Appendix A

Site Visit Photos

Photo 1 **Site 1a. Looking downstream at the sinuous channel with bare banks with undercutting at station 1+50.**

Photo 2: **Site 1a. Looking downstream at station 2+75. The left bank is bare at a vertical angle, while the right bank is angled and has a soil material change at the bottom foot of the bank.**

Photo 3: **Site 1b. Looking downstream at sediment build up on left bank and bare right bank at station 4+60**

Photo 4: **Site 1b. Looking downstream at station 5+00, both banks have tree roots present.**

Photo 5: **Site 1c. Looking downstream at station 6+40, slight undercut for left bank and slumping on the right bank.**

Photo 6: **Site 1d. Looking downstream at the straight channel segment at station 7+20.**

Photo 7: **Site 1d. Looking downstream at station 7+75, the right bank is eroding due to a sharp turn and could encroach on the trail.**

Photo 8: **Site 1e. Looking downstream at station 9+25, the left bank is angled and bare while the right bank is vertical with spotty plant coverage.**

Photo 9: **Site 1f. The creek begins to become more sinuous at station 11+40 and the left bank has undercut.**

Photo 10: **Site 1f. Looking downstream at station 12+50, low bank on left side, higher bank on right side, plant cover is intermittent.**

Photo 11: Site 1g. Looking downstream at station 14+00, both banks are low with some undercutting.

Photo 12: Site 1g. Looking downstream at station 15+10, multiple outlets enter this location and could contribute to the eroding banks.

Photo 13: Site 1h. Looking downstream at station 16+00, upstream of a large pool that is at least 6 feet deep.

Photo 14: Site 1h. Looking downstream at station 16+80, the channel becomes sinuous and sediment deposition has occurred on the right bank.

Photo 15: Site 2a. Looking downstream at station 19+20, this location is downstream of an outlet; flows with high exit velocities are eroding the left bank.

Photo 16: Site 2a. Looking downstream at station 20+30, the right bank is bare and vertical. There are two footbridges in this vicinity.

Photo 17: Site 2b. Looking downstream at station at 22+00, there is a buildup of sediment in the channel that is approximately 40 feet by 100 feet in area.

Photo 18: Site 2b. Looking upstream at 23+20. Roughly 40% of the channel width is filled in. Most of the sediment buildup is 1 foot above the water surface level, with a few locations reaching 2 feet higher than the water surface.

Photo 19: Site 2c. Looking downstream at station 23+50 from the pedestrian trail.

Photo 20: Site 2c. Looking downstream at station 24+80 with steep eroding banks and woody debris in the channel.

Photo 21: Site 2d. Looking upstream at station 26+50, both banks are angled at approximately 60 degrees and are bare.

Photo 22: Site 2d. Looking at the right bank at station 27+90, the bank is mostly exposed.

Photo 23: Site 2e. Looking downstream at station 30+30, the right bank is bare while the left bank had moderate cover.

Photo 24: Site 2e. Looking downstream at station 31+10, woody debris has fallen into the channel and there is slight sediment accumulation at the bottom of the banks.

Photo 25: Site 2f. Looking downstream at station 34+40, multiple fallen trees in the channel creating woody debris and potential channel blockages.

Photo 26: **Site 3a. Looking downstream at the sediment island formed at station 37+00 due to the pipe crossing at Vicksburg Road. The island width ranges from 1 to 10 feet wide, is 30-feet long, and roughly 1 foot above the water surface level.**

Photo 27: **Site 3c. Looking downstream at station 42+90, both banks have minimal vegetative surface protection.**

Photo 28: Site 3c. Looking downstream at a bend at station 45+20.

Photo 29: Site 3d. Looking downstream at station 46+70 where the channel widens.

Photo 30: Site 3d. Looking downstream at station 47+50, the channel has bare banks and minor meandering and good floodplain connection.

Photo 31: Site 4a. Looking downstream at station 54+00, downstream of the Rockford Road crossing. Undercut bank (six inches or less).

Photo 32: Site 4a. Looking downstream at station 55+00, both banks have slight undercutting at the water line.

Photo 33: Site 4b. Looking downstream at station 57+00, the banks are vertical and bare.

Photo 34: Site 4b. Looking downstream at station 57+80, woody debris has fallen into the channel.

Photo 35: Site 4c. Looking downstream at station 59+00, the right bank is undercut below the tree roots.

Photo 36: Site 4c. Looking downstream at station 60+00, the left bank is undercut.

Photo 37: Site 4d. Looking downstream at station 62+30, sediment accumulation on the right bank.

Photo 38: Site 4e. Looking downstream at station 63+00, mild channel blockage.

Photo 39: Site 4e. Looking downstream at station 64+20, upstream of a larger deep pool.

Photo 40: Site 4f. Looking downstream at station 65+60, the banks are bare but have good floodplain connection

Photo 41: Site 4f. Looking downstream at station 66+90 towards the 38th Avenue crossing. The center and right culvert are partially blocked by sediment deposition.

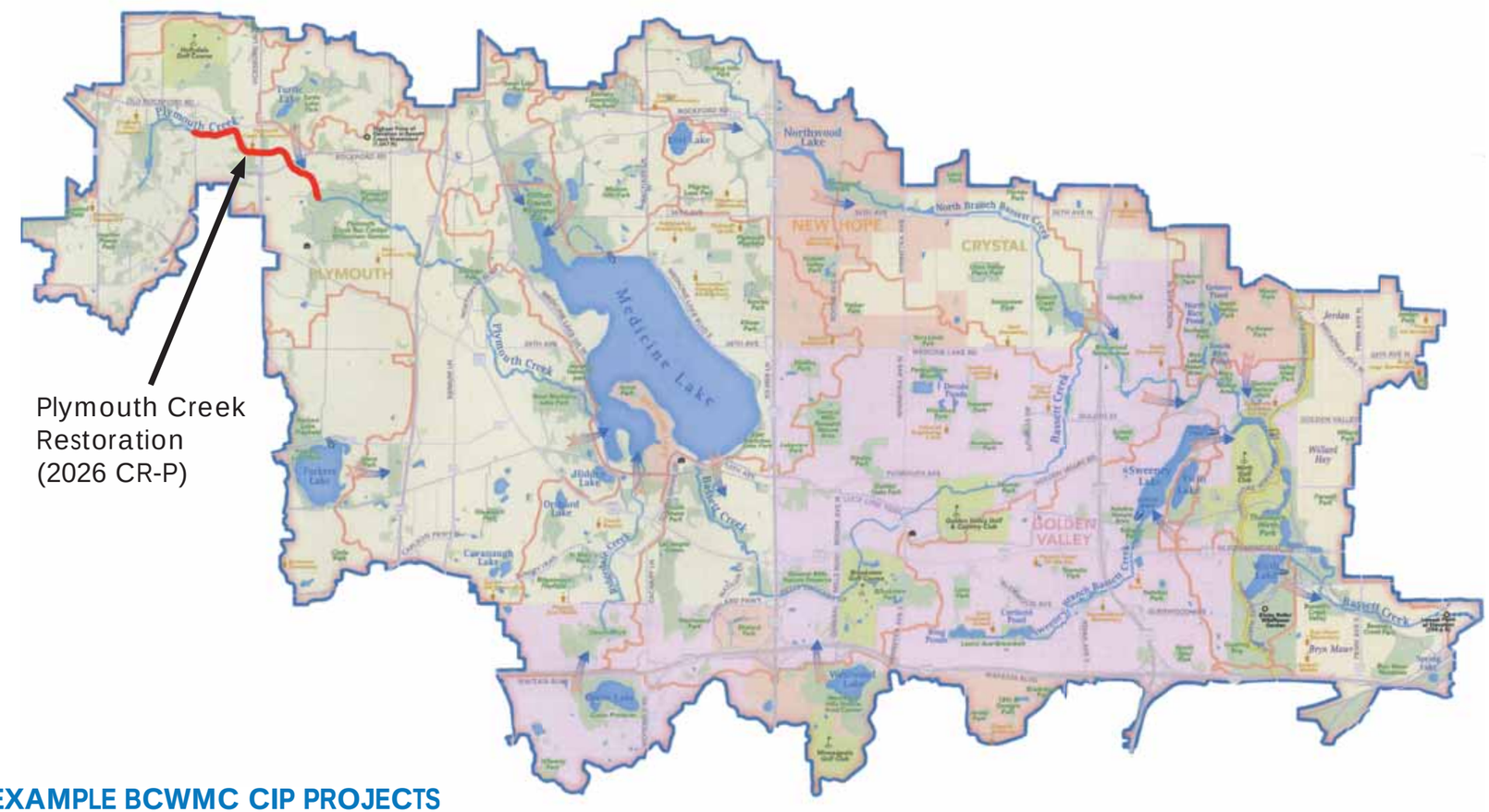
Photo 42: Site 4g. Looking upstream at station 69+00 towards the 38th Avenue crossing. Slight sediment build up in center of channel near the culverts.

Appendix B

Open House Materials

About the Bassett Creek Watershed Management Commission (BCWMC)

The vision: stewardship of water resources to protect and enhance our communities



About the BCWMC

- **Regional government organization** formed in 1969 to focus on flood control along Bassett Creek
- **Operates under a 10-year management plan**
- **Focused on providing flood management and improving and protecting the water quality** of Bassett Creek and lakes/streams
- **Nine member cities:** Crystal, Golden Valley, Medicine Lake, Minneapolis, Minnetonka, New Hope, Plymouth, Robbinsdale, St. Louis Park,
- **Area:** approximately 40 square miles

Commission funding

- Contributions from nine member cities (approximately $600,000 per year)
- Hennepin County tax levy for major projects (approximately $1.5–2 million per year)
- Grant funds and application fees (varies)

Commission activities

- Implements capital improvement projects that reduce flooding and improve lakes, streams, and wetlands throughout the watershed
- Monitors water quality, performs studies, maps resources
- Provides water resource education and watershed-wide coordination
- Reviews developments for compliance with standards and requirements

EXAMPLE BCWMC CIP PROJECTS

Wirth Lake outlet

Plymouth Creek restoration (before and after)

Plymouth Creek Restoration Project

Plymouth Creek Erosion Issues and Restoration Prioritization

- Plymouth Creek
- Bike and/or Pedestrian Trail
- Parcel Boundary
- Public Parcel
- Easements

Bank Erosion Hazard Index (BEHI)

- Very High
- High
- Moderate
- Low

Utilities

- Gravity Storm Sewe
- Sanitary Main

Bioengineering Features

- Coir Log
- Cross-Vanes
- J-Hook
- Root Wads
- Vanes
- Brush Mattresses
- Plug Planting
- Grading
- Live Staking
- Rock Riprap
- Seeding
- VRSS
- Debris Removal

0 500 Feet

Restoration Prioritization Factors

Several factors will impact prioritization of Plymouth Creek restoration locations, including:

- Severity of existing erosion
- Public access/ownership
- Protection of existing structures/infrastructure
- Impact to surrounding areas
- Public visibility/accessibility
- Potential for future erosion (near-bank stress and bank erosion hazard index ratings)
- Opportunity for habitat creation or restoration
- Maintaining healthy, native significant trees (minimize removal)
- Vegetation establishment potential (exposure to sunlight)
- Ease of construction access
- Consideration of proximity/possibility for other improvements (e.g. new sediment trapping device in nearby storm drains)
- Potential for public education/ signage

Any type of erosion comes with the associated issues:

- Introduction of sediment to stream and downstream waterbodies
- Degradation of bank vegetation and reduced potential for re-growth
- Degradation of in-stream and bank habitats
- Increased risk of continued erosion
- Changed stream shape and size over time

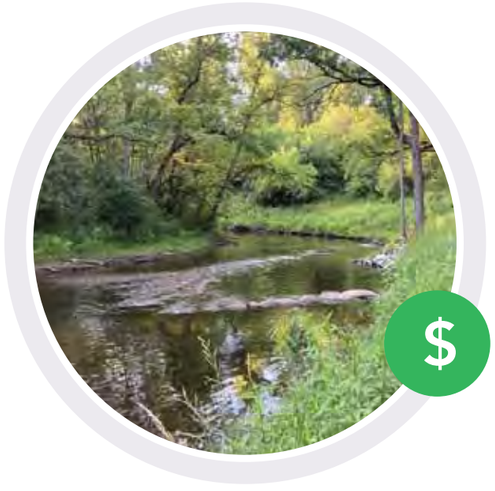
City of Plymouth

Bassett Creek Watershed Management Commission

Plymouth Creek Restoration Project

Stream Stabilization Methods

1



In-stream structures

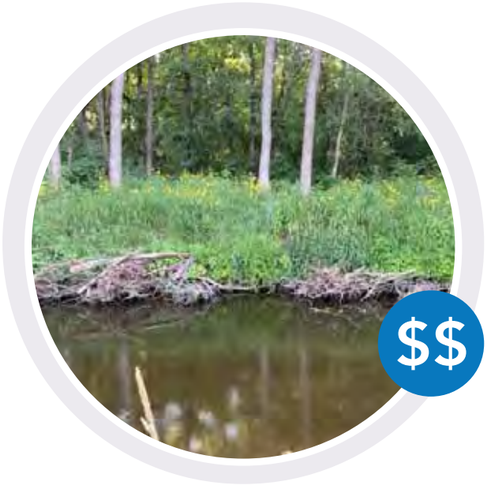
Pros

- Reduces near-bank stress
- Minimal bank disturbance
- Lowest construction cost
- Diversifies flow within stream, including energy dissipation pools
- Provides in-stream habitat

Cons

- In-stream features can be obstructed with sediment and debris
- Continued erosion on unprotected bank toe outside the zone of influence of the structures

2



Bank stabilization with bioengineering methods

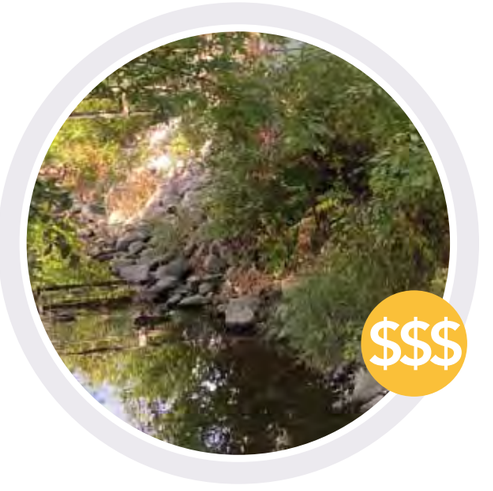
Pros

- More erosion protection along the base of the bank, also known as the bank toe
- Bioengineering and vegetation features can improve in-stream and bank habitat

Cons

- Requires establishment period for vegetation features
- Moderate grading can increase construction costs, bank disturbance, and potential tree removal

3



Bank grading with riprap and vegetation establishment

Pros

- Riprap allows for the most protection against damaging (high shear stress) flows
- Immediate stabilization of eroding areas

Cons

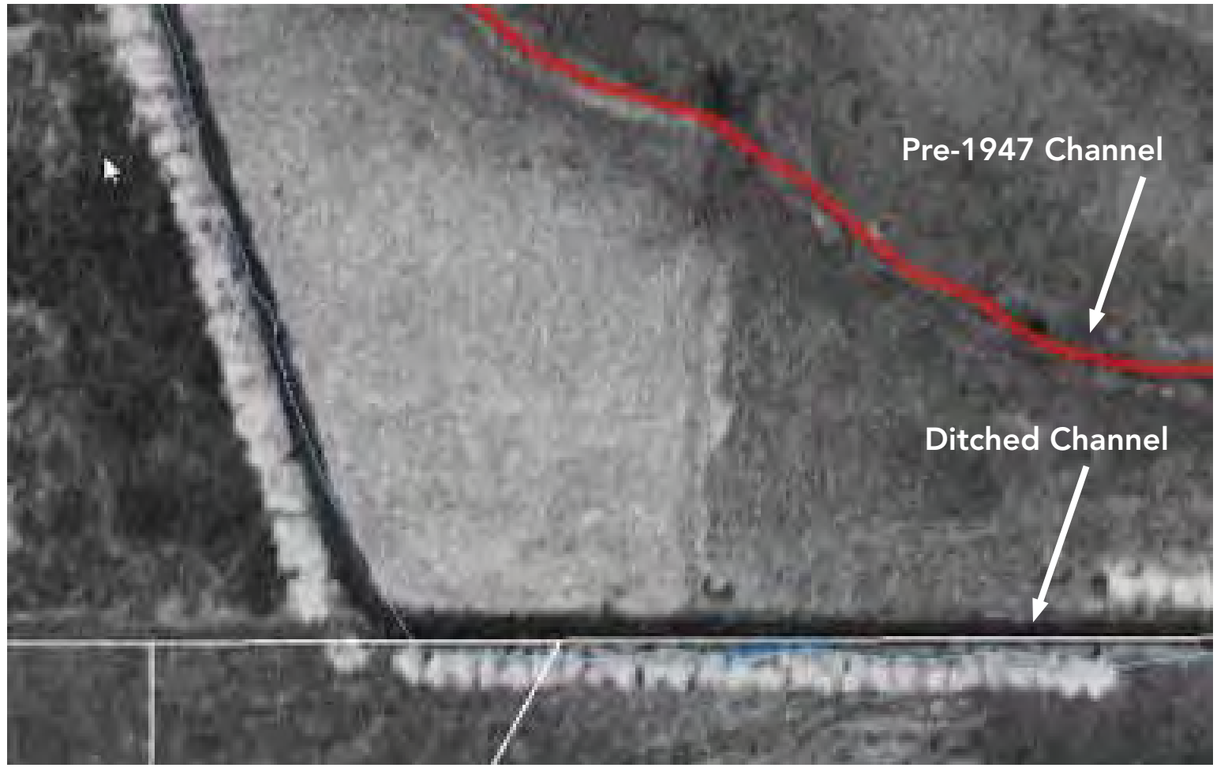
- Riprap provides minimal in-stream or bank habitat
- Riprap and grading are more cost intensive
- Most bank disturbance during construction, and potential tree removal

Potential Re-meandering

In 1947, Plymouth Creek was ditched and straightened, possibly to improve access to agricultural fields. It is likely that even the pre-1947 channel had been altered from the original stream flowpath. Natural channels are typically sinuous, and re-establishing a meandering pattern can be an important part of restoring a ditched and straightened stream. Creek re-meandering is one restoration option under consideration for the portion of the creek that is west and south of Plymouth Creek Elementary School.

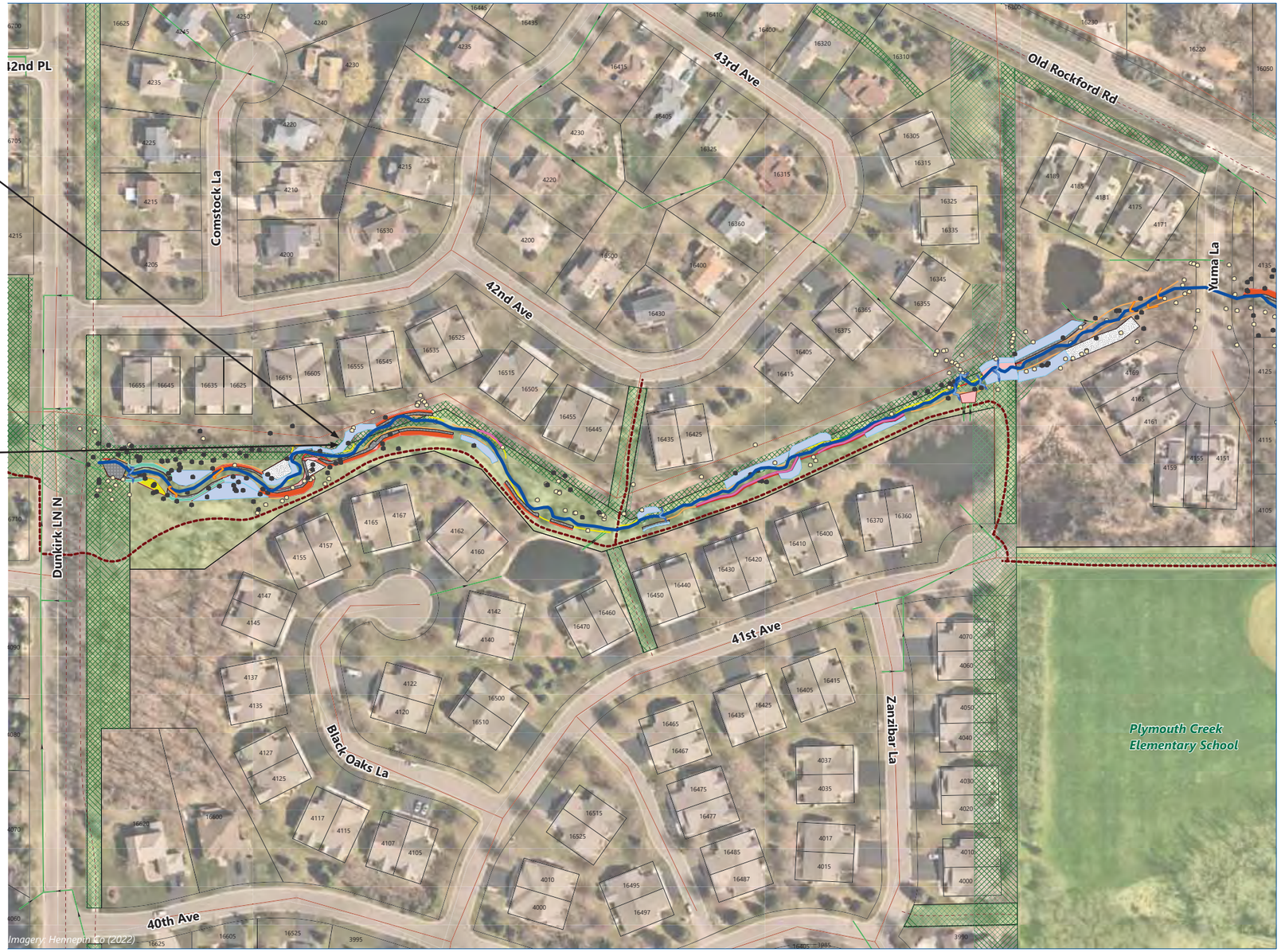
Benefits of Re-meandering

- Increases stream length and sinuosity
- Decreases flow rates and likelihood of bank erosion
- Increases resiliency during higher flow storm events
- Enhances habitat
- Promotes groundwater connectivity
- Enhances geomorphic processes including sediment transport and deposition



Preliminary Concept for Reach 1, Dunkirk Lane to Yuma Lane

- Regrade channel and stream banks to improve floodplain connection and soften tight curves
- Stabilize stream bank toe with rock riprap, coconut-fiber (coir) log, or root wads
- Stabilize stream bank with vegetative material (seed, live plugs, shrubs, and/or live cuttings)
- Remove invasive buckthorn within riparian zone and replace with native plantings



- Significant Trees
- Plymouth Creek
- Bike and/or Pedestrian Trail
- Parcel Boundary
- Public Parcel
- Easements

Bank Erosion Hazard Index (BEHI)

- Very High
- High
- Moderate
- Low

Utilities

- Gravity Storm Sewer
- Sanitary Main

Bioengineering Features

- Coir Log
- Cross-Vanes
- J-Hook
- Brush Mattresses
- Grading
- Live Staking
- Plug Planting
- Rock Riprap
- Seeding
- VRSS

* Significant tree: Any healthy tree measuring 8 inches in diameter or larger at a height of 54 inches above ground for deciduous trees, and measuring 4 inches in diameter or larger at a distance of 54 inches above ground for coniferous trees.

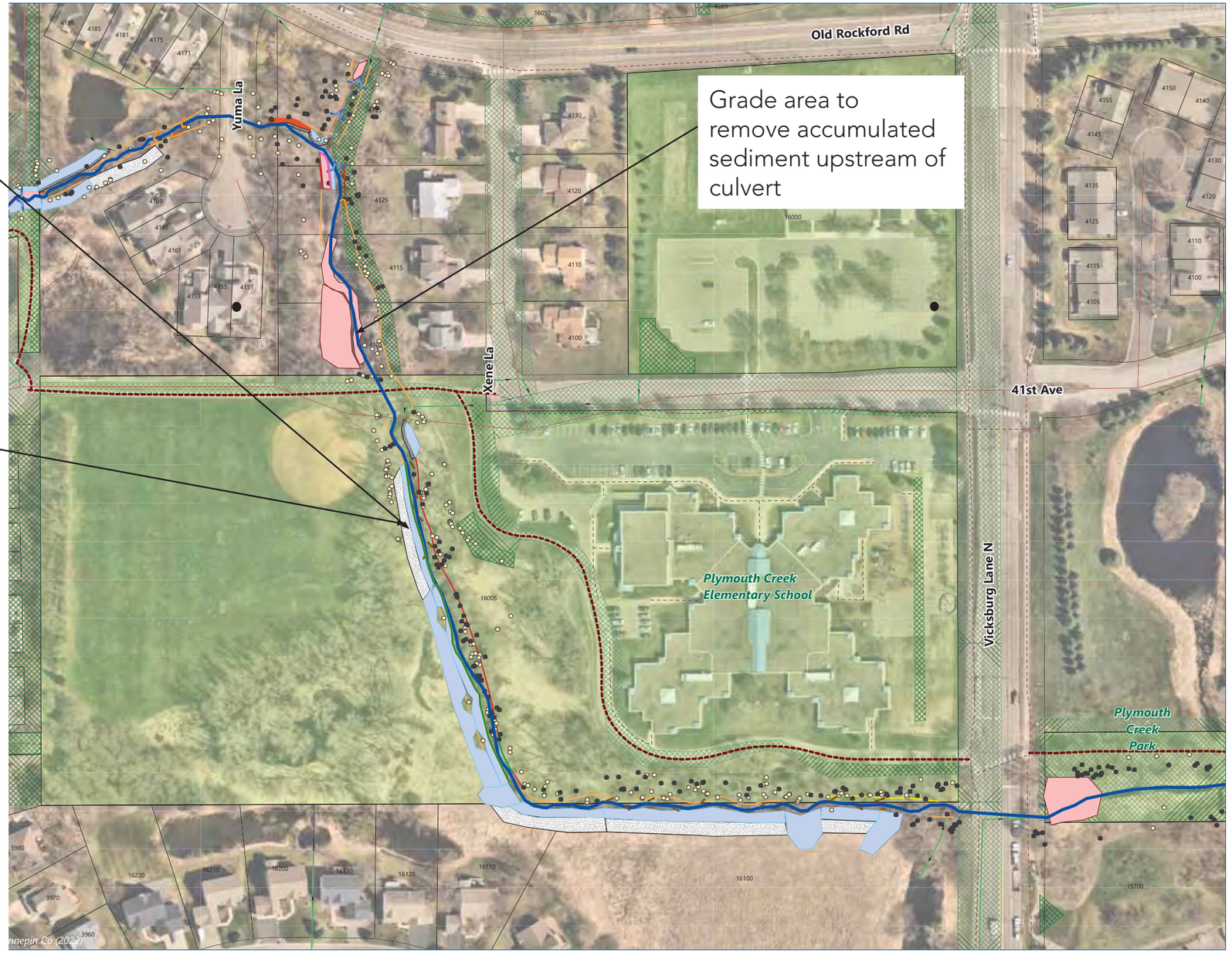
0 100 200
Feet

Plymouth Creek Restoration Project

Preliminary Concept for Reach 2, Yuma Lane to Vicksburg Road

- Regrade channel and stream banks to improve floodplain connection
- Install rock vanes to maintain channel grade and route erosive flows away from stream banks
- Stabilize stream bank with vegetative material (seed, live plugs, shrubs, and/or live cuttings)
- Remove invasive buckthorn within riparian zone and replace with native plantings

* See channel re-alignment board for potential stream meander layout next to school.



- Significant Trees
- Plymouth Creek
- Bike and/or Pedestrian Trail
- Parcel Boundary
- Public Parcel
- Easements

Bank Erosion Hazard Index (BEHI)

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- High
- Moderate
- Low

Utilities

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- Sanitary Main

Bioengineering Features

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- Cross-Vanes
- J-Hook
- Root Wads
- Vanes
- Grading
- Plug Planting
- Rock Riprap
- Seeding
- VRSS

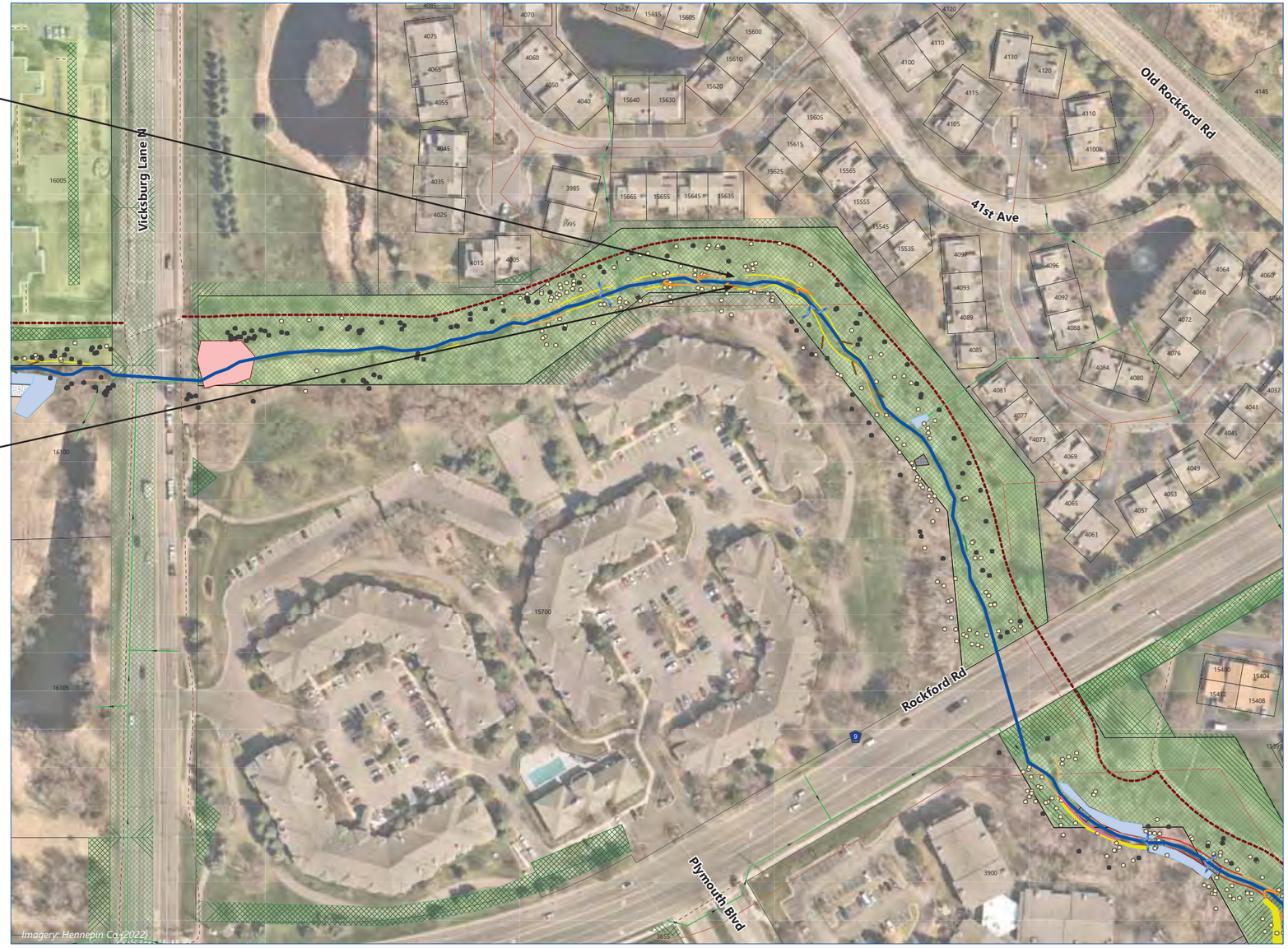
* Significant tree: Any healthy tree measuring 8 inches in diameter or larger at a height of 54 inches above ground for deciduous trees, and measuring 4 inches in diameter or larger at a distance of 54 inches above ground for coniferous trees.

0 100 200
Feet

Plymouth Creek Restoration Project

Preliminary Concept for Reach 3, Vicksburg Road to Rockford Road

- Install rock vanes to maintain channel grade and J-hook vanes to route erosive flows away from stream banks
- Stabilize culvert outlets with grading, riprap, erosion control blanket, and/or live plugs and seed
- Remove invasive buckthorn within riparian zone and replace with native plantings



- Significant Trees
- Plymouth Creek
- Bike and/or Pedestrian Trail
- Parcel Boundary
- Public Parcel
- Easements

Bank Erosion Hazard Index (BEHI)

- Very High
- High
- Moderate
- Low

Utilities

- Gravity Storm Sewer
- Sanitary Main

Bioengineering Features

- Coir Log
- Cross-Vanes
- J-Hook
- Vanes
- Grading
- Live Staking
- Plug Planting
- Rock Riprap
- Seeding

* Significant tree: Any healthy tree measuring 8 inches in diameter or larger at a height of 54 inches above ground for deciduous trees, and measuring 4 inches in diameter or larger at a distance of 54 inches above ground for coniferous trees.

0 100 200
Feet

Plymouth Creek Restoration Project

Preliminary Concept for Reach 4, Rockford Road to 38th Avenue

- Install rock vanes to maintain channel grade and J-hook vanes to route erosive flows away from stream banks
- Grade banks, place erosion control blanket and live plugs with live stakes and seeding to enhance floodplain
- Remove invasive buckthorn within riparian zone and replace with native plantings

- Significant Trees
- Plymouth Creek
- Bike and/or Pedestrian Trail
- Parcel Boundary
- Public Parcel
- Easements

Bank Erosion Hazard Index (BEHI)

- Very High
- High
- Moderate
- Low

Utilities

- Gravity Storm Sewer
- Sanitary Main

Bioengineering Features

- Coir Log
- Cross-Vanes
- J-Hook
- Brush Mattresses
- Grading
- Live Staking
- Plug Planting
- Rock Riprap
- Seeding
- VRSS
- Debris Removal

* Significant tree: Any healthy tree measuring 8 inches in diameter or larger at a height of 54 inches above ground for deciduous trees, and measuring 4 inches in diameter or larger at a distance of 54 inches above ground for coniferous trees.

0 100 200
Feet

Plymouth Creek Restoration Project

Timeline, Funding, and Project Impacts

Timeline (watch for project updates!)

September 19, 2024 — BCWMC Public Hearing

Winter 2024-Spring 2025 — Project Design

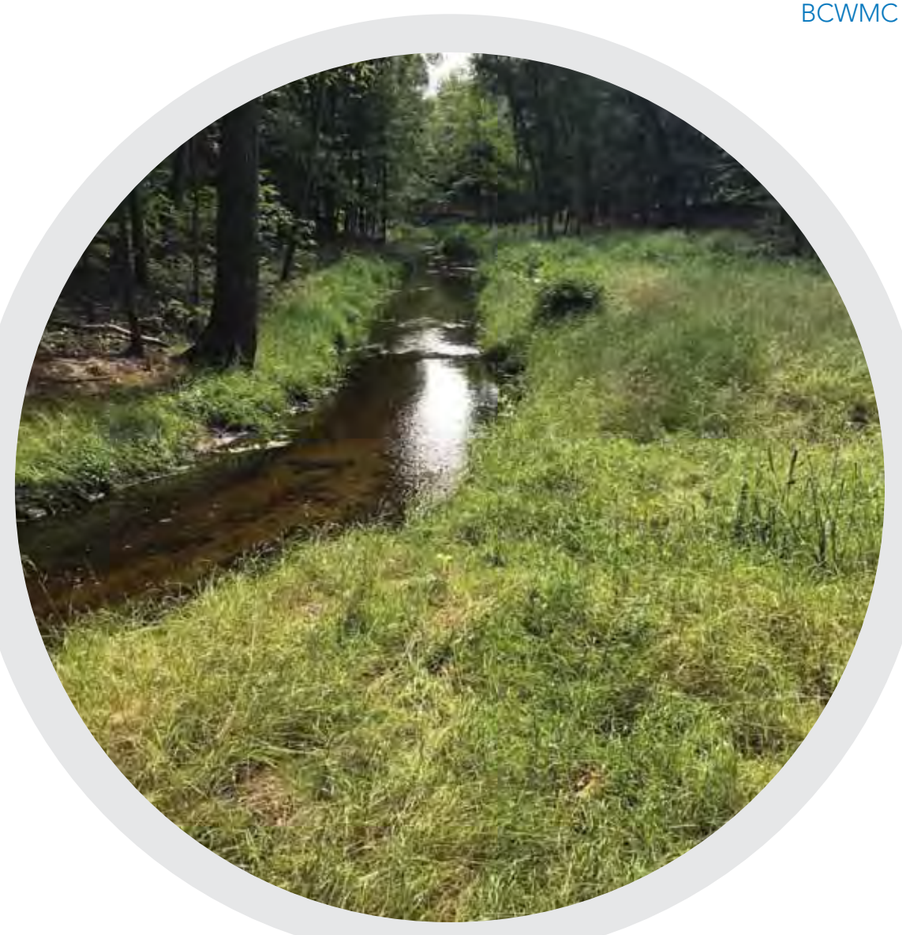
Spring 2025 — Contacting Individual Landowners

Winter 2025/2026 and Potentially Winter 2026/2027 — Project Construction

BCWMC Project Page

Funding

BCWMC Capital Funds levied by Hennepin County on all watershed residents



Project Impacts

- Improve water quality
- Reduce erosion along creek
- Improve in-stream and riparian habitat
- Protect infrastructure and utilities along creek
- Limit trail closures
- Limit tree removals or replace, as warranted

Plymouth Creek Potential Riparian Vegetation Regeneration Overview

Plymouth Creek riparian areas have lost much of their ecological value and stormwater runoff treatment capacity due to changes within the watershed. Regenerating native vegetation within the riparian zone of Plymouth Creek provides many opportunities to meet District goals including:

- **to restore ecological value**
- **to provide additional stormwater runoff treatment**
- **to clean up debris**
- **to restore wildlife habitat**
- **to provide passive recreation**

Understory and herbaceous ground layer species within the riparian corridor vary from non-native invasives (e.g., Tatarian honeysuckle, common burdock, thistles, and buckthorn) to native generalists (e.g., snakeroot, woodbine, Canada goldenrod, and asters). This plant community structure and species composition is a direct result of past human disturbance (e.g., plowing, grading, grazing, etc.).

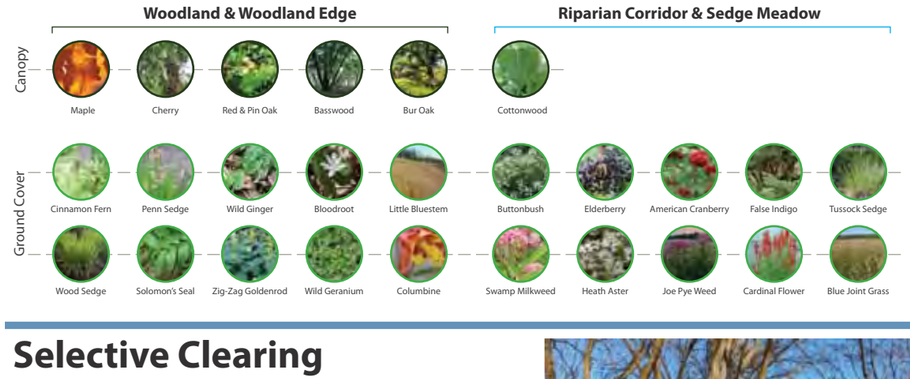
An invasive plant is defined as a plant that is non-native or native (e.g., Canada goldenrod, ragweed, and box elder) and has negative effects on our economy, environment, or human health. Invasive plants are aggressive species that can establish rapidly and outcompete native plants. When invasive species displace native plants they degrade wildlife habitat by altering the physical structural cover of a plant community and by eliminating essential food sources. Invasive species present along the creek, like buckthorn and garlic mustard, can create areas of exposed soils which lead to erosion and result in the degradation of water quality in lakes and streams. The removal of invasive species and the prevention of future species establishing is a project priority.

Existing Plant Community: **Plymouth Creek & Dunkirk Ln**

Existing Plant Community: **Plymouth Creek & Rockford Rd**

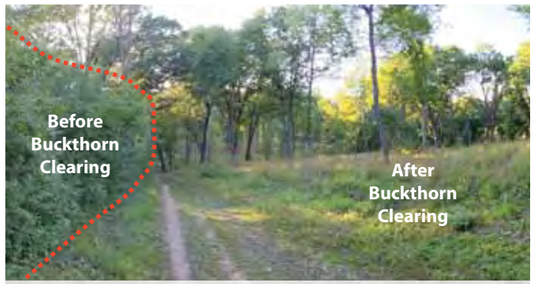
Existing Plant Community: **Plymouth Creek & 41st Ave**

Target Community



Example Target Plant Community: **Sedge Meadow**

Example Target Plant Community: **Sedge Meadow**



Example Target Plant Community: **Woodland**

Selective Clearing

Before re-introducing native plant communities, invasive and non-native perennial plants will be cleared. In addition, trees that are diseased, dying, and prone to infestation are to be identified for removal. Opening up the tree canopy allows for the reintroduction of the native plant communities that were once present. Trees targeted for tree removal include:

- Buckthorn
- Ash (emerald ash borer)
- Siberian elm
- Boxelder
- Dead or dying trees that may be a hazard

Plymouth Creek Riparian Area: **Existing Invasive Species**

Example of Tree Removal: **Forestry Mower Clearing Trees**

Example of Degraded Woodland Restoration: **Before**

Example of Degraded Woodland Restoration: **After**

How long will it take?

It can take 5-7 years for restored native plant communities to reach full maturity. Proper site maintenance following a planting is essential to reduce weed competition and ensure the success of the restoration project.

Year 1

The site will look bare and weedy during the first growing season. Cover crop grasses establish quickly (to stabilize soils) but native perennial plants may only grow to a height of six inches in a season. Mowing is the best way to control annual weeds during the first few years. Site mowing is typically done 2-3 times in the first year to prevent annual weeds from going to seed.

Example Woodland Restoration: **Year 1**

Year 2

Some of the short-lived flowering species bloom in abundance during the second year. Plants like wild bergamot, fragrant hyssop, and black-eyed Susan are usually the first to flower during restoration.

Mowing is generally limited to one or two times during the second year. Some herbicide spot spraying is anticipated for persistent woody invasive species.

Example Woodland Restoration: **Year 2**

Year 3 & Beyond

The composition and appearance of these planted communities will continue to fluctuate and evolve over time. Most native flowers and grasses begin to reach maturity during the third year.

The frequency of weed management activities will be reduced over time but continued management is going to be important for most restoration projects.

Example Woodland Restoration: **Year 3**

Appendix C

Restoration Table

Restoration Table

Site Area Restoration	Severity of Existing Erosion [1]	Creek Ownership	Riparian Ownership/Access for Stabilization[2]	Riparian Ownership/Access for Vegetation Work [2]	Ease of Construction Access [2]	Protection of Existing Structures/ Infrastructure [2]	Impact to Surrounding Areas [3]	Potential for Future Erosion (BEHI/NBS) [4]	Opportunity for Habitat Restoration (riparian/upland) Based on Proposes Stream Stabilization	Opportunity for Habitat Restoration (in channel)	Maintaining Healthy, Native Significant Trees [5]	Vegetation Establishment	Education Potential [6]	Count	Rank
1a. Right and left bank stabilization with floodplain and channel realignment grading, rock toe, and vegetation establishment (Sta. 0+00 to 3+85)	3	2	2	1	3	5	0	9	2	2	0	2	2	33	High
1b. Right and left bank stabilization with rock toe, plantings, and VRSS (Sta. 3+85 to 6+05)	3	2	1	1	3	15	0	4	2	0	2	2	2	37	High
1c. Right bank stabilization with grading and plantings (Sta. 6+05 to 7+05)	2	3	2	1	3	5	0	3	2	0	2	2	2	27	Medium
1d. Right bank stabilization with rock toe and VRSS (Sta. 7+05 to 8+90)	1	3	3	1	0	5	0	2	2	0	2	2	2	23	Medium
1e. Right and left bank stabilization with rock toe, VRSS, plantings and cross vane (Sta. 9+10 to 10+20)	2	3	2	1	0	5	0	3	2	2	2	2	2	26	Medium
1f. Right and left bank stabilization with coir logs, grading, and plantings (Sta. 10+20 to 13+55)	3	3	2	1	0	5	0	7	2	0	0	2	2	27	Medium
1g. Right and left bank stabilization with channel realignment, cross vanes, and plantings (Sta. 13+55 to 15+35)	3	3	2	3	3	15	0	9	2	2	2	2	2	48	High
1h. Right and left bank stabilization with rock toe, vegetation, and j-hooks (Sta. 15+35 to 18+30)	3	2	2	2	3	0	0	4	2	2	0	2	0	22	Medium

Restoration Table

Site Area Restoration	Severity of Existing Erosion [1]	Creek Ownership	Riparian Ownership/Access for Stabilization[2]	Riparian Ownership/Access for Vegetation Work [2]	Ease of Construction Access [2]	Protection of Existing Structures/ Infrastructure [2]	Impact to Surrounding Areas [3]	Potential for Future Erosion (BEHI/NBS) [4]	Opportunity for Habitat Restoration (riparian/upland) Based on Proposes Stream Stabilization	Opportunity for Habitat Restoration (in channel)	Maintaining Healthy, Native Significant Trees [5]	Vegetation Establishment	Education Potential [6]	Count	Rank
2a. Right and left bank stabilization with rock toe, cross vanes, j-hook, and vegetation establishment (Sta. 18+70 to 21+00)	3	2	2	2	3	0	0	4	2	2	0	2	0	22	Medium
2b. Grading to improve channel definition and improve settling capacity of basin (Sta. 21+00 to 23+30)	0	2	2	2	0	0	0	1	0	0	2	0	0	9	Low
2c. Right and left bank stabilization with grading, rock toe, root wads, log vanes, and vegetation establishment (Sta. 23+40 to 25+40)	3	3	3	3	3	15	0	4	2	2	0	2	1	41	High
2d. Right and left bank stabilization with grading, root wads, log vanes, woody debris removal, and vegetation establishment (Sta. 25+40 to 29+30)	3	3	3	3	3	0	0	4	2	2	0	2	1	26	Medium
2e. Right and left bank stabilization with grading banks and side channels, log vanes, woody debris removal, and vegetation establishment (Sta. 29+30 to 33+90)	2	1	1	1	3	0	0	8	2	2	0	2	1	23	Medium
2f. Right and left bank stabilization with grading, woody debris removal, log vanes, and vegetation establishment (Sta. 33+90 to 36+00)	1	1	1	1	3	0	0	3	2	2	2	2	1	19	Medium

Restoration Table

Site Area Restoration	Severity of Existing Erosion [1]	Creek Ownership	Riparian Ownership/Access for Stabilization[2]	Riparian Ownership/Access for Vegetation Work [2]	Ease of Construction Access [2]	Protection of Existing Structures/ Infrastructure [2]	Impact to Surrounding Areas [3]	Potential for Future Erosion (BEHI/NBS) [4]	Opportunity for Habitat Restoration (riparian/upland) Based on Proposes Stream Stabilization	Opportunity for Habitat Restoration (in channel)	Maintaining Healthy, Native Significant Trees [5]	Vegetation Establishment	Education Potential [6]	Count	Rank
3a. Grading to improve channel definition and remove accumulated sediment (Sta. 37+00 to 38+00)	0	3	1	1	3	0	0	1	0	0	2	0	2	13	Low
3b. Right and left bank vegetation management (Sta. 38+00 to 42+30)	0	3	3	1	3	0	1	0	0	0	0	2	2	15	Low
3c. Right and left bank stabilization with cross vanes, j-hooks, and woody debris removal (Sta. 42+30 to 46+40)	2	3	2	1	3	15	1	3	0	2	2	0	0	34	High
3d. Right and left bank stabilization with log vanes, plantings, and installation of riprap (Sta. 46+40 to 49+00)	2	3	1	1	3	0	0	3	0	2	2	2	0	19	Medium
3e. Right and left bank vegetation management (Sta.49+00 to 51+50)	0	3	3	1	3	0	1	0	0	0	0	2	2	15	Low

Restoration Table

Site Area Restoration	Severity of Existing Erosion [1]	Creek Ownership	Riparian Ownership/Access for Stabilization[2]	Riparian Ownership/Access for Vegetation Work [2]	Ease of Construction Access [2]	Protection of Existing Structures/ Infrastructure [2]	Impact to Surrounding Areas [3]	Potential for Future Erosion (BEHI/NBS) [4]	Opportunity for Habitat Restoration (riparian/upland) Based on Proposes Stream Stabilization	Opportunity for Habitat Restoration (in channel)	Maintaining Healthy, Native Significant Trees [5]	Vegetation Establishment	Education Potential [6]	Count	Rank
4a. Right and left bank stabilization with cross vanes, rock riffles, coir log, grading, and vegetation establishment (Sta. 53+00 to 56+75)	2	1	1	1	3	15	0	3	2	2	0	2	2	34	High
4b. Right and left bank stabilization with j-hooks and live staking (Sta. 56+75 to 58+60)	3	3	3	1	3	0	1	4	2	2	2	2	2	28	Medium
4c. Right and left bank stabilization with grading, rock toe, cross vanes, and plantings (Sta. 58+60 to 61+10)	2	3	3	1	3	0	0	3	2	2	2	2	2	25	Medium
4d. Right and left bank stabilization with riprap banks and live staking (Sta. 61+10 to 62+85)	3	3	3	1	3	0	0	4	2	0	2	2	2	25	Medium
4e. Right and left bank stabilization with coir log, j-hooks, cross vanes, and live staking (Sta. 62+85 to 65+00)	3	3	3	1	3	0	0	4	2	2	2	2	0	25	Medium
4f. Right and left bank stabilization with cross vanes, j-hook, and grading (Sta. 65+00 to 67+70)	3	3	3	3	3	0	0	4	0	2	0	0	0	21	Medium
4g. Right and left bank stabilization with cross vane and grading to remove accumulated sediment (Sta. 68+50 to 70+00)	2	3	3	3	3	5	0	3	0	2	0	0	2	26	Medium

[1] Based on maximum BEHI score for the reach. Moderate=1, High=2, Very high= 3

[2] Given score of 15 if protects a sanitary sewer, 5 for other infrastructure

[3] Given score of 1 if little earth work

[4] Based on adding maximum BEHI and NBS. Moderate BEHI=1, High BEHI=2, Very high BEHI= 3, Very low NBS=1, Low NBS=2, Moderate NBS=3, High NBS= 4, Very high NBS=5, Extreme NBS=6

[5] Given score of 2 if maintaining trees that are not buckthorn, box elder, green ash, and siberian elm

[6] Given score 2 if stream restoration would be seen by the trail. Given score of 1 if the stream restoration is near Plymouth Elementary.

Appendix D

Erosion Rates

Left Bank Erosion Rates

Reach	Restoration Area	Site Length	Length of Eroding Bank (ft)	Length of Eroding Bank Repaired if repaired)	Est. Avg. Bank Height (ft)	BEHI rating	NBS rating	Est. Erosion Rate (ft/yr)	Est. Erosion Rate (CF/yr)	Est. Sed. Load (ton/yr)	Est "Stable" Erosion Rate (ft/yr)	Est "Stable" Sed. Load Rate (ft/yr)	"Stable" Sed. Load (ton/yr)	Est. Sed. Load Reduction (ton/yr)	TSS Reduction (lb/yr)	TP Reduction (lb/yr)	Rank of Site
Station 0+00 To 3+85	1a	385	75	75	3.0	Moderate	Very Low	0.01	2.3	0.1	0.005	1.1	0.1	0.1	110	0.1	High
Station 0+00 To 3+85	1a	385	35	35	3.0	Moderate	Extreme	0.3	31.5	1.5	0.005	0.5	0.0	1.5	2,980	1.5	High
Station 0+00 To 3+85	1a	385	127	127	2.6	High	Very Low	0.08	25.9	1.2	0.005	1.6	0.1	1.2	2,340	1.2	High
Station 0+00 To 3+85	1a	385	35	35	2.6	High	Extreme	0.4	35.7	1.7	0.005	0.4	0.0	1.7	3,390	1.7	High
Station 0+00 To 3+85	1a	385	10	10	3.0	Very High	Very Low	0.3	8.8	0.4	0.005	0.1	0.0	0.4	830	0.4	High
Station 3+85 To 6+05	1b	220	48	27	3.3	Moderate	Very Low	0.01	1.6	0.1	0.005	0.4	0.1	0.0	40	0.0	High
Station 3+85 To 6+05	1b	220	113	108	3.0	High	Very Low	0.08	27.2	1.3	0.005	1.6	0.1	1.2	2,350	1.2	High
Station 6+05 To 7+05	1c	100	33	15	3.0	Moderate	Very Low	0.01	1.0	0.0	0.005	0.2	0.0	0.0	20	0.0	Medium
Station 6+05 To 7+05	1c	100	58	22	3.0	High	Very Low	0.08	13.9	0.7	0.005	0.3	0.4	0.2	470	0.2	Medium
Station 9+10 To 10+20	1e	110	48	18	2.8	Moderate	Very Low	0.01	1.3	0.1	0.005	0.2	0.1	0.0	20	0.0	Medium
Station 10+20 To 13+55	1f	335	65	29	4.0	Moderate	Very Low	0.01	2.6	0.1	0.005	0.6	0.1	0.0	60	0.0	Medium
Station 10+20 To 13+55	1f	335	170	130	3.2	High	Very Low	0.08	43.7	2.1	0.005	2.1	0.6	1.5	3,010	1.5	Medium
Station 13+55 To 15+35	1g	180	105	40	2.5	Moderate	Very Low	0.008	2.1	0.1	0.005	0.5	0.1	0.0	30	0.0	High
Station 13+55 To 15+35	1g	180	13	13	2.8	Very High	Very Low	0.3	10.7	0.5	0.005	0.2	0.0	0.5	1,020	0.5	High
Station 13+55 To 15+35	1g	180	20	20	2.8	Very High	Extreme	0.5	27.5	1.3	0.005	0.3	0.0	1.3	2,620	1.3	High
Station 15+35 To 18+30	1h	295	245	245	2.9	High	Very Low	0.08	55.9	2.7	0.005	3.5	0.2	2.5	5,050	2.5	Medium
Station 15+35 To 18+30	1h	295	10	10	3.0	Very High	Very Low	0.3	8.7	0.4	0.005	0.1	0.0	0.4	830	0.4	Medium
Station 18+70 To 21+00	2a	360*	332	332	3.0	High	Very Low	0.08	79.7	3.8	0.005	5.0	0.2	3.6	7,190	3.6	Medium
Station 18+70 To 21+00	2a	360*	48	48	4.0	Very High	Very Low	0.3	57.1	2.8	0.005	1.0	0.0	2.7	5,410	2.7	Medium
Station 21+00 To 23+30	2b	230	224	0	1.0	High	Very Low	0.08	17.9	0.9	0.005	0.0	0.9	0.0	0	0.0	Low
Station 23+40 To 25+40	2c	200	98	63	2.5	High	Very Low	0.08	19.6	0.9	0.005	0.8	0.4	0.6	1,140	0.6	High
Station 23+40 To 25+40	2c	200	116	116	3.5	Very High	Very Low	0.3	121.9	5.9	0.005	2.0	0.1	5.8	11,550	5.8	High
Station 25+40 To 29+30	2d	390	325	315	4.5	Very High	Very Low	0.3	438.7	21.1	0.005	7.1	1.0	20.1	40,260	20.1	Medium
Station 29+30 To 33+90	2e	460	132	12	3.0	Moderate	Very Low	0.01	4.0	0.2	0.005	0.2	0.2	0.0	20	0.0	Medium
Station 29+30 To 33+90	2e	460	140	140	3.2	High	Very Low	0.08	36.0	1.7	0.005	2.2	0.1	1.6	3,250	1.6	Medium
Station 29+30 To 33+90	2e	460	40	40	3.2	High	Low	0.11	14.1	0.7	0.005	0.6	0.0	0.6	1,290	0.6	Medium
Station 29+30 To 33+90	2e	460	30	30	3.2	High	Extreme	0.4	38.4	1.8	0.005	0.5	0.0	1.8	3,650	1.8	Medium
Station 29+30 To 33+90	2e	460	14	0	0.0	Very High	Very Low	0.3	0.0	0.0	0.005	0.0	0.0	0.0	0	0.0	Medium

Left Bank Erosion Rates

Reach	Restoration Area	Site Length	Length of Eroding Bank (ft)	Length of Eroding Bank Repaired if repaired)	Est. Avg. Bank Height (ft)	BEHI rating	NBS rating	Est. Erosion Rate (ft/yr)	Est. Erosion Rate (CF/yr)	Est. Sed. Load (ton/yr)	Est "Stable" Erosion Rate (ft/yr)	Est "Stable" Sed. Load Rate (ft/yr)	"Stable" Sed. Load (ton/yr)	Est. Sed. Load Reduction (ton/yr)	TSS Reduction (lb/yr)	TP Reduction (lb/yr)	Rank of Site
Station 33+90 To 36+00	2f	210	156	106	3.0	Moderate	Very Low	0.01	4.7	0.2	0.005	1.6	0.1	0.1	150	0.1	Medium
Station 42+30 To 46+40	3c	410	293	243	2.4	Moderate	Very Low	0.01	7.1	0.3	0.005	2.9	0.2	0.1	280	0.1	High
Station 42+30 To 46+40	3c	410	156	81	2.2	High	Very Low	0.08	27.0	1.3	0.005	0.9	0.7	0.6	1,260	0.6	High
Station 46+40 To 49+00	3d	260	60	60	3.0	Moderate	Very Low	0.01	1.8	0.1	0.005	0.9	0.0	0.0	90	0.0	Medium
Station 53+00 To 56+75	4a	375	270	270	2.0	Moderate	Very Low	0.01	5.4	0.3	0.005	2.7	0.1	0.1	260	0.1	High
Station 53+00 To 56+75	4a	375	62	62	2.0	High	Very Low	0.08	10.0	0.5	0.005	0.6	0.0	0.5	900	0.5	High
Station 56+75 To 58+75	4b	200	61	61	1.7	Moderate	Very Low	0.01	1.0	0.1	0.005	0.5	0.0	0.0	50	0.0	Medium
Station 56+75 To 58+75	4b	200	122	122	2.3	High	Very Low	0.08	22.4	1.1	0.005	1.4	0.1	1.0	2,020	1.0	Medium
Station 58+75 To 61+10	4c	235	129	129	3.1	Moderate	Very Low	0.01	4.0	0.2	0.005	2.0	0.1	0.1	190	0.1	Medium
Station 58+75 To 61+10	4c	235	64	24	2.9	High	Very Low	0.08	14.9	0.7	0.005	0.4	0.5	0.3	510	0.3	Medium
Station 61+10 To 62+85	4d	175	55	55	3.5	Moderate	Very Low	0.01	1.9	0.1	0.005	1.0	0.0	0.0	90	0.0	Medium
Station 61+10 To 62+85	4d	175	87	67	4.8	High	Very Low	0.08	33.0	1.6	0.005	1.6	0.4	1.1	2290	1.1	Medium
Station 62+85 To 65+00	4e	215	193	148	2.6	High	Very Low	0.08	39.5	1.9	0.005	1.9	0.5	1.4	2740	1.4	Medium
Station 62+85 To 65+00	4e	215	27	27	2.5	Very High	Very Low	0.3	20.2	1.0	0.005	0.3	0.0	1.0	1910	1.0	Medium
Station 65+00 To 67+70	4f	270	123	83	1.8	High	Very Low	0.08	17.7	0.9	0.005	0.7	0.3	0.5	1080	0.5	Medium
Station 65+00 To 67+70	4f	270	95	95	2.1	Very High	Very Low	0.3	59.8	2.9	0.005	1.0	0.0	2.8	5660	2.8	Medium
Station 68+50 To 70+00	4g	410	71	71	2.5	Moderate	Very Low	0.01	1.8	0.1	0.005	0.9	0.0	0.0	80	0.0	Medium

*Includes channel that flows into Plymouth Creek

Right Bank Erosion Rates

Reach	Restoration Area	Site Length	Length of Eroding Bank (ft)	Length of Eroding Bank Repaired if repaired)	Est. Avg. Bank Height (ft)	BEHI rating	NBS rating	Est. Erosion Rate (ft/yr)	Est. Erosion Rate (CF/yr)	Est. Sed. Load (ton/yr)	Est "Stable" Erosion Rate (ft/yr)	Est "Stable" Sed. Load Rate (ft/yr)	"Stable" Sed. Load (ton/yr)	Est. Sed. Load Reduction (ton/yr)	TSS Reduction (lb/yr)	TP Reduction (lb/yr)	Rank of Site
Station 0+00 To 3+85	1a	385	124	124	4.3	High	Very Low	0.08	42.2	2.0	0.005	2.6	0.1	1.9	3810	1.9	High
Station 0+00 To 3+85	1a	385	55	55	4.3	High	Moderate	0.16	37.4	1.8	0.005	1.2	0.1	1.7	3490	1.7	High
Station 0+00 To 3+85	1a	385	50	50	4.3	High	Extreme	0.4	85.0	4.1	0.005	1.1	0.1	4.0	8080	4.0	High
Station 0+00 To 3+85	1a	385	102	102	3.8	Very High	Very Low	0.3	116.8	5.6	0.005	1.9	0.1	5.5	11060	5.5	High
Station 3+85 To 6+05	1b	220	220	220	0.0	Moderate	Very Low	0.008	0.0	0.0	0.005	0.0	0.0	0.0	0	0.0	High
Station 0+00 To 3+85	1a	385	40	40	3.8	Very High	Extreme	0.75	114.5	5.5	0.005	0.8	0.0	5.5	10950	5.5	High
Station 3+85 To 6+05	1b	220	168	168	3.9	High	Very Low	0.08	52.0	2.5	0.005	3.3	0.2	2.3	4700	2.3	High
Station 3+85 To 6+05	1b	220	37	37	3.5	Very High	Very Low	0.3	38.4	1.9	0.005	0.6	0.0	1.8	3640	1.8	High
Station 6+05 To 7+05	1c	100	72	56	3.3	High	Very Low	0.08	18.8	0.9	0.005	0.9	0.2	0.7	1330	0.7	Medium
Station 7+05 To 8+90	1d	185	181	111	4.5	Moderate	Very Low	0.01	8.2	0.4	0.005	2.5	0.3	0.1	240	0.1	Medium
Station 9+10 To 10+20	1e	110	74	58	5.0	High	Very Low	0.08	29.6	1.4	0.005	1.5	0.4	1.0	2100	1.0	Medium
Station 9+10 To 10+20	1e	110	2	2	5.0	Very High	Very Low	0.3	2.7	0.1	0.005	0.0	0.0	0.1	250	0.1	Medium
Station 10+20 To 13+55	1f	335	280	254	3.0	Very High	Very Low	0.3	247.9	11.9	0.005	3.7	1.3	10.6	21290	10.6	Medium
Station 10+20 To 13+55	1f	335	40	40	3.0	Very High	High	0.5	59.1	2.8	0.005	0.6	0.0	2.8	5640	2.8	Medium
Station 13+55 To 15+35	1g	180	89	25	3.0	High	Very Low	0.08	21.4	1.0	0.005	0.4	0.8	0.3	540	0.3	High
Station 13+55 To 15+35	1g	180	60	60	3.0	High	High	0.2	36.0	1.7	0.005	0.9	0.0	1.7	3380	1.7	High
Station 15+35 To 18+30	1h	295	264	264	3.8	High	Very Low	0.08	80.9	3.9	0.005	5.1	0.2	3.7	7310	3.7	Medium
Station 18+70 To 21+00	2a	360*	171	141	1.5	High	Very Low	0.08	20.5	1.0	0.005	1.1	0.2	0.8	1530	0.8	Medium
Station 18+70 To 21+00	2a	360*	45	45	3.3	Very High	Very Low	0.3	44.2	2.1	0.005	0.7	0.0	2.1	4190	2.1	Medium
Station 21+00 To 23+30	2b	230	26	0	1.0	High	Very Low	0.08	2.1	0.1	0.005	0.0	0.1	0.0	0	0.0	Low
Station 23+40 To 25+40	2c	200	78	78	2.5	High	Very Low	0.08	15.7	0.8	0.005	1.0	0.0	0.7	1420	0.7	High
Station 23+40 To 25+40	2c	200	75	75	4.5	Very High	Very Low	0.3	100.8	4.9	0.005	1.7	0.1	4.8	9550	4.8	High
Station 25+40 To 29+30	2d	390	288	288	5.0	High	Very Low	0.08	115.3	5.6	0.005	7.2	0.3	5.2	10410	5.2	Medium
Station 25+40 To 29+30	2d	390	95	95	4.5	Very High	Very Low	0.3	127.8	6.2	0.005	2.1	0.1	6.1	12100	6.1	Medium
Station 29+30 To 33+90	2e	460	434	434	3.0	High	Very Low	0.08	104.1	5.0	0.005	6.5	0.3	4.7	9400	4.7	Medium
Station 29+30 To 33+90	2e	460	50	50	3.0	High	High	0.2	30.0	1.4	0.005	0.8	0.0	1.4	2820	1.4	Medium
Station 33+90 To 36+00	2f	210	103	73	5.5	High	Very Low	0.08	45.3	2.2	0.005	2.0	0.7	1.4	2900	1.4	Medium
Station 42+30 To 46+40	3c	410	248	198	2.6	Moderate	Very Low	0.01	6.3	0.3	0.005	2.5	0.2	0.1	240	0.1	High
Station 42+30 To 46+40	3c	410	187	112	2.3	High	Very Low	0.08	33.7	1.6	0.005	1.3	0.7	0.9	1820	0.9	High

Right Bank Erosion Rates

Reach	Restoration Area	Site Length	Length of Eroding Bank (ft)	Length of Eroding Bank Repaired if repaired)	Est. Avg. Bank Height (ft)	BEHI rating	NBS rating	Est. Erosion Rate (ft/yr)	Est. Erosion Rate (CF/yr)	Est. Sed. Load (ton/yr)	Est "Stable" Erosion Rate (ft/yr)	Est "Stable" Sed. Load Rate (ft/yr)	"Stable" Sed. Load (ton/yr)	Est. Sed. Load Reduction (ton/yr)	TSS Reduction (lb/yr)	TP Reduction (lb/yr)	Rank of Site
Station 46+40 To 49+00	3d	260	65	65	2.5	Moderate	Very Low	0.01	1.6	0.1	0.005	0.8	0.0	0.0	80	0.0	Medium
Station 46+40 To 49+00	3d	260	89	89	3.0	High	Very Low	0.08	21.4	1.0	0.005	1.3	0.1	1.0	1940	1.0	Medium
Station 53+00 To 56+75	4a	375	289	289	1.8	Moderate	Very Low	0.01	5.1	0.2	0.005	2.5	0.1	0.1	240	0.1	High
Station 53+00 To 56+75	4a	375	60	60	2.0	High	Very Low	0.08	9.6	0.5	0.005	0.6	0.0	0.4	870	0.4	High
Station 56+75 To 58+75	4b	200	144	144	2.5	High	Very Low	0.08	28.7	1.4	0.005	1.8	0.1	1.3	2590	1.3	Medium
Station 56+75 To 58+75	4b	200	52	52	2.0	Very High	Very Low	0.3	30.9	1.5	0.005	0.5	0.0	1.5	2930	1.5	Medium
Station 58+75 To 61+10	4c	235	241	201	3.4	High	Very Low	0.08	66.4	3.2	0.005	3.5	0.7	2.5	5000	2.5	Medium
Station 61+10 To 62+85	4d	175	143	113	4.6	High	Very Low	0.08	52.5	2.5	0.005	2.6	0.7	1.9	3740	1.9	Medium
Station 61+10 To 62+85	4d	175	20	20	3.6	Very High	Very Low	0.3	21.2	1.0	0.005	0.4	0.0	1.0	2000	1.0	Medium
Station 62+85 To 65+00	4e	215	277	232	3.3	High	Very Low	0.08	73.0	3.5	0.005	3.8	0.8	2.8	5520	2.8	Medium
Station 62+85 To 65+00	4e	215	143	143	2.6	Very High	Very Low	0.3	109.8	5.3	0.005	1.8	0.1	5.2	10390	5.2	Medium
Station 65+00 To 67+70	4f	270	265	225	2.3	High	Very Low	0.08	48.1	2.3	0.005	2.6	0.5	1.8	3680	1.8	Medium
Station 68+50 To 70+00	4g	410	193	193	1.7	High	Very Low	0.08	26.3	1.3	0.005	1.6	0.1	1.2	2370	1.2	Medium
Station 68+50 To 70+00	4g	410	95	95	0	Very High	Very Low	0.3	0	0	0.005	0	0	0	0	0	Medium

*Includes channel that flows into Plymouth Creek

Appendix E

Tree Loss Summary

Tree Loss Summary

Species	Healthy Trees Removed for High, Medium, and Low Priority Sites	Healthy Trees Removed for High and Medium Low Priority Sites	Healthy Trees Removed for High Priority Sites
Apple	1	1	0
Green Ash	32	28	16
American Basswood	3	3	2
Paper Birch	1	1	1
Box Elder	105	99	38
Buckthorn	13	13	2
Cottonwood	29	29	19
American Elm	15	15	3
Hackberry	1	0	0
Norway Maple	3	0	0
Silver Maple	4	4	4
Bur Oak	7	7	4
Pin Oak	2	2	2
Red Oak	1	1	1
White Pine	1	1	1
Norway Spruce	3	3	3
White Spruce	4	3	3
Black Willow	23	23	8
	248	233	107

Appendix F

Cost Estimates

Plymouth Creek - Alternative 1, High Sites

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$ 39,240	$ 39,300
Control of Water	LS	1	$ 20,000	$ 20,000
Erosion Control	LS	1	$ 16,770	$ 16,800
Clearing and Grubbing	ACRE	0.6	$ 21,500	$ 12,900
Clear and Grub Woody Invasive Plant Removal (<=6" DBH tree)	ACRE	3.4	$ 5,700	$ 19,400
Clear and Grub Woody Invasive Plant Removal (>=6" DBH tree)	EACH	5	$ 700	$ 3,500
Herbaceous vegetation herbicide treatment	ACRE	3.4	$ 1,000	$ 3,400
Select Tree Removal (>6")	EACH	121	$ 450	$ 54,500
Debris Removal	EACH	2	$ 1,450	$ 2,900
Grading	SY	2350	$ 3	$ 7,100
Common Excavation	CY	280	$ 16	$ 4,500
Fieldstone Riprap	TONS	390	$ 120	$ 46,800
Clear and Salvage Trees and Install as Root Wad	EACH	1	$ 700	$ 700
Cross Vane	EACH	11	$ 4,200	$ 46,200
J-hook Vane (boulder)	EACH	2	$ 1,300	$ 2,600
J-hook Vane (log)	EACH	4	$ 2,500	$ 10,000
Log Vanes	EACH	5	$ 1,750	$ 8,800
Brush Mattress	SY	150	$ 80	$ 12,000
VRSS	SY	240	$ 90	$ 21,600
Coir Logs	LF	110	$ 40	$ 4,400
Plant Trees	EACH	40	$ 300	$ 12,000
Plant Shrubs	EACH	520	$ 42	$ 21,900
Plant Plugs	EACH	520	$ 5	$ 2,600
Seeding	ACRES	3.5	$ 4,400	$ 15,400
Coir Blanket	SY	1930	$ 11	$ 21,300
Live Stakes	EACH	80	$ 6	$ 500
Seeding and Erosion Control Blanket	SY	100	$ 4	$ 400
Annual Vegetation Maintenance	LS	3	$ 6,708	$ 20,200
			Construction Total	$ 431,700
			Construction Total w/ Contingency (20%)	$ 518,000
			Planning, Engineering & Design (30%)	$ 155,400
			Construction Management (10%)	$ 51,800
			Project Total	$ 726,000
			Total w/ Construction Lower Bound (-20%), Legal, and Engineering	$ 581,000
			Total w/ Construction Upper Bound (+30%), Legal, and Engineering	$ 944,000
			Annual Maintenance Cost (2%)	$ 14,600

High Priority Sites: 30-yr and Annualized Cost analysis	Project Total
Category:	Bioengineering
Estimated life span (years)	20
Number of major maint. Events	1
Annual maintenance % of original project cost	15%
End of life span % of original project cost	25%
Expected annual maintenance	$ 5,600
End of life span maintenance	$ 181,500
Future Capital Cost	$ 1,762,200
Future annual maintenance	$ 266,420
Future end of life span cost	$ 327,810
Total Future Worth	$ 2,356,000
Annualized Cost	$ 50,000
Annual Maintenance Cost	$ 14,500

Plymouth Creek - Alternative 2, High and Medium Sites

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$ 111,760	$ 111,800
Control of Water	LS	1	$ 60,000	$ 60,000
Erosion Control	LS	1	$ 47,635	$ 47,700
Clearing and Grubbing	ACRE	1.9	$ 21,500	$ 40,900
Clear and Grub Woody Invasive Plant Removal (<=6" DBH tree)	ACRE	10.5	$ 5,700	$ 59,900
Clear and Grub Woody Invasive Plant Removal (>=6" DBH tree)	EACH	18	$ 700	$ 12,600
Herbaceous vegetation herbicide treatment	ACRE	10.5	$ 1,000	$ 10,500
Select Tree Removal (>6")	EACH	371	$ 450	$ 167,000
Debris Removal	EACH	26	$ 1,450	$ 37,700
Grading	SY	8070	$ 3	$ 24,300
Common Excavation	CY	480	$ 16	$ 7,700
Fieldstone Riprap	TONS	670	$ 120	$ 80,400
Clear and Salvage Trees and Install as Root Wad	EACH	3	$ 700	$ 2,100
Cross Vane	EACH	20	$ 4,200	$ 84,000
J-hook Vane (boulder)	EACH	4	$ 1,300	$ 5,200
J-hook Vane (log)	EACH	11	$ 2,500	$ 27,500
Log Vanes	EACH	28	$ 1,750	$ 49,000
Brush Mattress	SY	360	$ 80	$ 28,800
VRSS	SY	410	$ 90	$ 36,900
Coir Logs	LF	550	$ 40	$ 22,000
Plant Trees	EACH	90	$ 300	$ 27,000
Plant Shrubs	EACH	2050	$ 42	$ 86,100
Plant Plugs	EACH	2050	$ 5	$ 10,300
Seeding	ACRES	10.9	$ 4,400	$ 48,000
Coir Blanket	SY	7350	$ 11	$ 80,900
Live Stakes	EACH	450	$ 6	$ 2,700
Seeding and Erosion Control Blanket	SY	300	$ 4	$ 1,200
Annual Vegetation Maintenance	LS	3	$ 19,054	$ 57,200
			Construction Total	$ 1,229,400
			Construction Total w/ Contingency (20%)	$ 1,475,300
			Planning, Engineering & Design (30%)	$ 442,600
			Construction Management (10%)	$ 147,500
			Project Total	$ 2,066,000
			Total w/ Construction Lower Bound (-20%), Legal, and Engineering	$ 1,653,000
			Total w/ Construction Upper Bound (+30%), Legal, and Engineering	$ 2,686,000
			Annual Maintenance Cost (2%)	$ 41,400

High and Medium Priority Sites: 30-yr and Annualized Cost analysis	Project Total
Category:	Bioengineering
Estimated life span (years)	20
Number of major maint. Events	1
Annual maintenance % of original project cost	15%
End of life span % of original project cost	25%
Expected annual maintenance	$ 19,700
End of life span maintenance	$ 516,500
Future Capital Cost	$ 5,014,700
Future annual maintenance	$ 937,240
Future end of life span cost	$ 932,860
Total Future Worth	$ 6,885,000
Annualized Cost	$ 145,000
Annual Maintenance Cost	$ 41,300

Plymouth Creek - Alternative 3, High, Medium and Low Sites

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$ 118,780	$ 118,800
Control of Water	LS	1	$ 60,000	$ 60,000
Erosion Control	LS	1	$ 50,800	$ 50,800
Clearing and Grubbing	ACRE	2.3	$ 21,500	$ 49,500
Clear and Grub Woody Invasive Plant Removal (<=6" DBH tree)	ACRE	12.9	$ 5,700	$ 73,600
Clear and Grub Woody Invasive Plant Removal (>=6" DBH tree)	EACH	18	$ 700	$ 12,600
Herbaceous vegetation herbicide treatment	ACRE	12.9	$ 1,000	$ 12,900
Select Tree Removal (>6")	EACH	372	$ 450	$ 167,400
Debris Removal	EACH	26	$ 1,450	$ 37,700
Grading	SY	9290	$ 3	$ 27,900
Common Excavation	CY	1100	$ 16	$ 17,600
Fieldstone Riprap	TONS	670	$ 120	$ 80,400
Clear and Salvage Trees and Install as Root Wad	EACH	3	$ 700	$ 2,100
Cross Vane	EACH	20	$ 4,200	$ 84,000
J-hook Vane (boulder)	EACH	4	$ 1,300	$ 5,200
J-hook Vane (log)	EACH	11	$ 2,500	$ 27,500
Log Vanes	EACH	28	$ 1,750	$ 49,000
Brush Mattress	SY	360	$ 80	$ 28,800
VRSS	SY	410	$ 90	$ 36,900
Coir Logs	LF	550	$ 40	$ 22,000
Plant Trees	EACH	91	$ 300	$ 27,300
Plant Shrubs	EACH	2050	$ 42	$ 86,100
Plant Plugs	EACH	2050	$ 5	$ 10,300
Seeding	ACRES	13.3	$ 4,400	$ 58,600
Coir Blanket	SY	8570	$ 11	$ 94,300
Live Stakes	EACH	450	$ 6	$ 2,700
Seeding and Erosion Control Blanket	SY	400	$ 4	$ 1,600
Annual Vegetation Maintenance	LS	3	$ 20,320	$ 61,000
			Construction Total	$ 1,306,600
			Construction Total w/ Contingency (20%)	$ 1,567,900
			Planning, Engineering & Design (30%)	$ 470,400
			Construction Management (10%)	$ 156,800
			Project Total	$ 2,196,000
			Total w/ Construction Lower Bound (-20%), Legal, and Engineering	$ 1,757,000
			Total w/ Construction Upper Bound (+30%), Legal, and Engineering	$ 2,855,000
			Annual Maintenance Cost (2%)	$ 44,000

High, Medium, and Low Priority Sites: 30-yr and Annualized Cost ana	Project Total
Category:	Bioengineering
Estimated life span (years)	20
Number of major maint. Events	1
Annual maintenance % of original project cost	15%
End of life span % of original project cost	25%
Expected annual maintenance	$ 23,300
End of life span maintenance	$ 549,000
Future Capital Cost	$ 5,330,300
Future annual maintenance	$ 1,108,510
Future end of life span cost	$ 991,560
Total Future Worth	$ 7,430,000
Annualized Cost	$ 156,000
Annual Maintenance Cost	$ 43,900

Plymouth Creek - Sites 2d and 2e

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$ 18,860	$ 18,900
Control of Water	LS	1	$ 10,000	$ 10,000
Erosion Control	LS	1	$ 8,040	$ 8,100
Clearing and Grubbing	ACRE	0.6	$ 21,500	$ 12,900
Clear and Grub Woody Invasive Plant Removal (<=6" DBH tree)	ACRE	0	$ 5,700	$ -
Clear and Grub Woody Invasive Plant Removal (>=6" DBH tree)	EACH	0	$ 700	$ -
Herbaceous vegetation herbicide treatment	ACRE	0	$ 1,000	$ -
Select Tree Removal (>6")	EACH	42	$ 450	$ 18,900
Debris Removal	EACH	18	$ 1,450	$ 26,100
Grading	SY	2460	$ 3	$ 7,400
Common Excavation	CY	0	$ 16	$ -
Fieldstone Riprap	TONS	0	$ 120	$ -
Clear and Salvage Trees and Install as Root Wad	EACH	2	$ 700	$ 1,400
Cross Vane	EACH	0	$ 4,200	$ -
J-hook Vane (boulder)	EACH	0	$ 1,300	$ -
J-hook Vane (log)	EACH	0	$ 2,500	$ -
Log Vanes	EACH	10	$ 1,750	$ 17,500
Brush Mattress	SY	110	$ 80	$ 8,800
VRSS	SY	0	$ 90	$ -
Coir Logs	LF	0	$ 40	$ -
Plant Trees	EACH	17	$ 300	$ 5,100
Plant Shrubs	EACH	670	$ 42	$ 28,200
Plant Plugs	EACH	670	$ 5	$ 3,400
Seeding	ACRES	0.199972222	$ 4,400	$ 900
Coir Blanket	SY	2460	$ 11	$ 27,100
Live Stakes	EACH	50	$ 6	$ 300
Seeding and Erosion Control Blanket	SY	700	$ 4	$ 2,800
Annual Vegetation Maintenance	LS	3	$ 3,216	$ 9,700
			Construction Total	$ 207,500
			Construction Total w/ Contingency (20%)	$ 249,000
			Planning, Engineering & Design (30%)	$ 74,700
			Construction Management (10%)	$ 24,900
			Project Total	$ 349,000
			Total w/ Construction Lower Bound (-20%), Legal, and Engineering	$ 280,000
			Total w/ Construction Upper Bound (+30%), Legal, and Engineering	$ 454,000
			Annual Maintenance Cost (2%)	$ 7,000

Sites 2d and 2e: 30-yr and Annualized Cost analysis	Project Total
Category:	Bioengineering
Estimated life span (years)	20
Number of major maint. Events	1
Annual maintenance % of original project cost	15%
End of life span % of original project cost	25%
Expected annual maintenance	$ 4,200
End of life span maintenance	$ 87,250
Future Capital Cost	$ 847,100
Future annual maintenance	$ 199,820
Future end of life span cost	$ 157,580
Total Future Worth	$ 1,205,000
Annualized Cost	$ 25,000
Annual Maintenance Cost	$ 7,000

Plymouth Creek - Channel Re-Meander

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$ 34,780	$ 34,800
Control of Water	LS	1	$ 10,000	$ 10,000
Erosion Control	LS	1	$ 15,210	$ 15,300
Clearing and Grubbing	ACRE	1.744719927	$ 21,500	$ 37,600
Clear and Grub Woody Invasive Plant Removal (<=6" DBH tree)	ACRE	0	$ 5,700	$ -
Clear and Grub Woody Invasive Plant Removal (>=6" DBH tree)	EACH	0	$ 700	$ -
Herbaceous vegetation herbicide treatment	ACRE	0	$ 1,000	$ -
Select Tree Removal (>6")	Each	10	$ 450	$ 4,500
Debris Removal	LS	0	$ -	$ -
Grading	SY	0	$ 3	$ -
Common Excavation and Refill Original Ditch	CY	1600	$ 4	$ 6,400
Common Excavation and Remove from Site	CY	1500	$ 16	$ 24,000
Fieldstone Riprap	SY	0	$ 120	$ -
Clear and Salvage Trees and Install as Root Wad	EACH	0	$ 700	$ -
Cross Vane	EACH	0	$ 4,200	$ -
J-hook Vane (boulder)	EACH	0	$ 1,300	$ -
J-hook Vane (log)	EACH	0	$ 2,500	$ -
Log Vanes	EACH	0	$ 1,750	$ -
Brush Mattress	SY	0	$ 80	$ -
VRSS	SFF	0	$ 90	$ -
Coir Logs	LF	0	$ 40	$ -
Plant Trees	EACH	5	$ 300	$ 1,500
Plant Shrubs	EACH	3650	$ 42	$ 153,300
Plant Plugs	EACH	3650	$ 5	$ 18,300
Seeding	ACRES	1.504820937	$ 4,400	$ 6,700
Coir Blanket	SY	2100	$ 11	$ 23,100
Live Stakes	EACH	0	$ 6	$ -
Seeding and Erosion Control Blanket	SY	7200	$ 4	$ 28,800
Annual Vegetation Maintenance	LS	3	$ 6,084	$ 18,300
			Construction Total	$ 382,600
			Construction Total w/ Contingency (20%)	$ 459,100
			Planning, Engineering & Design (30%)	$ 137,700
			Construction Management (10%)	$ 45,900
			Project Total	$ 643,000
			Total w/ Construction Lower Bound (-20%), Legal, and Engineering	$ 515,000
			Total w/ Construction Upper Bound (+30%), Legal, and Engineering	$ 836,000
			Annual Maintenance Cost (2%)	$ 12,900

Channel Re-Meander: 30-yr and Annualized Cost analysis	Project Total
Category:	Bioengineering
Estimated life span (years)	20
Number of major maint. Events	1
Annual maintenance % of original project cost	15%
End of life span % of original project cost	25%
Expected annual maintenance	$ 4,500
End of life span maintenance	$ 160,750
Future Capital Cost	$ 1,560,700
Future annual maintenance	$ 214,090
Future end of life span cost	$ 290,330
Total Future Worth	$ 2,065,000
Annualized Cost	$ 43,000
Annual Maintenance Cost	$ 12,900