintenance.

It is anticipated that this project will incorporate both bioengineering and more engineered approaches to the project based on access to the creek, property owner input, and the ability to clear trees along the corridor.

4.4 Funding Sources

The City of Golden Valley proposes the utilization of BCWMC capital improvement program (CIP) funds to fund 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 anticipated to begin in spring of 2014. Permits for the project will be submitted in the late spring of 2014. The construction work will likely be completed during the winter of 2014 - 2015. For project work to occur in 2014, the BCWMC must hold a public hearing and order the project in time for the BCWMC's submittal of its 2015 ad valorem tax levy request to Hennepin County in September 2014. 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 City will gather public input, prepare the final design, and obtain permits.

Table 3a. Site Locations, Potential Bioengineering Stream Stabilization Practices, and Overall Opinion of Cost for the 2015 Bassett Creek Main Stem Restoration Project.

Site Locations, Potential Stream Stabilization Practices, and Overall Opinion of Cost for the 2015 Bassett Creek Main Stem Restoration Project.				
Site Number	**Site Station[1]**	**Site Length (ft)**	**Proposed Stream Stabilization Practice**	**Estimate Site Expense**
1	1+50	-	Remove 30 in Cotton Wood Tree	$2,000.00
2	0+50-8+00	750	Reshape and Stabilize Streambanks with 12 in Biolog and 12 in Live Fascine (1,500 ft) Remove 120 Trees	$171,000.00
3	4+50	-	Remove 36 in Cottonwood Tree	$2,000.00
4	5+75	-	Remove 42 in Cottonwood Tree	$2,000.00
5 & 6	8+00 & 9+00	100	Remove Existing Gabions and Grouted Rip Rap at Culvert Place 30 tons of Class III Fieldstone Rip Rap at Each End of Culvert	$6,000.00
7	36+50 to 41+50	500	Reshape and Stabilize Streambanks with 12 in Biolog with 1 ft section of Class II Fieldstone Rip Rap (1,000 ft) Install 6 Root Wads Install 6 Rock Vanes Remove 75 Trees	$68,250.00
8	43+25	-	Remove 68 in Cottonwood Tree	$2,000.00
9	42+50 to 45+50	300	Reshape and Stabilize Streambanks with 12 in Biolog and a 1 ft Section of Class II Fieldstone Rip Rap (600 ft) Install 5 Root Wads Install 5 Rock Vanes Remove 75 trees	$56,250.00

10	48+00 to 53+50	550	Reshape and Stabilize Streambanks with 12 in Biolog and a 1 ft Section of Class II Fieldstone Rip Rap (1100 ft) Install 5 Root Wads Install 5 Rock Vanes Remove 80 Trees	$84,700.00
11	50+90	-	Stabilize 12 in FES	$1,000.00
12	54+75	-	Remove 66 in Cottonwood Tree	$2,000.00
13	56+00	-	Remove (5) 50 in and greater Cottonwood Trees	$10,000.00
14	54+50 to 58+70	420	Reshape and Stabilize Streambanks with 12 in Biolog and 1 ft Section of Class II Fieldstone Rip Rap (840 ft) Remove 75 Trees	$62,450.00
15	58+70 to 59+70	100	Reshape and Stabilize Streambanks with a 6 ft section of Fieldstone Boulders (840 ft)	$102,500.00
16	65+20	-	Reattach FES and Pipe Tie joints Reinstall sheet piling under FES	$10,000.00
17	62+75	-	Install 8" Galvanized FES on 8 in CMP	$750.00
18	63+80 to 64+60	80	Remove block wall (80 ft)	$500.00
19	65+50 to 80+50	1500	Reshape and Stabilize Streambanks with 12 in Biolog and 1 ft Section of Class II Fieldstone Rip Rap (3,600 ft) Install 28 Root Wads Install 25 Rock Vanes Remove 200 Trees	$275,900.00
20	68+50 to 71+00	250	Stabilize streambank with VRSS (305 sq yd)	$76,250.00
21 & 22	76+00 & 77+00	100	Install Turf Reinforcement Mat on Peninsulas (700 sq yd)	$8,500.00

23	83+00 to 94+00	1100	Reshape and Stabilize Streambanks with 12 in Biolog and 12 in Live Fascine (2,200 ft) Install 18 Root Wads Install 17 Rock Vanes Remove 175 Trees	$184,050.00
24	86+50 to 86+70	20	Remove gabion baskets (20ft)	$1,000.00
25	87+60	-	Install FES on 12 in and 24 in RCP pipe	$2,000.00
26	87+90	-	Install Galvanized FES on 12 in PVC pipe	$750.00
27	89+25	-	Install FES on 12 in RCP and PVC pipe	$1,500.00
28	89+90	-	Install FES on 12in RCP	$1,000.00
29	90+80 to 91+00	20	Remove gabion baskets (20 ft)	$1,000.00
			Construction Subtotal	$1,135,350.00
			Construction Contingency (20%)	$227,070.00
			Design, Permitting and Administration (15%)	$170,302.50
			Contingency for Contaminated Soils(3%)	$34,060.50
			Additional Cultural and Historical Investigation	$ 7,500.00
			3- Year Vegetation Warranty and Manteca Period (7.5%)	$85,151.25
			Total	$1,659,434.25

[1] Steam Stationing: 0+00 is located at the end of the culvert north of 10th Ave at Rohde Island Avenue

Table 3a. Site Locations, Potential Engineered (Hard Armoring) Stream Stabilization Practices, and Overall Opinion of Cost for the 2015 Bassett

Site Locations, Potential Stream Stabilization Practices, and Overall Opinion of Cost for the 2015 Bassett Creek Main Stem Restoration Project.				
Site Number	**Site Station**[1]	**Site Length (ft)**	**Proposed Stream Stabilization Practice**	**Estimate Site Expense**
1	1+50	-	Remove 30 in Cotton Wood Tree	$2,000.00
2	0+50- 8+00	750	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (1,500 ft) Remove 50 trees	$90,500.00
3	4+50	-	Remove 36 in Cottonwood Tree	$2,000.00
4	5+75	-	Remove 42 in Cottonwood Tree	$2,000.00
5 & 6	8+00 & 9+00	100	Remove Existing Gabions and Grouted Rip Rap at Culvert Place 30 tons of Class III Fieldstone Rip Rap at Each End of Culvert	$6,000.00
7	36+50 to 41+50	500	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (1,000 ft) Remove 50 Trees	$64,500.00
8	43+25	-	Remove 68 in Cottonwood Tree	$2,000.00
9	42+50 to 45+50	300	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (600 ft) Remove 30 trees	$38,700.00
10	48+00 to 53+50	550	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (1100 ft) Remove 40 Trees	$67,200.00
11	50+90	-	Stabilize 12 in FES	$1,000.00
12	54+75	-	Remove 66 in Cottonwood Tree	$2,000.00
13	56+00	-	Remove (5) 50 in and greater Cottonwood Trees	$10,000.00

14	54+50 to 58+70	420	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (840 ft) Remove 20 Trees	$53,700.00
15	58+70 to 59+70	100	Reshape and Stabilize Streambanks with a 6 ft section of Fieldstone Boulders (840 ft)	$102,500.00
16	65+20	-	Reattach FES and Pipe Tie joints Reinstall sheet piling under FES	$10,000.00
17	62+75	-	Install 8" Galvanized FES on 8 in CMP	$750.00
18	63+80 to 64+60	80	Remove block wall (80 ft)	$500.00
19	65+50 to 80+50	1500	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (3,600 ft) Remove 130 Trees	$219,700.00
20	68+50 to 71+00	250	Reshape and Stabilize Streambank with 9 ft Fieldstone Boulder section (250 ft)	$76,250.00
21 & 22	76+00 & 77+00	100	Install Turf Reinforcement Mat on Peninsulas (700 sq yd)	$8,500.00
23	83+00 to 94+00	1100	Reshape and Stabilize Streambanks with 2 ft section of Class II Fieldstone Rip Rap (2,200 ft) Remove 80 Trees	$134,400.00
24	86+50 to 86+70	20	Remove gabion baskets (20ft)	$1,000.00
25	87+60	-	Install FES on 12 in and 24 in RCP pipe	$2,000.00
26	87+90	-	Install Galvanized FES on 12 in PVC pipe	$750.00
27	89+25	-	Install FES on 12 in RCP and PVC pipe	$1,500.00
28	89+90	-	Install FES on 12in RCP	$1,000.00
29	90+80 to 91+00	20	Remove gabion baskets (20 ft)	$1,000.00

Construction Subtotal	$	901,450.00
Construction Contingency (20%)	$	180,290.00
Design, Permitting and Administration (15%)	$	135,217.50
Contingency for Contaminated Soils(3%)	$	27,043.50
Additional Cultural and Historical Investigation	$	7,500.00
3- Year Vegetation Warranty and Manteca Period (7.5%)	$	67,608.75
Total		$1,319,109.75

[1] Steam Stationing: 0+00 is located at the end of the culvert north of 10th Ave at Rohde Island Avenue

5 References

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

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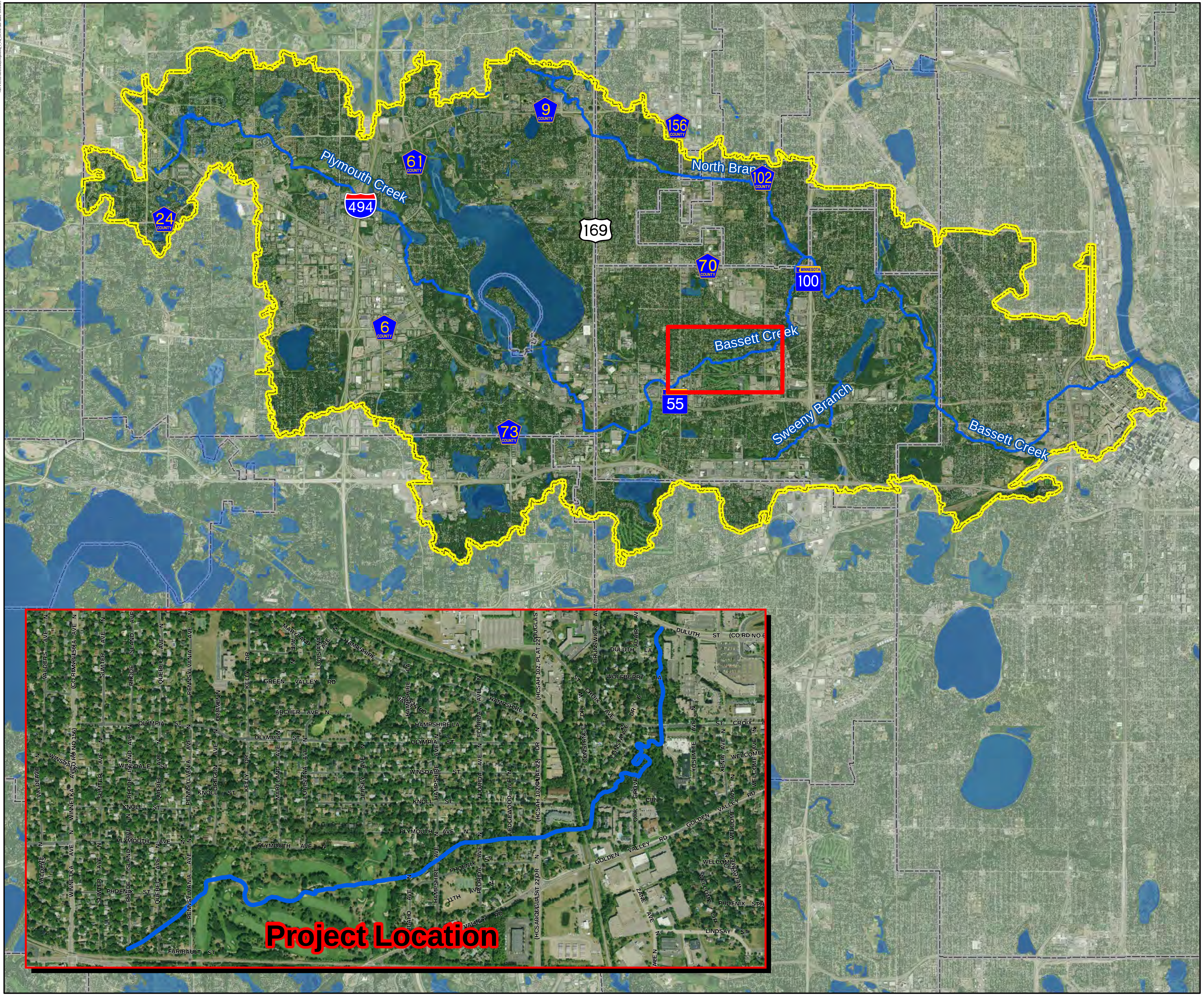
2015 Bassett Creek Restoration Feasibility Study

Appendix A

Figures



city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study
for the
2015 Bassett Creek
Main Stem
Restoration
City of Golden Valley
Minnesota

Figure 1

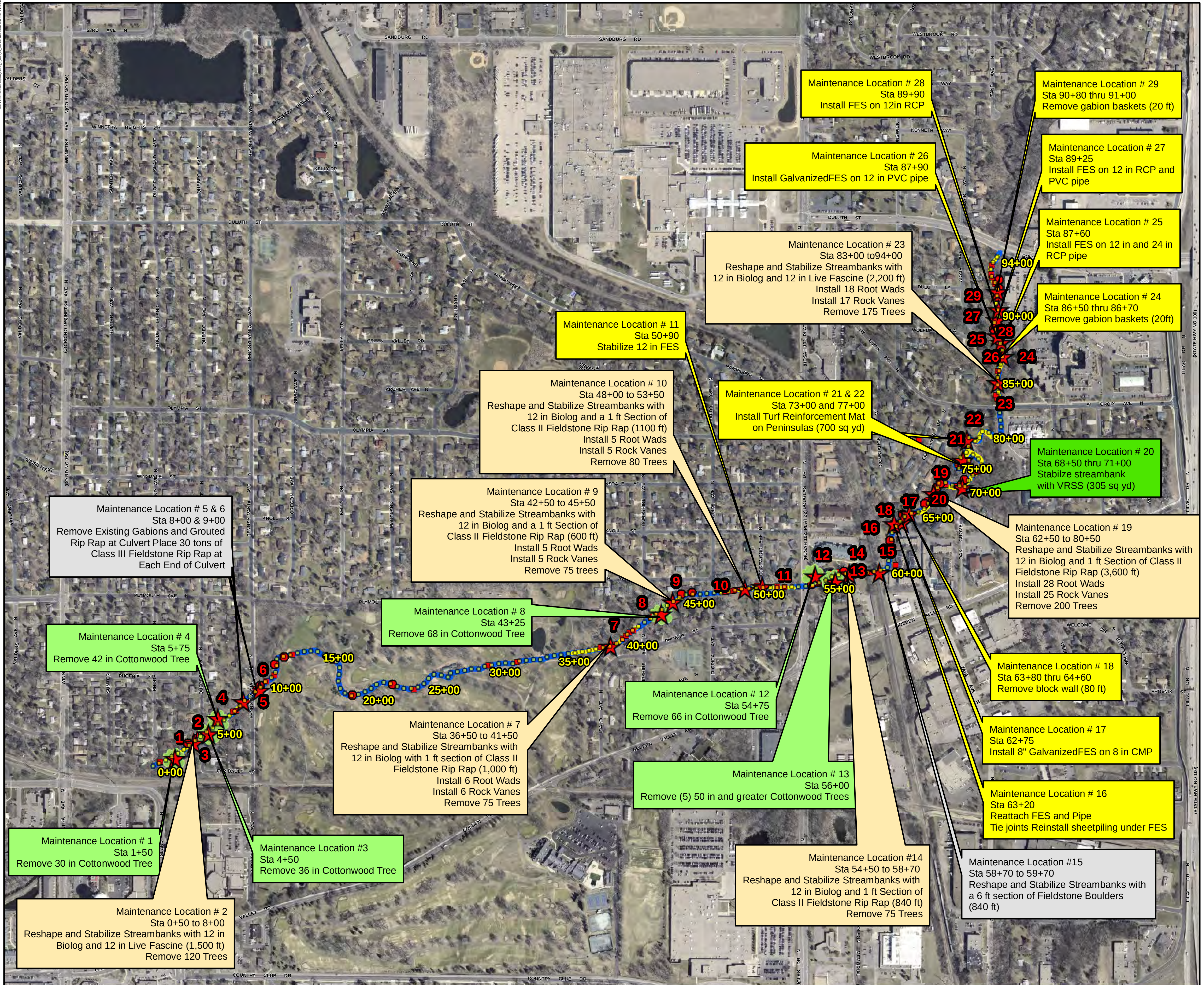
Legend

- Bassett Creek Watershed
- Surface Water
- Creeks/Stream
- City Boundary

N

0 2,500 5,000 10,000 Feet

WSB & Associates, Inc.



Feasibility Study for the 2015 Bassett Creek Main Stem Restoration City of Golden Valley Minnesota

Option 1 Proposed Soft Armoring Maintenance Locations Figure 2

Legend

- Identified Maintenance Location
- Maintenance Location
- Large Tree Removal
- Observed Bank Erosion
- Photos
- 2015 Bassett Creek

N

Feet
0 250 500 1,000

city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett Creek Main Stem Restoration City of Golden Valley Minnesota

Option 2 Proposed Hard Armoring Maintenance Locations

Figure 3

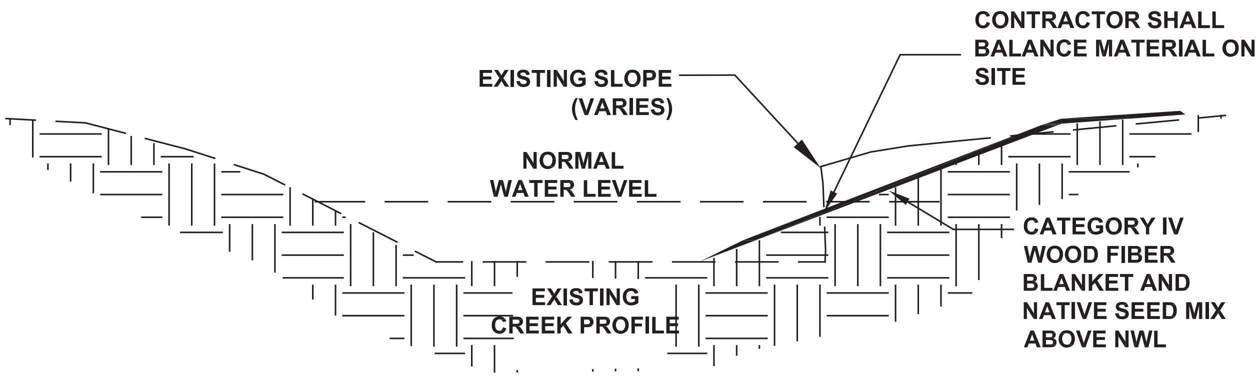
Legend

- Identified Maintenance Location
- Maintenance Location
- Large Tree Removal
- Observed Bank Erosion
- Photos
- 2015 Bassett Creek

N

Feet
0 250 500 1,000

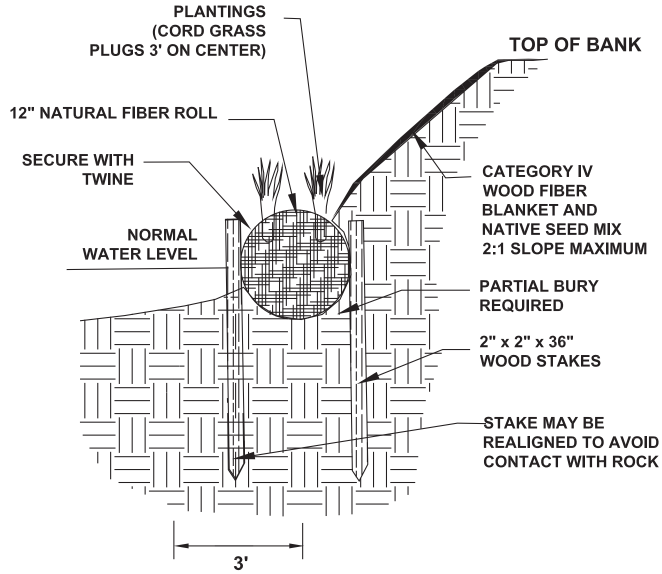
WSB & Associates, Inc.



Slope Preparation

This work consists of shaping the contours of the maintenance areas to achieve slopes as shown on the plans. Slope preparation will aid in the placement of the selected slope stabilization method. It is anticipated that earthwork on this project will balance on site.

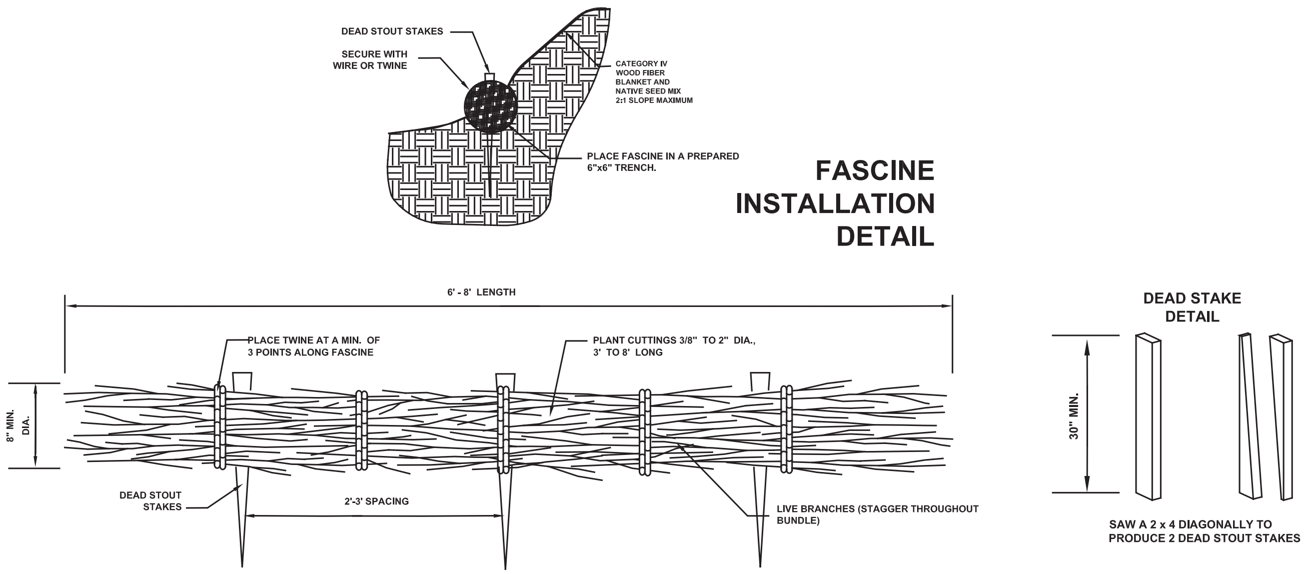
Bio-log Bank Protection (With or Without Stone)



Bio-log Bank Protection

Bio-logs 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 bio-logs are typically 12 inches in diameter. Because they are made of natural fiber, vegetation can grow on the bio-logs. When needed, grading of the stream bank slope above the bio-log will achieve a more stable slope (2:1 to 3:1). Cord grass plugs will be placed within the bio-log three feet on center.

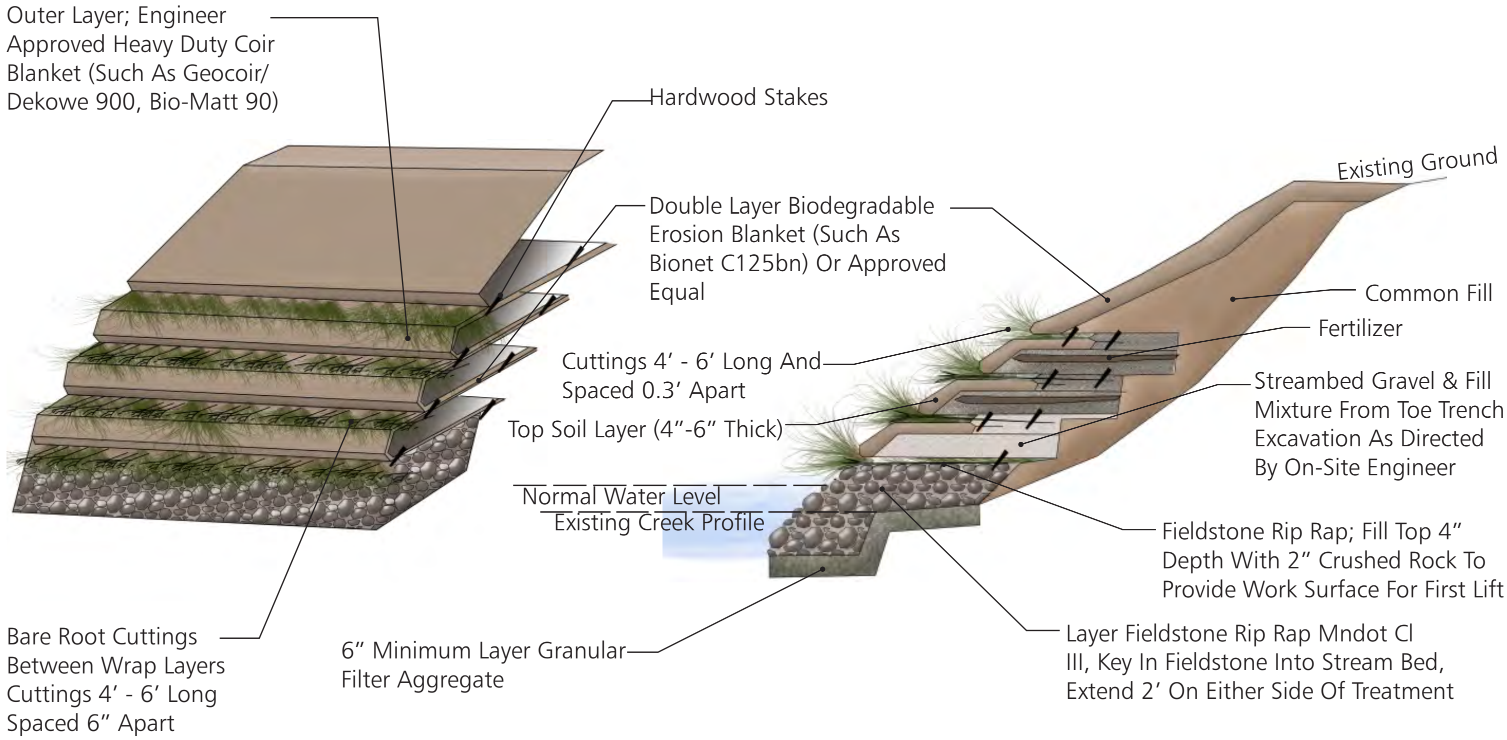
Live Facines



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

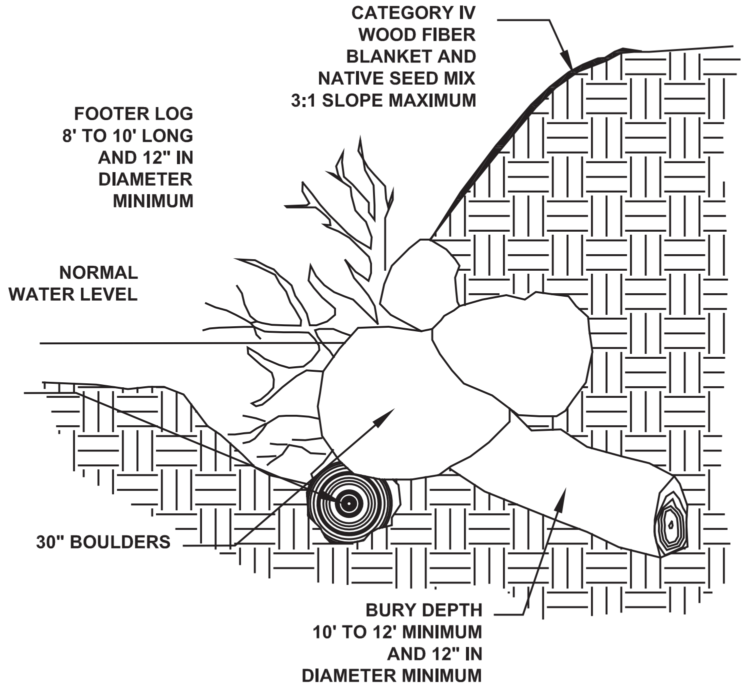
VRRS



Vegetated Reinforced Slope Stabilization (VRSS)

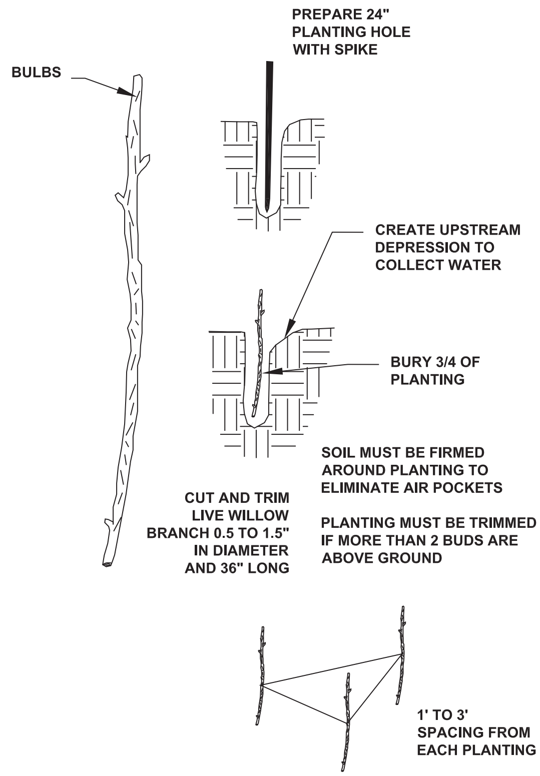
VRSS is a bioengineering method that combines rock, geosynthetics, soil, and plants to stabilize steep, eroding banks. Vrss typically involves protecting layers of soil with a blanket or geotextile material creating "soil lifts" (also called "soil pillows") and vegetating the slope. The vegetation root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

Before After



Root Wads

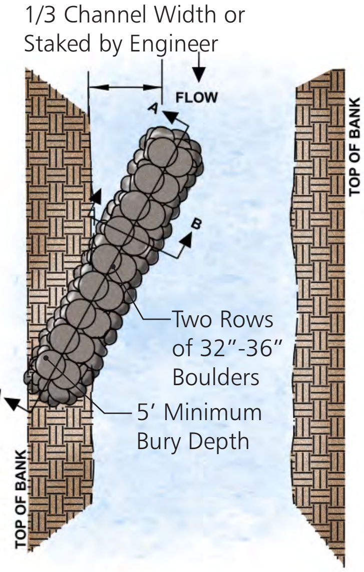
Root wads are constructed from root balls of trees removed as part of this project. The trunks are buried into the bottom of the stream bank, with the root wad end sticking out into the stream. Supporting "footer logs" and boulders are used to stabilize the root wads.

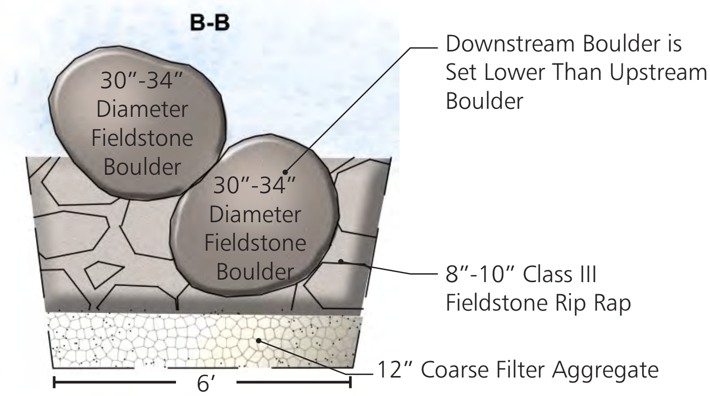


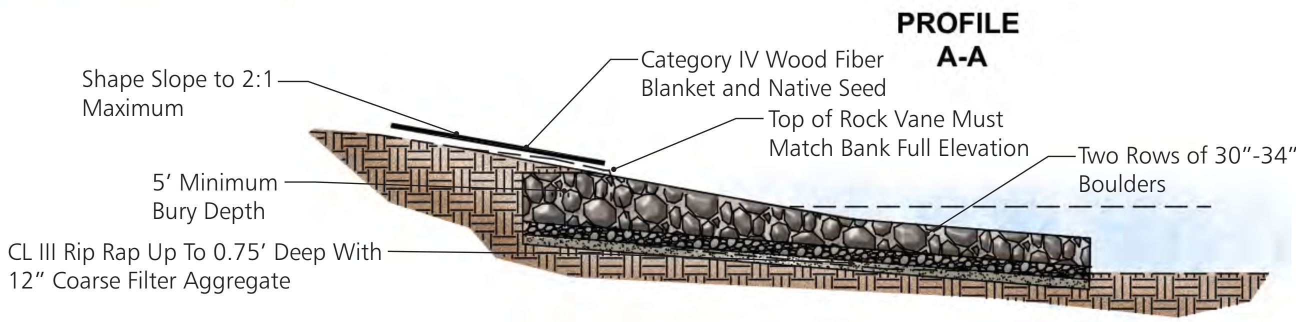
Live Stakes

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 revegetating a stream bank. Materials will be cut and placed in a container of water to be transported to the site and kept in water until installed. Taper the cutting with the end going into the ground at right angles to the slope face, 2/3 - 3/4 of their length. Care shall be taken not to split the ends or damage the bark of the cuttings. The engineer shall stake the location of live stakes in the field.

Rock Vanes



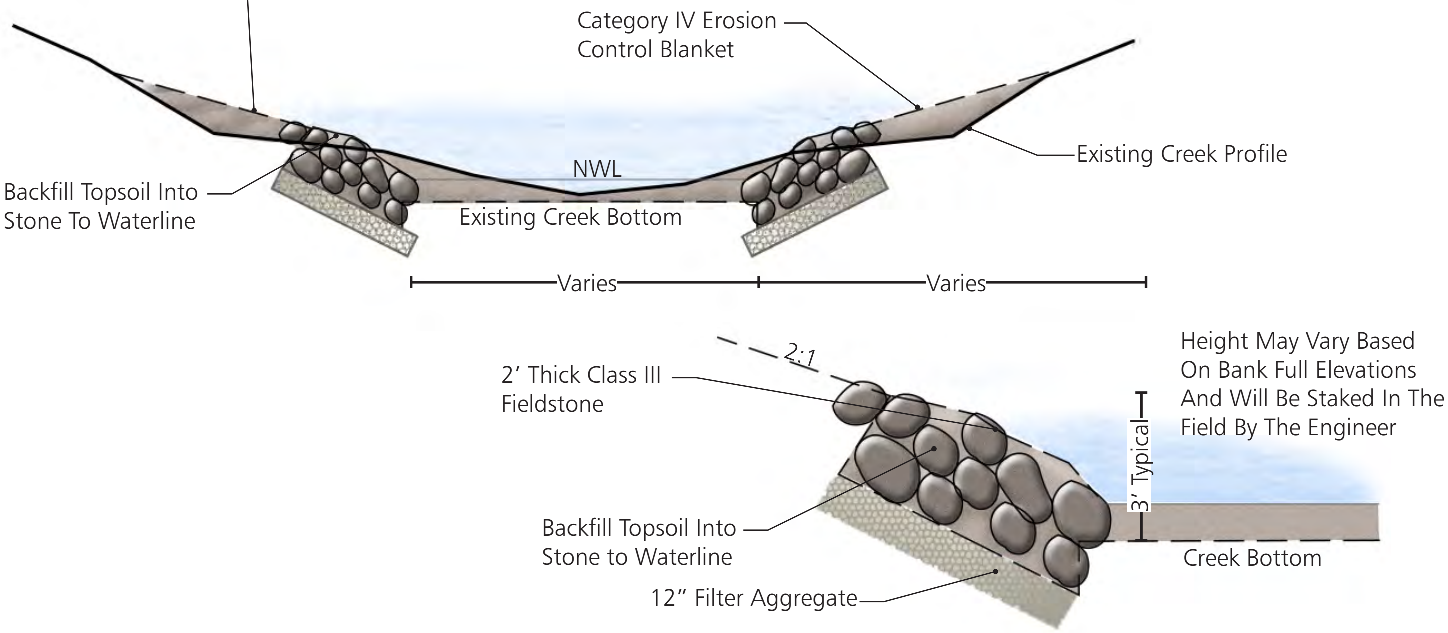




Rock Vanes

Rock vanes, or j-vanes, are constructed of boulders embedded into the creek bottom. The vanes are embedded (five feet) in the stream bank and are oriented upstream (20 to 30 degrees) to direct the flow away from that bank. J-vanes will not occupy no more than one-third of the channel width.

Stone Toe Protection



Fieldstone Rip Rap

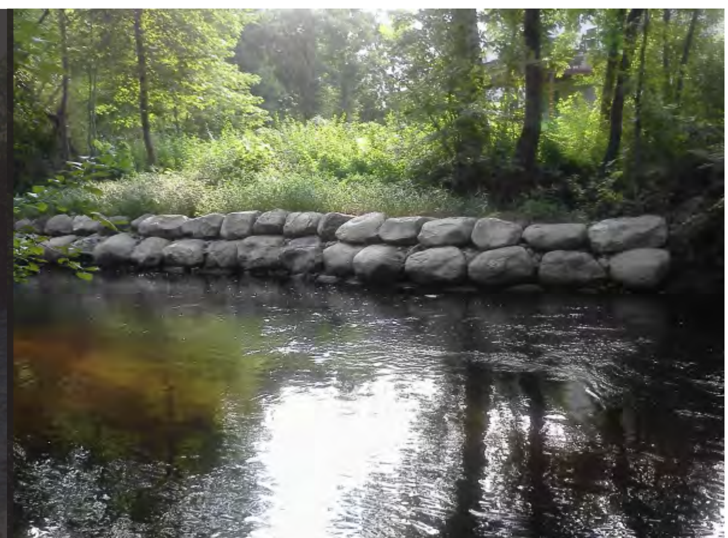
Fieldstone rip rap will be used to protect the toe of the stream bank. In stream systems, rip rap consists of cobble-sized rock (12 inches to 18 inches in diameter). The riprap is keyed in to the streambed and extends up the reshaped slope and cannot extend past the top of bank. The exact location and elevation of the stone toe will be staked in the field by the engineer. Hand placement of fieldstone rip rap will be required and will be directed by the engineer. Placement of fieldstone rip rap must not result in a decrease of channel cross section.

Before

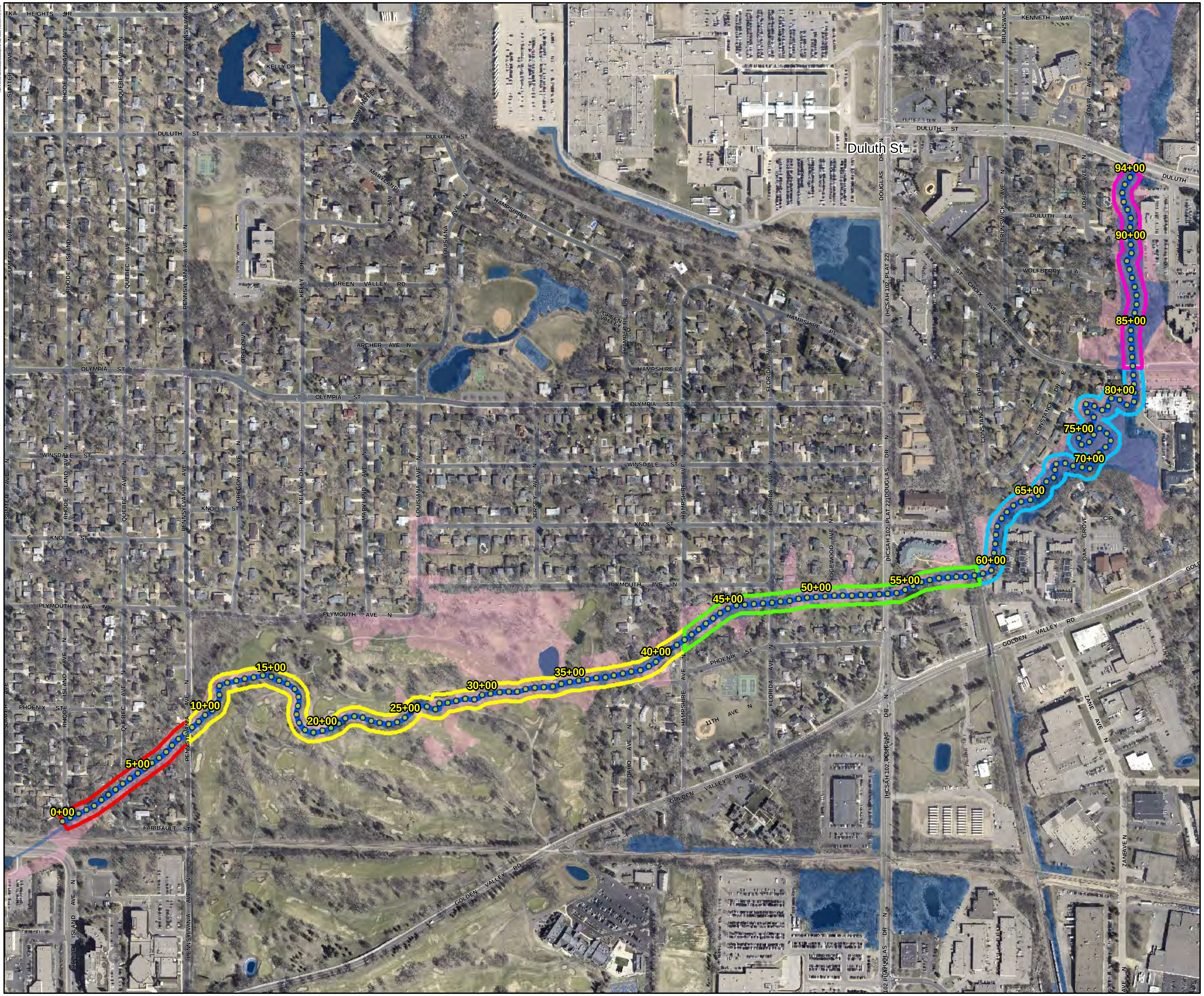
After

Fieldstone Boulder

Fieldstone boulder will be used to protect the toe of the stream bank. In stream typically consists of boulder-sized rock (30 inches to 34 inches in diameter) placed over a half foot thick layer of class i fieldstone rip rap and a half foot layer of coarse filter aggregate. The boulder will extend up the reshaped slope and cannot extend past the top of bank. The exact location and elevation of the boulder toe will be staked in the field by the engineer. Placement of fieldstone boulders must not result in a decrease of channel cross section.



Before After



city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett Creek Main Stem Restoration City of Golden Valley Minnesota

Legend

- 2015 Bassett Creek Restoration Project
- Area A
- Area B
- Area C
- Area D
- Area E
- NWI
- 100 Year Flood Elev

N

0 250 500 1,000 Feet

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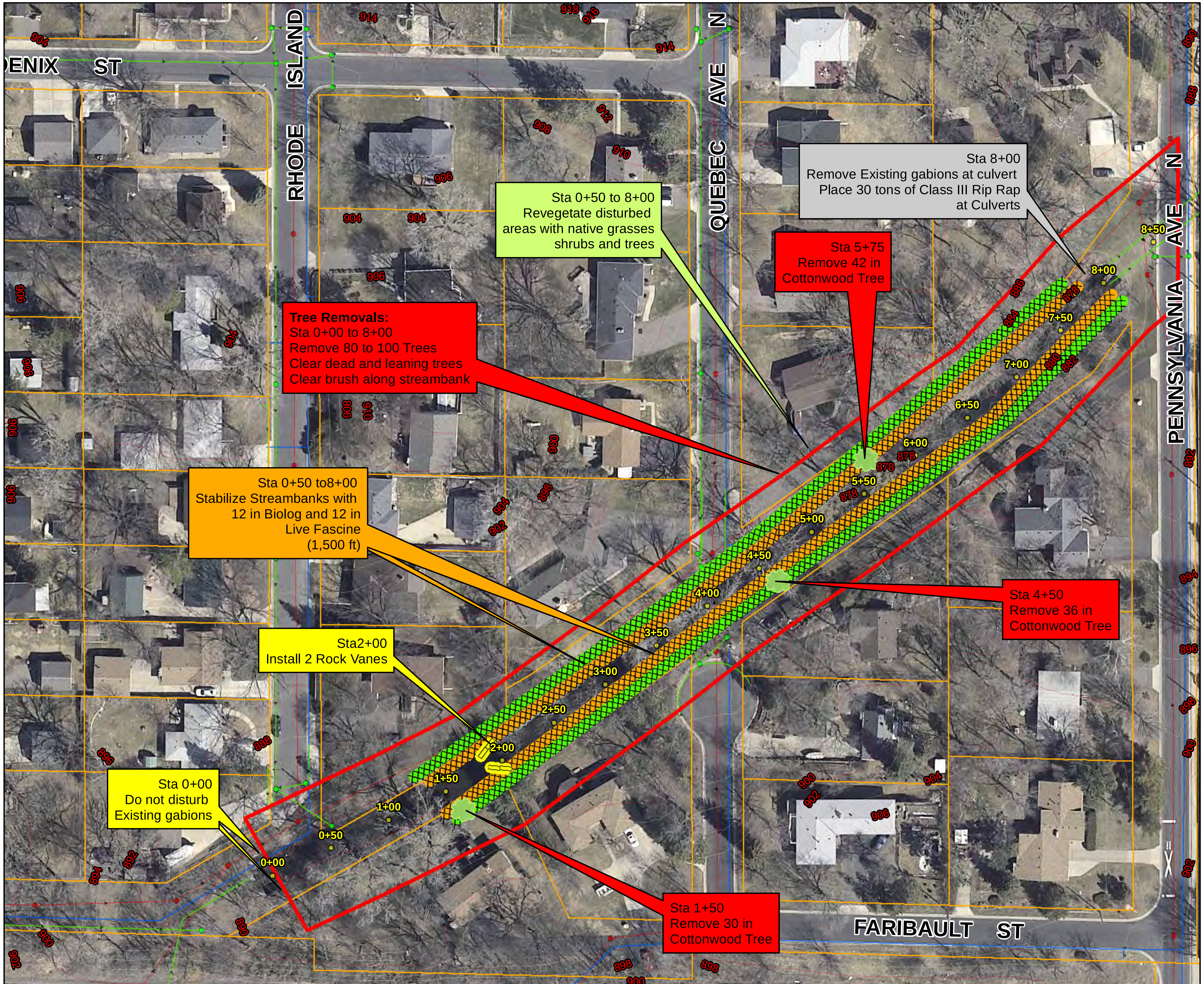


city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett Creek Main Stem Restoration City of Golden Valley Minnesota

Soft Armoring Option Area A

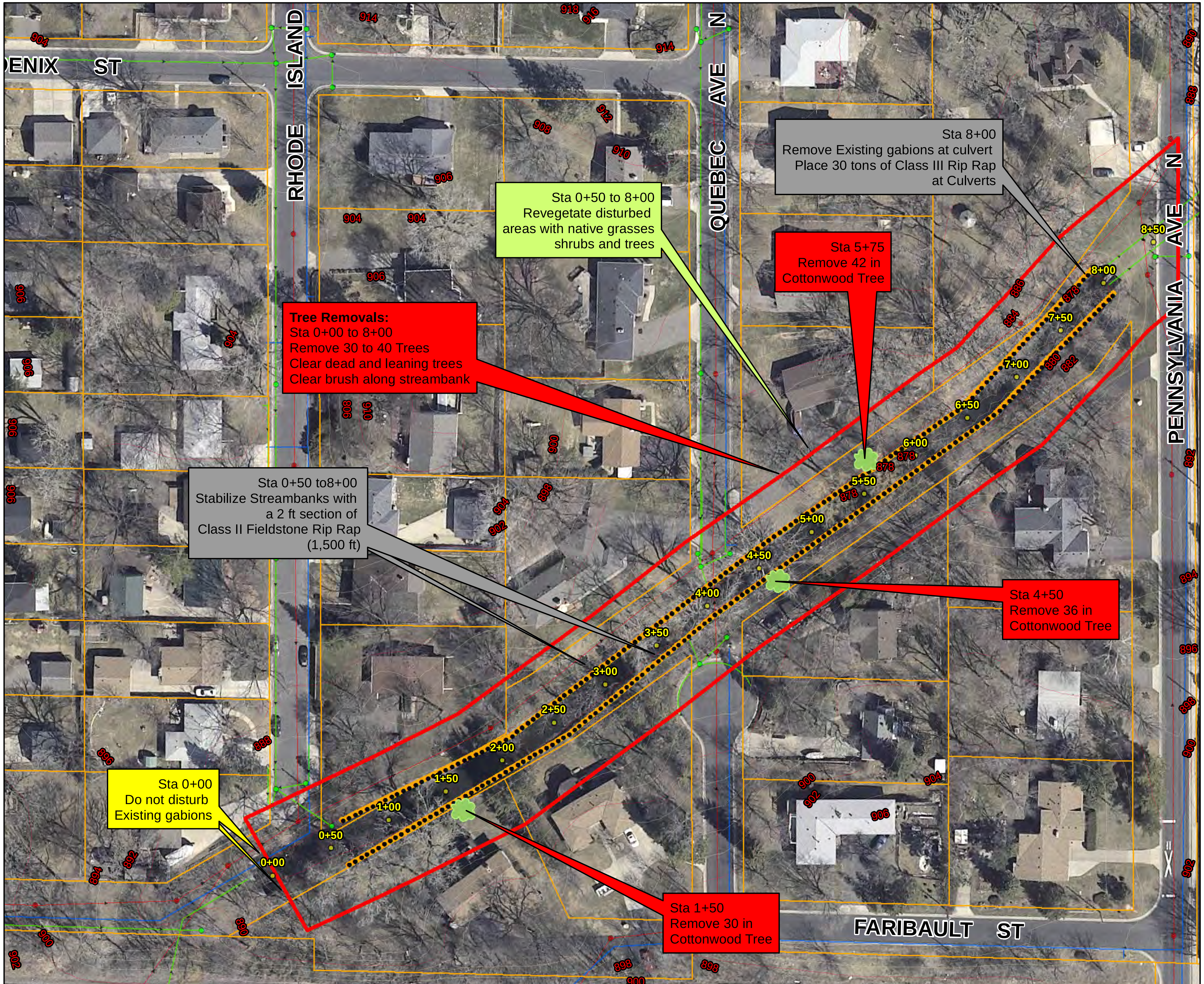
Legend

- Area A
- Rock Vane
- Biolog
- Live Fascine
- Parcel Boundaries
- Index (10-Foot)
- Intermediate (2-Foot)
- Storm Sewer
- Watermain
- Sanitary Sewer

N

0 25 50 100 Feet

WSB & Associates, Inc.



city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett Creek Main Stem Restoration City of Golden Valley Minnesota

Hard Armoring Option Area A

Legend

- Area A
- Fieldstone
- Parcel Boundaries
- Index (10-Foot)
- Intermediate (2-Foot)
- Storm Sewer
- Watermain
- Sanitary Sewer

N

Feet
0 25 50 100

WSB & Associates, Inc.

city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett CreekMain Stem Restoration Project City of Golden Valley Minnesota

Soft Armoring Option Area B

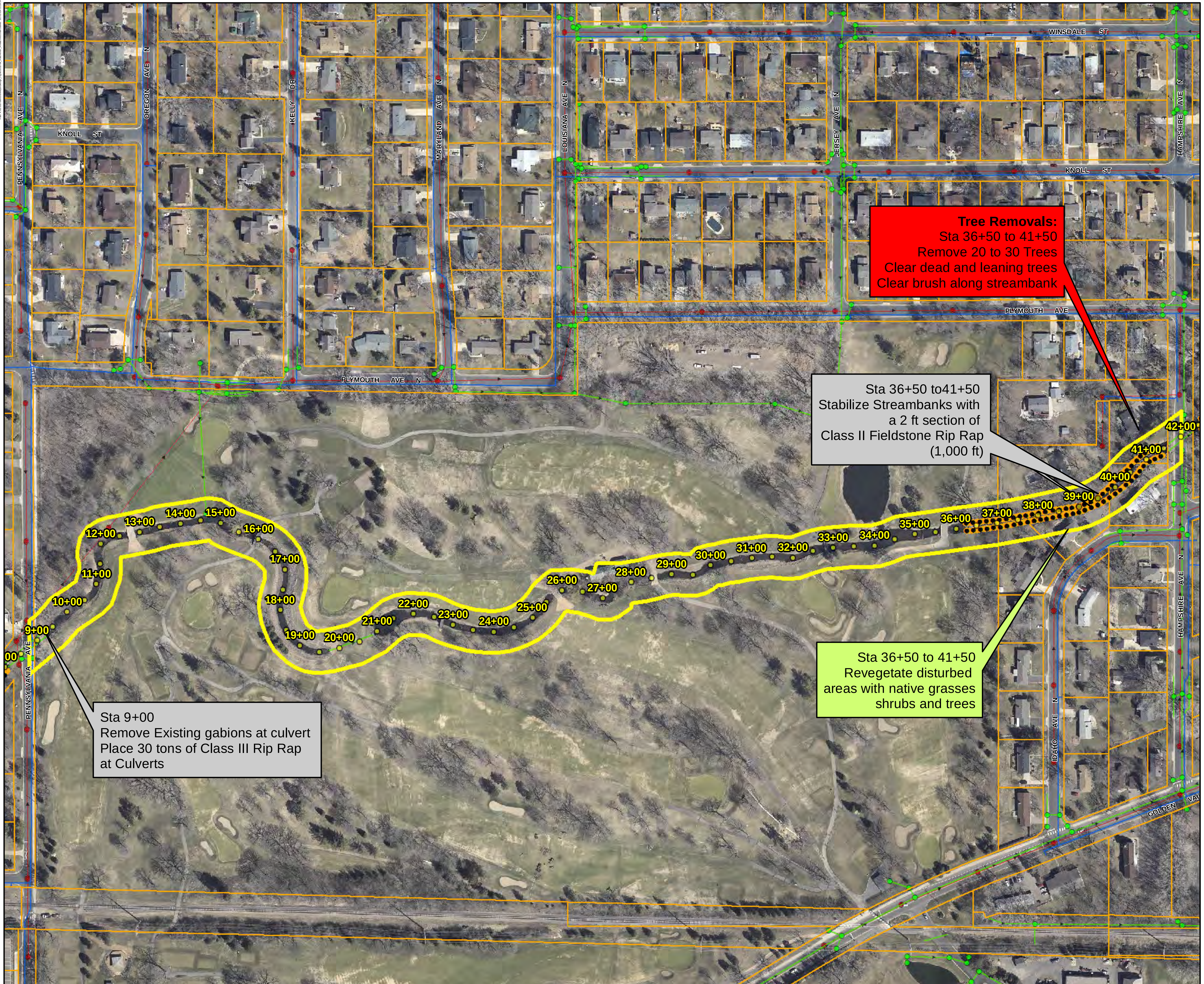
Legend

- Large Tree
- Area B
- Root_Wad
- Rock Vane
- Biolog Fieldstone
- Biolog
- Parcel Boundaries
- Storm Sewer Manholes
- Storm Sewer
- Watermain
- Sanitary Sewer
- Sanitary Sewer Manhole

N

Feet
0 50 100 200

WSB & Associates, Inc.



city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett CreekMain Stem Restoration Project City of Golden Valley Minnesota

Hard Armoring Option Area B

Legend

- Large Tree
- Area B
- Fieldstone
- Parcel Boundaries
- Storm Sewer Manholes
- Storm Sewer
- Watermain
- Sanitary Sewer
- Sanitary Sewer Manhole

N

Feet
0 50 100 200

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city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett CreekMain Stem Restoration Project City of Golden Valley Minnesota

Soft Armoring Option Area C

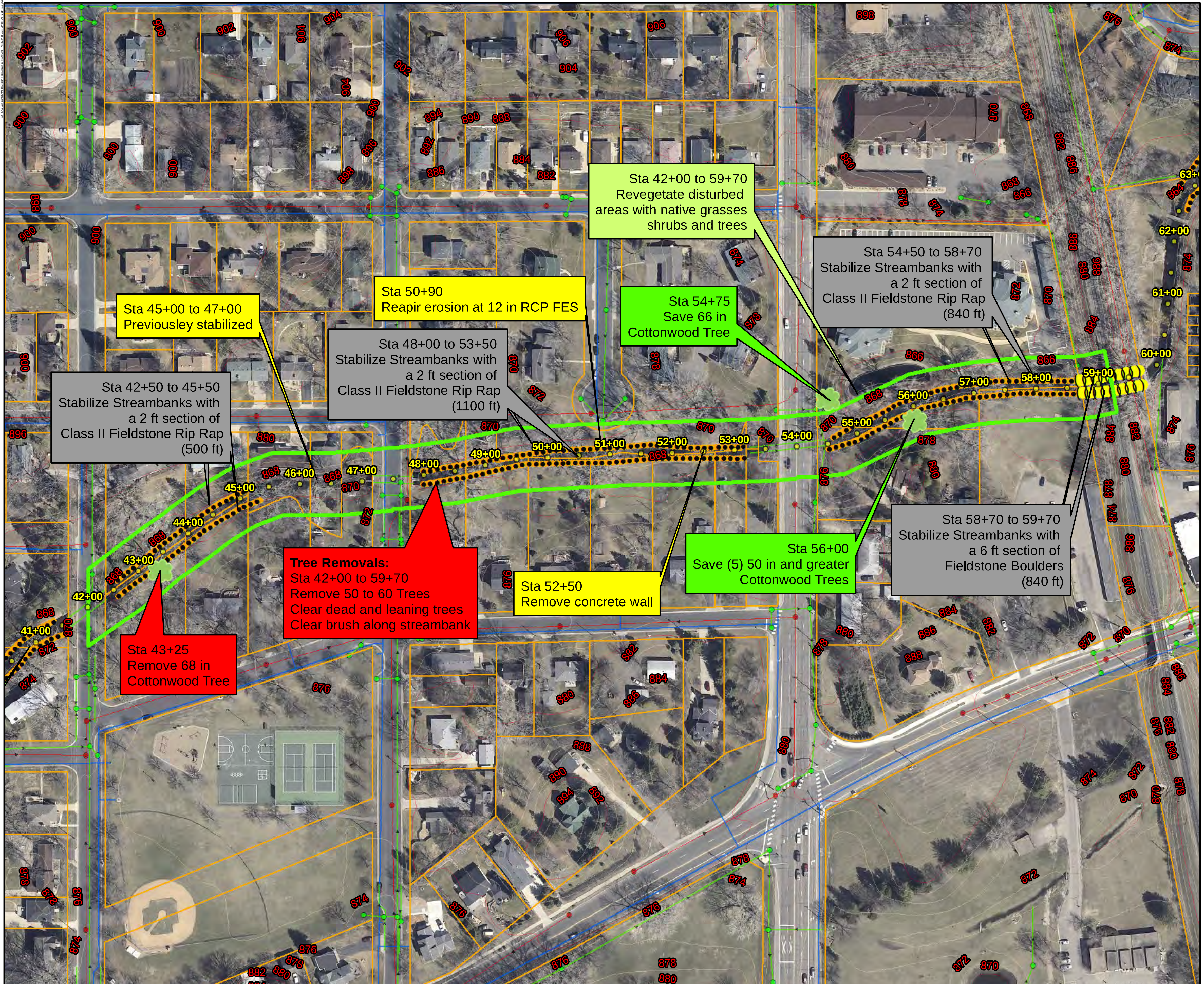
Legend

- Area C
- Parcel Boundaries
- Rock Vane
- Root_Wad
- Biolog Fieldstone
- Index (10-Foot)
- Intermediate (2-Foot)
- Storm Sewer
- Watermain
- Sanitary Sewer
- Fieldstone Bouler

N

Feet
0 50 100 200

WSB & Associates, Inc.



city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett CreekMain Stem Restoration Project City of Golden Valley Minnesota

Hard Armoring Option Area C

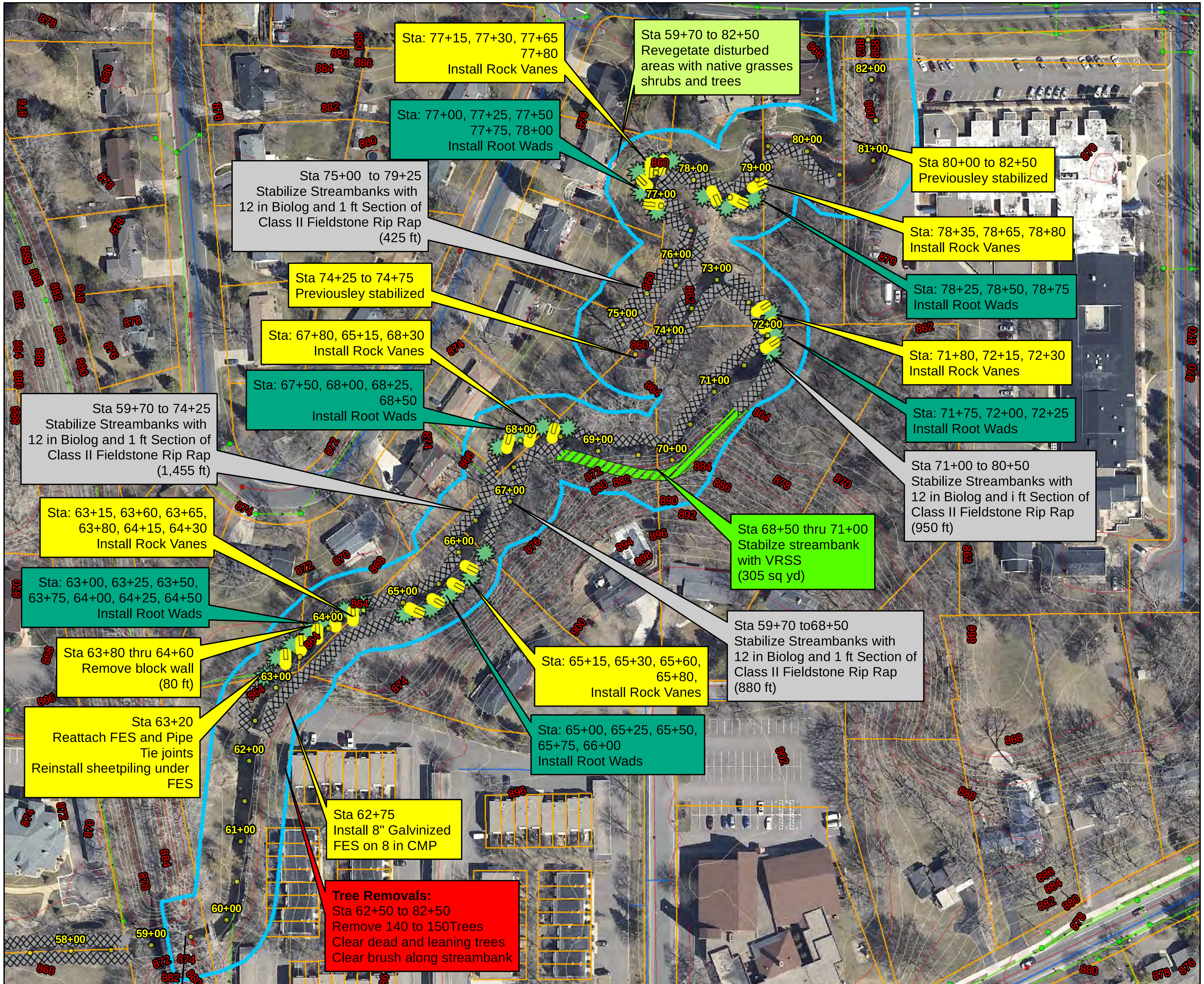
Legend

- Area C
- Parcel Boundaries
- Index (10-Foot)
- Intermediate (2-Foot)
- Storm Sewer
- Watermain
- Sanitary Sewer
- Fieldstone
- Fieldstone Bouler

N

Feet 0 50 100 200

WSB & Associates, Inc.



city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett CreekMain Stem Restoration Project City of Golden Valley Minnesota

Soft Armoring Option Area D

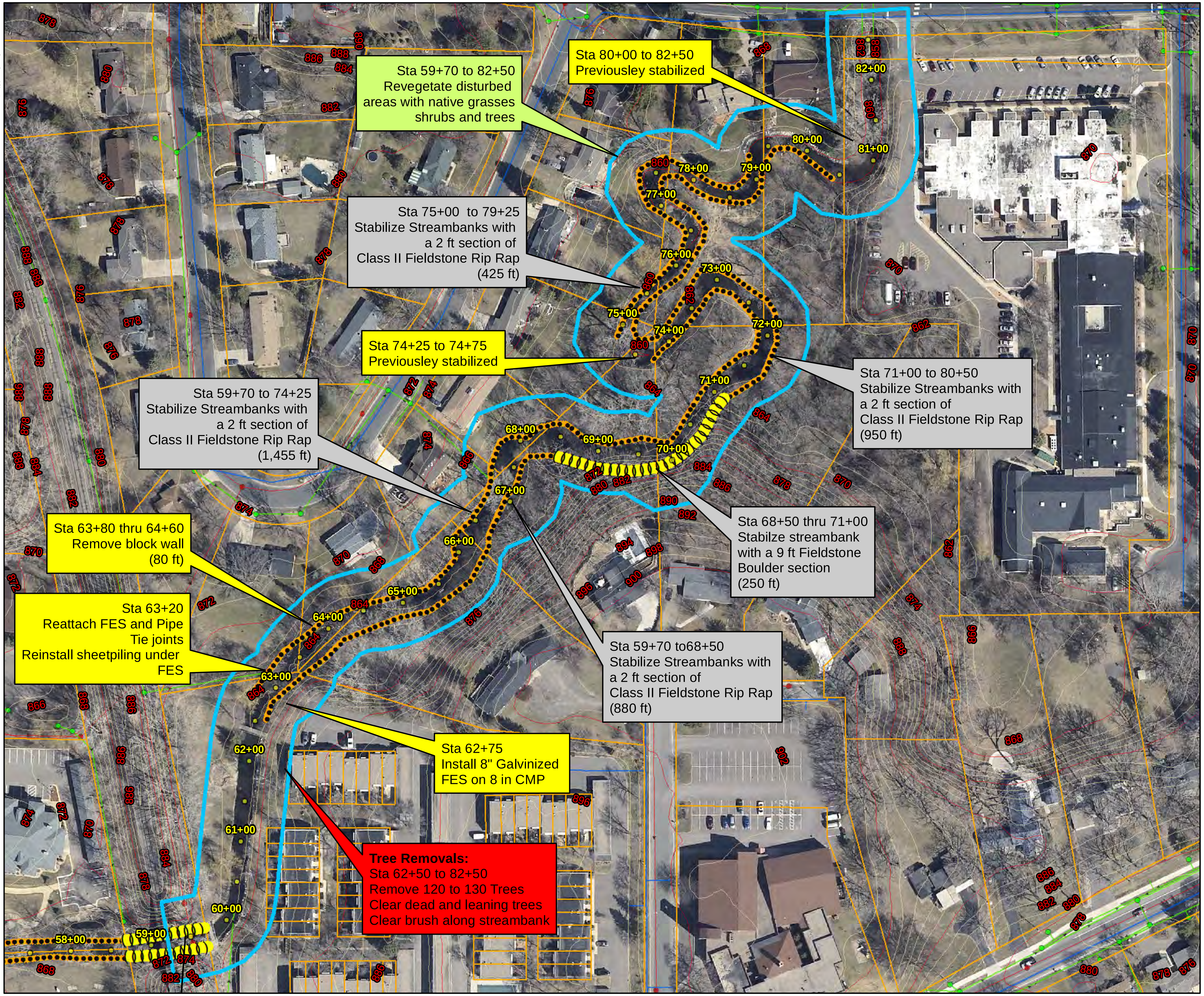
Legend

- Area D
- Rock Vane
- Root_Wad
- Biolog Fieldstone
- VRSS
- Parcel Boundaries
- Index (10-Foot)
- Intermediate (2-Foot)
- Storm Sewer
- Watermain
- Sanitary Sewer

N

0 50 100 200 Feet

WSB & Associates, Inc.



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Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett CreekMain Stem Restoration Project City of Golden Valley Minnesota

Hard Armoring Option Area D

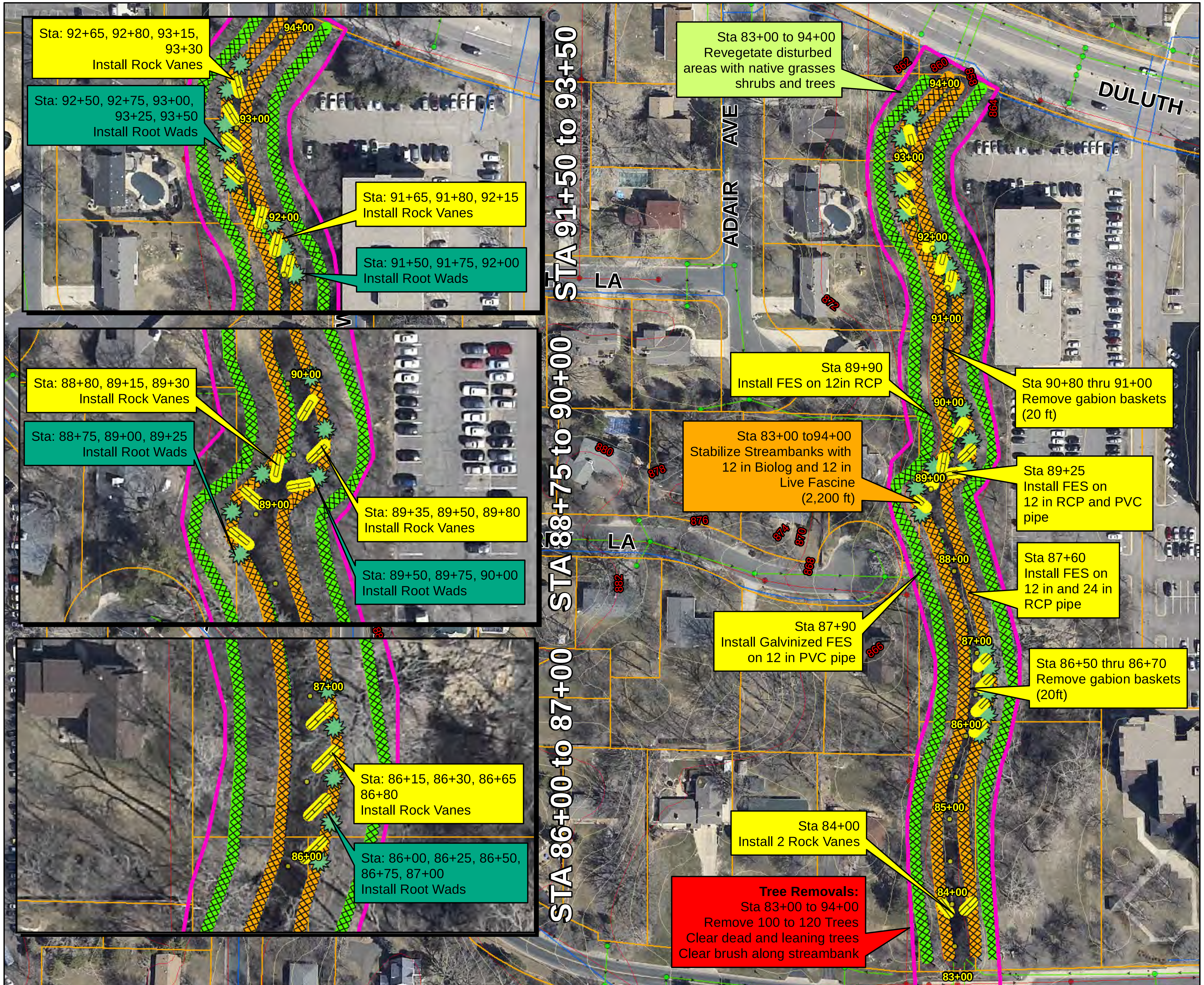
Legend

- Area D
- Fieldstone Bouler
- Fieldstone
- Parcel Boundaries
- Index (10-Foot)
- Intermediate (2-Foot)
- Storm Sewer
- Watermain
- Sanitary Sewer

N

Feet
0 50 100 200

WSB & Associates, Inc.



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Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett CreekMain Stem Restoration Project City of Golden Valley Minnesota

Soft Armoring Option Area E

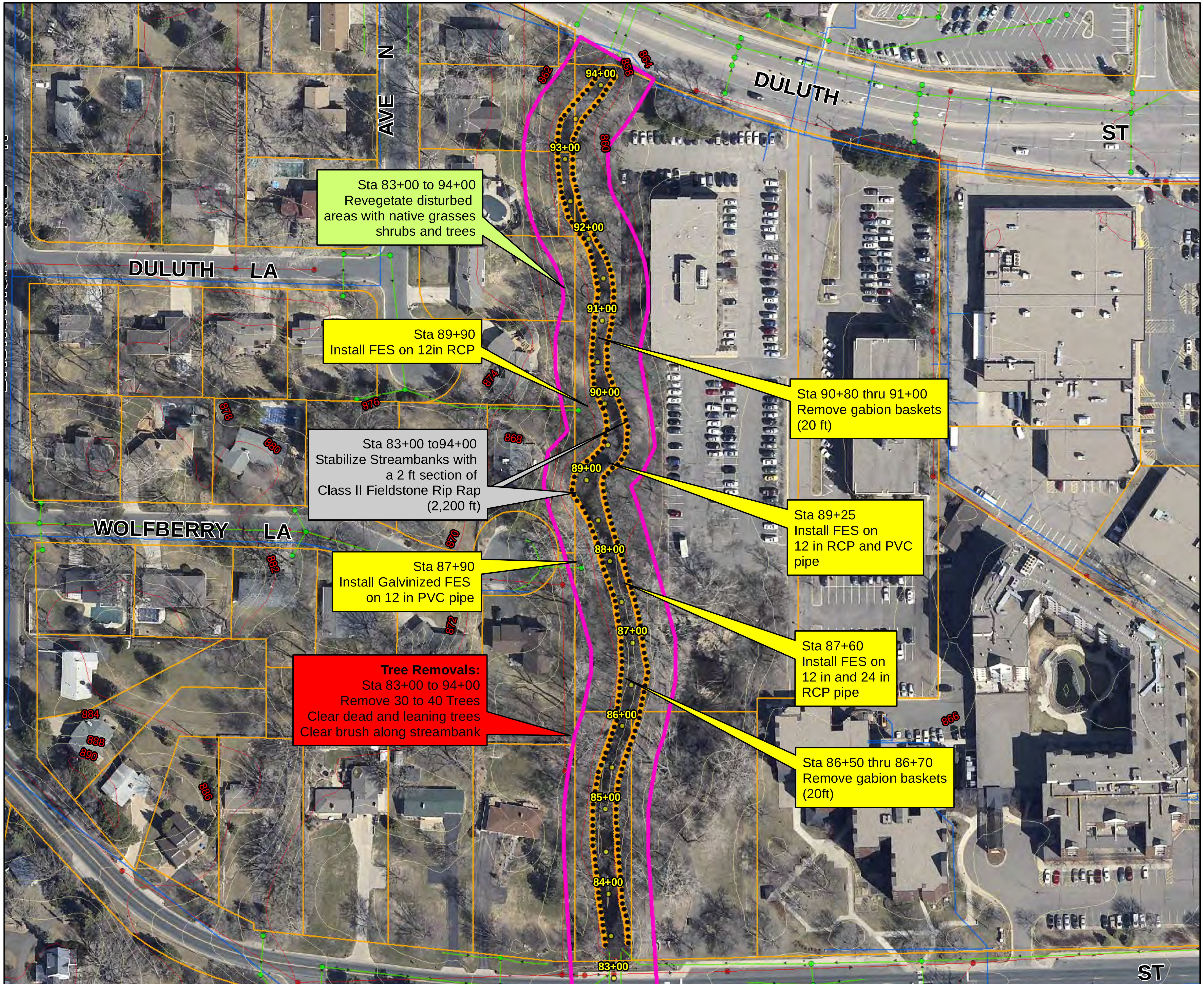
Legend

- Area E
- Rock Vane
- Root Wad
- Biolog
- Live Fascine
- Parcel Boundaries
- Index (10-Foot)
- Intermediate (2-Foot)
- Storm Sewer
- Watermain
- Sanitary Sewer

N

0 50 100 200 Feet

WSB & Associates, Inc.



city of golden valley

Bassett Creek Watershed Management Commission

Feasibility Study for the 2015 Bassett CreekMain Stem Restoration Project City of Golden Valley Minnesota

Hard Armoring Option Area E

Legend

- Area E
- Fieldstone
- Parcel Boundaries
- Index (10-Foot)
- Intermediate (2-Foot)
- Storm Sewer
- Watermain
- Sanitary Sewer

N

0 50 100 200 Feet

WSB & Associates, Inc.