Minnesota Department of Natural Resources
Minnesota Board of Water and Soil Resources

Program Process Project Evaluations

Appendix B: 2020 Legacy Fund Restoration Evaluation

Report March 2020

Minnesota Department of Natural Resources
Minnesota Board of Soil and Water Resources
Restoration Evaluations
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Legislative Charge
Parks and Trails Fund: M.S. 85.53, Subd. 5.
Outdoor Heritage Fund: M.S. 97A.056, Subd. 10.
Clean Water Fund: M.S. 114D.50, Subd. 6.

As requested by Minnesota Statute 3.197: This report cost $8,800 to prepare, including staff time, printing and mailing expenses.

Upon request, this material will be made available in an alternative format such as large print, Braille or audio recording. Printed on recycled paper.

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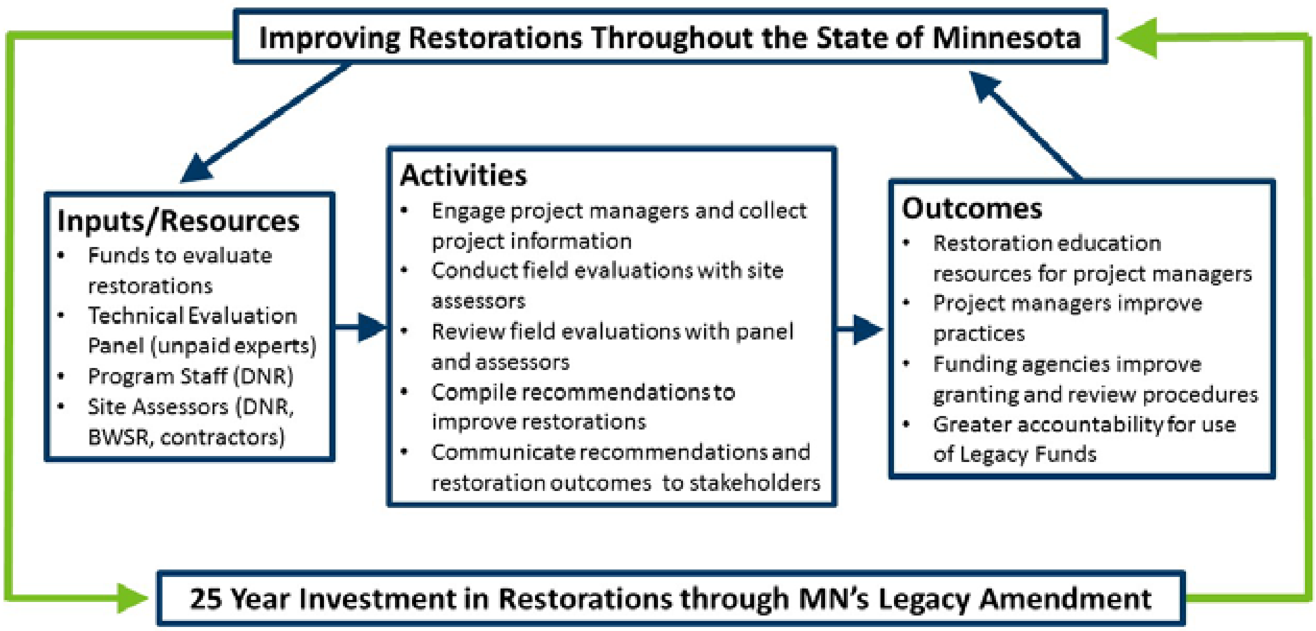
Evaluation Process

State law directs the DNR and BWSR to convene an expert panel to evaluate restorations completed with Clean Water Land and Legacy Funds. The evaluations include directly engaging project managers and are completed by third party experts to identify gaps and capture lessons learned from restorations. The agencies use this information to improve restorations throughout the state.

Program Model

The Restoration Evaluation Program was developed with the ultimate goal of improving restorations throughout the state. The diagram below outlines the inputs, activities, and outcomes of the program and our continued investment in improving restorations.



Roles and Responsibilities

Evaluation Panel

Statute directs the evaluation panel to:

- Evaluate restorations relative to the law, current science, and the stated goals and standards in the restoration plan
- Provide findings on the evaluations, determining whether restorations are meeting planned goals, identify problems with implementation of restorations and, provide recommendations on improving restorations

Members of the panel are unpaid experts chosen to fulfill statutory requirements and provide needed expertise in a variety of ecosystems and restoration techniques.

Program Staff

The program staff are responsible for coordinating site assessments, program administration and managing the work of the panel. They are directed in statute to:

- Identify restoration projects completed with Parks and Trails, Outdoor Heritage, and Clean Water Funds
- Secure restoration plans for selected projects
- Summarize the findings of the panel
- Provide reports to the legislature

The staff also promote and document continuous improvement in restorations. Staff work with the panel and agencies to identify and promote actions and provide guidance for implementing improved restorations. DNR and BWSR have assigned staff to ensure consistency in program implementation. The staff are currently housed in DNR's Ecological and Water Resources Division.

Site Assessors

The site assessors are responsible for conducting site assessments. Site assessors are selected based on knowledge of restoration practices and work closely with program staff in assessing project plans, conducting field evaluations, and participating in panel reviews. Site assessors include:

- State agency staff
- Local government staff
- Federal agency staff
- Private contractors

Services provided by assessors are negotiated through the use of contracts, State Interagency Agreements, or work assignments.

Project Managers

Project managers are expected to actively participate in the evaluation process. Project managers provide the necessary project background and attend field evaluations when possible to:

- Identify project work sites
- Provide project context
- Answer assessor questions

It is necessary to acknowledge the diversity of managing organizations and their scope and focus when evaluating projects.

Example project managers for the three Legacy Funds.

Clean Water Fund

- Soil and Water Conservation District manager or technician
- Watershed District staff
- Watershed Management Organization staff
- County Water Resources of Environmental Services staff
- City Water Resource staff

Outdoor Heritage Fund

- State agency staff (DNR, BWSR)
- Federal agency staff (USFWS)
- County conservation and land management staff
- Watershed District staff
- Nongovernmental wildlife organizations

Parks and Trails Fund

- MN DNR Parks and Trails Division, resource management staff
- Metro Regional Parks managers, including county park systems and Three Rivers Park District
- Greater Minnesota park managers

Evaluation Methods

Project Selection

Program staff update the pool of eligible restoration projects on an annual basis. For each fund projects are considered to be eligible if they are complete and contain restoration or enhancement work. Projects evaluated represent a variety of habitat types and geographic distributions of restorations in the state.

Projects are selected in relative proportion to each Fund's appropriation to restoration evaluations. Many grants and appropriations fund restoration activities at multiple project sites. A smaller subsample of project sites is typically evaluated.

Site Assessments

DNR, BWSR and the panel developed a simple and consistent process to facilitate evaluations. To the extent possible the evaluation process engages project managers in conducting site visits and communicating lessons learned. Facilitating an inclusive evaluation process with project managers increases the transfer of knowledge between field practitioners and agencies, ultimately improving restorations.

A site evaluation form was developed to provide project information and address evaluation requirements directed by law. This form describes site assessors' observations of project effectiveness, estimated outcomes based on current conditions and application of current science.

Project sites are evaluated by third party assessors. Field visits include inspecting the project's structural components and plant communities. Restored plant communities may take several years or even decades to mature. Evaluations are based on observations of the present and projected conditions relative to the project goals. Assessments of project sites do not represent an overall evaluation of the larger program or Fund.

Restoration science is continually evolving. Best practices are an area of ongoing discussion between practitioners, researchers, agencies and stakeholders. Site assessors and the panel evaluate projects based on methods commonly considered to be within the range of current science.

Legacy Fund Attributes and Requirements

Each of the Legacy Funds has a distinct focus on restoration and specific requirements for projects.

	Clean Water Fund	Outdoor Heritage Fund	Parks and Trails Fund
Fund Purpose	*protect, enhance, and restore water quality in lakes, rivers, and streams and protect groundwater from degradation*	*restore, protect, and enhance wetlands, prairies, forests, and habitat for fish, game, and wildlife*	*support parks and trails of regional or statewide significance*
Primary Restoration Goal	Restore water quality	Restore specific wildlife habitat types	Ecological restoration of specific habitat types
Guidance for project types and locations	Local water management plan, TMDL Implementation plans, or Watershed Restoration and Protection Strategies	Statewide or national wildlife habitat plans	State or Regional Park natural area management plans
Funding source for restoration projects	Competitive grants administered by BWSR	Appropriation to project manager; recommended by Outdoor Heritage Council, or Conservation Partners grants administered by MN DNR	MN DNR appropriation: resource management, or Met Council appropriation: County Regional Park System, Three Rivers Park District
Statutory Requirements	MS 114D.50 Subd. 4. (a) *include measurable outcomes, as defined in section 3.303, subdivision 10, and a plan for measuring and evaluating the results. A project must be consistent with current science and incorporate state-of-the-art technology.*	Different appropriation years are subject to different requirements but all include: • *Prepare and retain an ecological restoration and management plan* • *Use current conservation science to achieve the best restoration* • *Establishment of diverse plant species* Appropriations in 2009 and 2010 also included. • *Plant vegetation or sow seed only of ecotypes native to Minnesota.*	MS *85.53 Subd. 2* (a) *include measurable outcomes, as defined in section 3.303, subdivision 10, and a plan for measuring and evaluating the results. A project or program must be consistent with current science and incorporate state-of-the-art technology*

Projects Evaluated

This report focuses on 70 stream evaluations completed between 2012 and 2019 including:

- 27 Clean Water Fund projects
- 33 Outdoor Heritage Fund project sites, including 10 Conservation Partners Legacy projects
- three Parks and Trails Fund projects
- 7 project revisit evaluations

Fund	Project	Project Manager	Year Published in Program Report
CWF	Nine Mile Creek Stabilization and Habitat Restoration	Nine Mile Creek WD	2012
CWF	Knife River Sediment Reduction BMP Implementation	South St. Louis SWCD	2012
CWF	Restoring Upper Porter and Picha Creeks	Scott WMO	2013
CWF	Dobbins Creek Watershed Restoration	Cedar River WD	2013
CWF	Dobbins Creek Watershed Restoration	Cedar River WD	2013
CWF	Sauk River Runoff Reduction and Riparian Restoration	Sauk River WD	2013
CWF	Enhanced Shoreline Restoration, Infiltration & Protection	Stearns SWCD	2013
CWF	Brown's Creek Thermal Load Reduction	Brown's Creek WD	2014
CWF	Knife River Bank Stabilization Project	Lake County SWCD	2015
CWF	Stewart River - Big Rock Road	Lake County SWCD	2015
CWF	Stewart River Stabilization and Habitat Improvement	Lake County SWCD	2015
CWF	Grand Marais Creek Cutoff Channel	Red Lake WD	2015
CWF	Minnehaha Creek Stream Meander	City of St. Louis Park	2015
CWF	Plymouth Creek Stabilization Projects	Bassett Creek Watershed Commission	2015
CWF	Bassett Creek and Plymouth Creek Stabilization Projects	Bassett Creek Watershed Commission	2015
CWF	9 Mile Creek Stream Restoration (Revisit)	Nine Mile Creek WD	2017
CWF	Picha Creek Stream Restoration (Revisit)	Scott WMO	2017
CWF	Cascade Creek - Meadow Lakes' stream channel	Olmsted County SWCD	2018
CWF	Sand Hill River Watershed Projects	West Polk SCWD	2019
CWF	Burnham Creek Watershed Projects	West Polk SCWD	2019
CWF	Thief River Erickson Streambank Enhancement	Pennington SWCD	2019
CWF	Thief River Halvorson Streambank Enhancement	Pennington SWCD	2019
CWF	Elm Creek Channel Realignment	Martin County SWCD	2109
CWF	Elm Creek Adam’s Project	Martin County SWCD	2109
CWF	Deer Creek Dam Removal and Streambank Restoration	Carlton SWCD	2019
CWF	Rum River West Branch Stabilization	Mille Lacs SWCD	2019
CWF	Stewart River Channel Restoration (Revisit)	Lake County SWCD	2109
CWF	Stewart River Watershed Protection (Revisit)	Lake County SWCD	2109
CWF	Knife River Bank Stabilization Project (Revisit)	Lake County SWCD	2019
CWF	Knife River Toewood Bank Stabilization (Revisit)	South St. Louis SWCD	2019
CWF	Lambert Creek Kohler Enhancement	Ramsey Conservation District	2019
CWF	Lambert Creek Oakmeade Enhancement	Ramsey Conservation District	2019
CWF	Wolverton Creek Restoration	Buffalo Red WD	2019
OHF	Cold Water River & Stream Restoration, Protection and Enhancement	Trout Unlimited	FY13
OHF	Grand Marais Creek Stream Channel Restoration	Red Lake WD	FY15

Fund	Project	Project Manager	Year Published in Program Report
OHF	Knife River Habitat Rehabilitation – Second Falls	Lake Superior Steelhead Association	2017
OHF	Knife River Habitat Rehabilitation – Reaches 9 & 12	Lake Superior Steelhead Association	2017
OHF	Knife River Habitat Rehabilitation – Gordy's Memorial Forest	Lake Superior Steelhead Association	2017
OHF	Knife River Habitat Rehabilitation – White Landing	Lake Superior Steelhead Association	2017
OHF	St. Louis River Estuary – Chamber's Grove	MN DNR	2017
OHF	St. Louis River Estuary – Radio Tower Bay	MN DNR	2017
OHF	St. Louis River Estuary – Knowlton Creek	MN DNR	2017
OHF	Montevideo Dam Removal	City of Montevideo	2018
OHF	Montevideo Bankfull Shelf	City of Montevideo	2018
OHF	Spring Creek	Brown County	2018
OHF	Lawndale Creek	Trout Unlimited	2018
OHF	Sand Hill River Fish Passage	Sand Hill River WD	2019
OHF	Seven Mile Creek Habitat Enhancement	Trout Unlimited	2019
OHF	Portage Creek Fish Passage Restoration	USFWS Chippewa NF	2019
OHF	Buffalo River Stream Channel Restoration	MN DNR	2019
OHF	Buffalo River Hawley Restoration	MN DNR	2019
OHF	Sauk River Dam Removal and Streambank Restoration	City of St. Cloud	2019
OHF	Rock River Knutson Streambank Restoration	Rock County SWCD	2019
OHF	Rock River Boelman Streambank Restoration	Rock County SWCD	2019
OHF	Wedge Creek Habitat Restoration	Shell Rock WD	2019
OHF	Zumbro River Channel Restoration	MN DNR	2019
OHF	Rush Creek Restoration/Enhancement	Trout Unlimited	2019
OHF	Pickwick Creek Restoration/Enhancement	Trout Unlimited	2019
OHF	Rat Root River Log Jam Removal	Koochiching County SWCD	2019
OHF	Rat Root River Sediment Control	Koochiching County SWCD	2019
OHF	Rat Root River Spawning Riffles	Koochiching County SWCD	2019
OHF	Little Stewart River Habitat Enhancement Tree Planting	Trout Unlimited	2019
OHF	Little Stewart River Restoration/Enhancement	Trout Unlimited	2019
OHF	West Indian Creek Restoration/Enhancement (Revisit)	Trout Unlimited	2019
OHF	East Indian Creek Habitat Enhancement	Trout Unlimited	2019
OHF	Middle Branch Whitewater River Restoration/Enhancement	Trout Unlimited	2019
OHF	Middle Fork Whitewater River Restoration	MN DNR	2019
PTF	Trout Brook Channel Restoration	MN DNR	2019
PTF	Sucker Channel Restoration	Ramsey County Parks & Rec.	2019
PTF	Whitewater State Park Enhancement	MN DNR	2019

1) Deer Creek Dam Removal and Streambank Restoration

Project Background

Project Name: Phase II Red Clay Dam: Deer Creek Tributary Restoration

Project Site: Unnamed tributary of Deer Creek

Township/Range Section: Township 47N Range 16E Section 20

Project Manager / Affiliated Organization: Neva Widner / Carlton SWCD

Fund: CWF ***Fiscal Year Funds:*** 2014

Project Start Date: 3/2014

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest

Project Status: Establishment Phase

County: Carlton County

Primary Activity: Stream/River Restoration

Project Size: 550 lin ft

Project Completed: 10/2016

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Partially excerpted from the Final Report:
   The purpose of the project was to restore an unnamed tributary to Deer Creek where an earthen dam had failed. The project components included re-grading the stream channel and hillslopes throughout the impoundment, stabilizing the channel with wooden grade control structures, stabilizing hillslopes with erosion control matting and revegetating the work area.

2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Michealson Red Clay Dam Stream Restoration As-built Plans. Technical Service Area 3 and Carlton Soil and Water Conservation District. Carlton County, MN. June 2016.
   Phase II Red Clay Dam Project: Deer Creek Stream Restoration Final Report. Carlton Soil and Water Conservation District. Carlton, MN. March 2018.
   Phase I Red Clay Dam Project: Deer Creek Red Clay Dam Options. Carlton County Soil and Water Conservation District. Carlton, MN. December 2014.

3. ***What are the stated goals of the project?***

Prevent the further washout of a failed dam by restoring a stable stream channel, banks, and hillslope throughout the former impoundment area.

4. ***What are the desired outcomes of achieving the stated goals of the project?***
   The site is located on an unnamed tributary of Deer Creek which flows into the Nemadji River. Both flowages have a long history of sediment issues and both are listed as impaired due to high turbidity. The desired outcomes are to create a stable stream channel throughout the impoundment area and improve the clarity in downstream flowages by reducing the sediment load coming from the former dam area.

5. ***Were measures of restoration success identified in plans? No***
   If yes, list specific measurements.
   Although the final report mentioned that the dam failure was contributing an estimated 78 tons of sediment to the stream system each year, there were no performance standards set for the project.
6. ***Are plan Sets available?*** **Yes** ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   See Record Drawing in Appendix A
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***

   Natural Channel Design (NCD) methodology was implemented to inform analysis and design. NCD is a practice that works to emulate a natural system by using dimension, pattern, and profile measurements from a stable "reference" reach. The Record Drawing/ Plan Set includes details for Log Grade Control and Brush Toe structures. These types of structures are commonly used in stream restoration projects.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Due to approved alignment changes, 2 of the 17 log grade control structures within the plan were not installed. The Brush Toe structures were also not installed due to the alignment change.
9. ***In what ways did alterations change the proposed project outcome?***
   These changes likely did not affect the project outcome.

Site Assessment

Field Review Date: 7/23/2019

Field Visit Attendees: Wade Johnson (DNR), Gina Quiram (DNR), Marcey Westrick (BWSR), Jeff Hrubes (BWSR), Melanie Bomier (SWCD), Keith Anderson (SWCD TSA III) and Mike Majeski (EOR)

10. ***Surrounding Landscape Characteristics:***

The project is located on an unnamed tributary of Deer Creek in the headwaters of the Nemadji River watershed in eastern Carlton County, MN. The former impoundment was positioned just above the confluence with Deer Creek near the top of the ravine. The ravine area and the surrounding parcels are densely wooded, mixed conifer/ hardwood forest.

11. Site Characteristics:

a. Soil Series:

The site is entirely composed of the Udorthents soil group. This is a well-drained reddish clay loam that occupies steep slopes and is highly erodible.

b. Topography:

The Deer Creek ravine has steep irregular slopes and eroding slumps. Within the project site, the hillslopes have been regraded to 3/1 or flatter and the new stream was graded to a 4.1% slope through the old impoundment area.

c. Hydrology:

The region has an average annual rainfall of 31.5 inches. The project site is near the top of the watershed and has a 220-acre catchment. The tributary drains into Deer Creek at the southern end of the project site. Deer Creek is a perennial stream with an average daily flow of 7.2 cubic feet per second (cfs) which often peaks in April when mean flow is around 25 cfs. Deer Creek flows into the Nemadji River 1.75 miles downstream from the project site; the Nemadji River crosses into Wisconsin before discharging into Lake Superior through Superior Bay.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

Restored prairie within old impoundment area. Dominate species include dark green rush (5-25%), horsetail (5-25%), and black-eyed Susan (1-5%). Invasive cover included reed canary grass (1-5%), alsike clover (1-5 %), white sweet clover (1-5%), and bridsfoot trefoil (1-5%). The native vegetation within the project site was quite diverse and well established with few invasive species observed.

e. Vegetation B: Meander Search Species List (as appropriate for site)

American manna grass, fowl mana grass, blue vervain, common yarrow, woolgrass, sandbar willow, oxeye, Carex species (see Table 1-1 for more specifics).

12. ***Is the plan based on current science?*** Yes

Natural channel design of a "B" channel with grade control structures.

13. List indicators of project goals at this stage of project:

The dam side slopes were pulled back / re-graded and a "B" channel was excavated through historic sediment deposits within the impoundment area. Significant site grading was completed to remove the earthen dam.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

The re-sloping of the dam, side slopes, and creation of a stream channel within the impoundment area has greatly reduced the threat of dam failure and subsequent mass-wasting and erosion of the side-slopes. However, the stated goal to create a stable stream channel has not yet been achieved due to headcutting within the constructed "B" channel.

15. Are corrections or modifications needed to achieving proposed goals?

Yes, to achieve goals in the near term the project will require repairs to the constructed stream channel where grade control structures have failed within the middle section of the project reach. The failed grade control structures appear to occur within the area of the impoundment where dam sediment was likely the most unconsolidated.

16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    There is opportunity to repair the project, but no known funding source(s) have been secured to do so. Site access is difficult, but additional materials could be imported through existing access routes.
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    The failed grade control structures have resulted in unintended channel erosion and have reduced the number of pools available for fish and other aquatic organisms within the tributary.
18. ***Are follow-up assessments needed? Explain.***
    Follow-up assessments are necessary if the site is proposed for repair. An assessment should be conducted prior to any repairs to determine if further degradation has occurred within the restored stream channel, or if any other grade control structures have failed. It is strongly recommended to conduct a few soil borings near the failed grade control structures to determine the depth of the historic sediments within the impoundment to help guide the repair design (i.e. a change in the type or quantity of material to create stable grade control structures).
19. ***Additional comments on the restoration project.***
    The establishment of native vegetation within the project site is outstanding with good diversity of native plants observed throughout. Invasive species do occur but are in low density.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    minimally achieved the stated goals.
21. ***The project will:***
    Minimally meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    The project has certainly met the goal to prevent further erosion of a failed dam; however, the rating that the project has minimally achieved the stated goals and will minimally meet proposed outcomes was based on the stated goal to restore a stable stream channel. The failed grade control structures within the stream channel have induced a headcut within the middle section of the project, which has led to channel incision and subsequent downcutting of the stream channel. The restored channel in its current state is unstable. If the site cannot be repaired, the headcut will likely continue to advance upstream and cause further channel incision and bank erosion upstream of the project site, which subsequently will negatively impact the water quality and sediment load in Deer Creek and other downstream resources. Although the project has significantly reduced the threat of further dam failure

and bank sloughing, the overall reduction in site erosion and sediment delivery to Deer Creek is being offset by the erosion occurring within the restored channel as a result of the headcut, especially if the site cannot be repaired before the headcut advances upstream.

23. ***Site Assessor(s) Conducting Review:***

    Mike Majeski - EOR

Appendix A: Site maps, Project plans or Vegetation tables

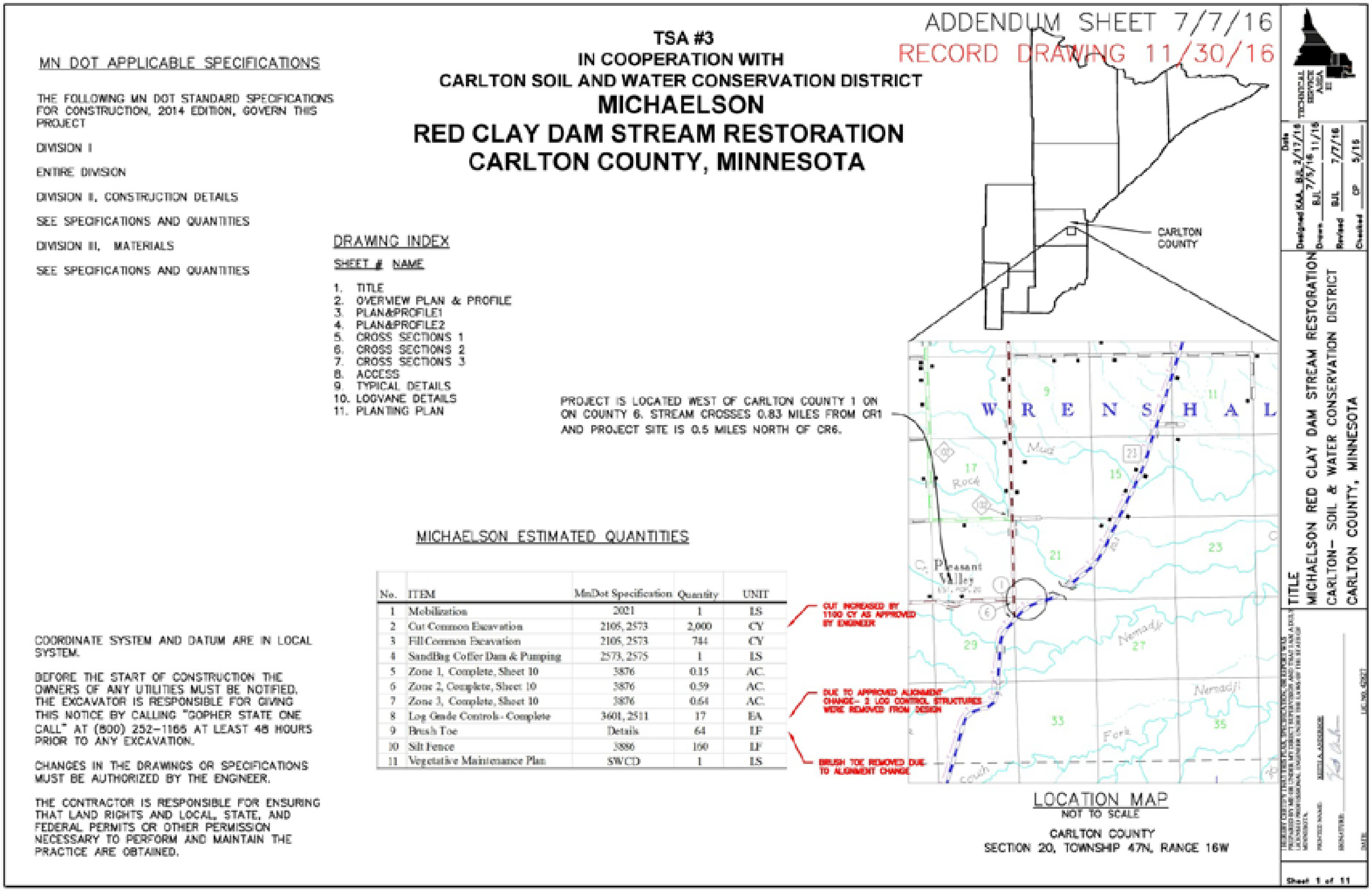


Figure 1-1 Michaelson Red Clay Dam Project Plan Set (Page 1) provided by the Carlton SWCD.

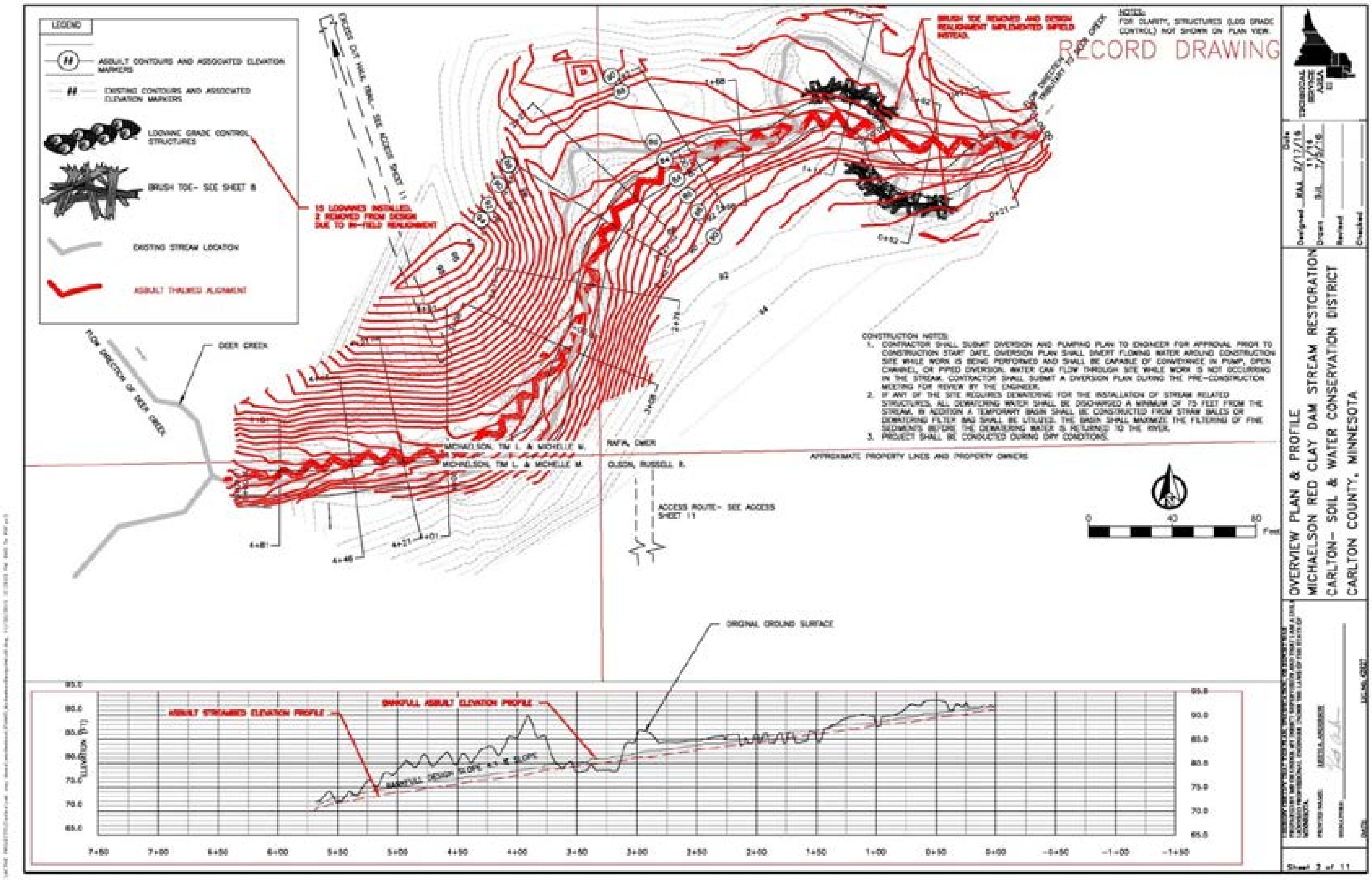


Figure 1-2 Michaelson Red Clay Dam Project Plan Set (Page 2) provided by the Carlton SWCD.

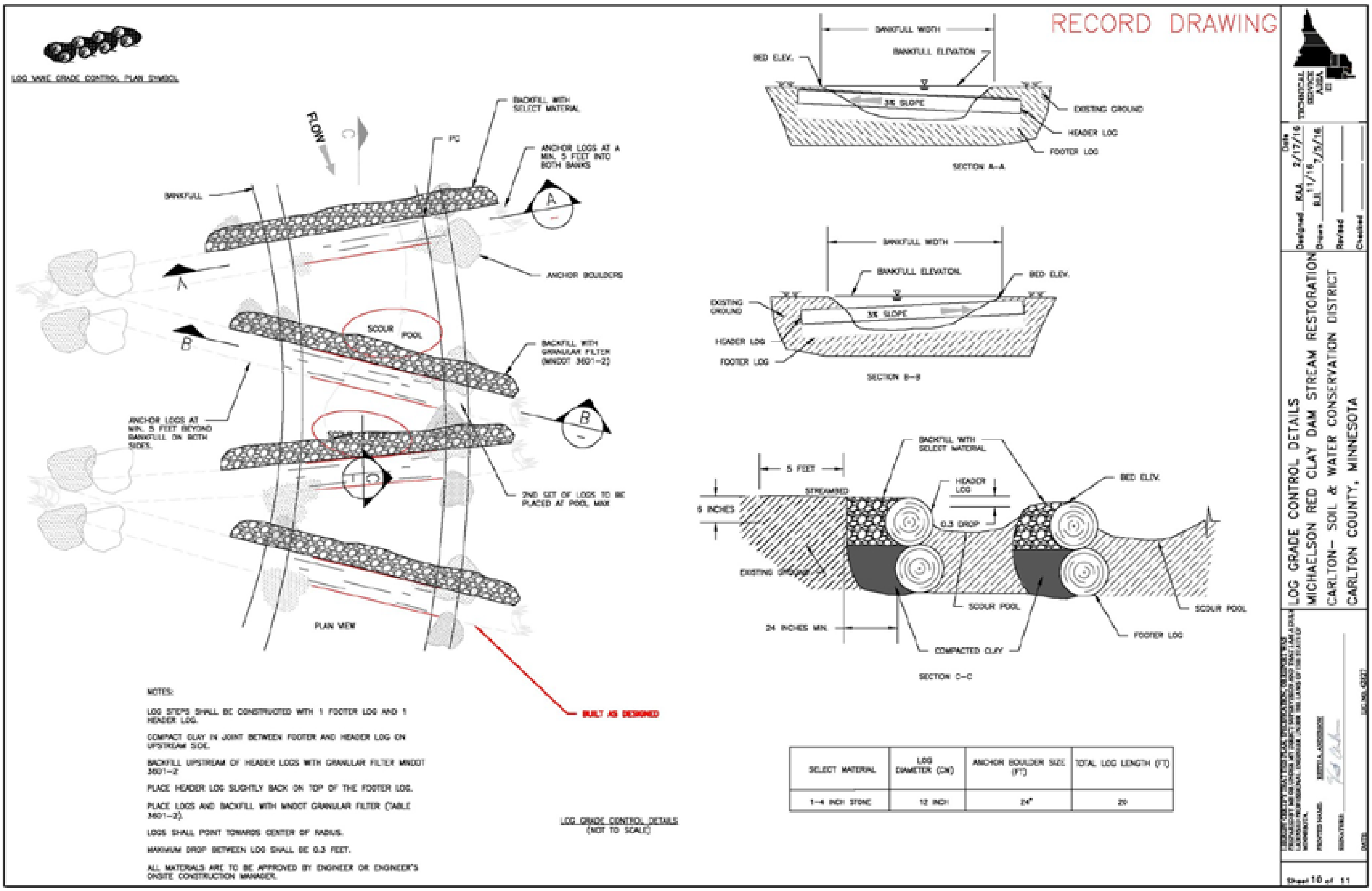


Figure 1-3 Michaelson Red Clay Dam Project Plan Set (Page 10) provided by the Carlton SWCD.

Table 1-1 Vegetation observed during the project meander survey.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Achillea millefolium	Common yarrow	1-3%	Unknown	Native
Carex spp.	Sedge (possibly Fox sedge)	1-3%	Yes	Native
Equisetum spp.	Horsetail	10-25%	Unknown	Native
Glyceria grandis	American manna grass	1-3%	Yes	Native
Glyceria striata	Fowl manna grass	1-3%	Yes	Native
Leucanthemum vulgare	Ox-eye daisy	1-3%	Unknown	Non-native
Lotus corniculatus	Birdsfoot trefoil	5-10%	Unknown	Non-native
Melilotus alba	White sweet clover	1-3%	Unknown	Non-native
Phalaris arundinacea	Reed canary grass	1-3%	No	Non-native
Rudbeckia hirta	Black-eyed Susan	5-10%	Yes	Native
Salix interior	Sandbar willow	1-3%	Unknown	Native
Scirpus atrovirens	Dark green rush	15-25%	Yes	Native
Scirpus cyperinus	Woolgrass	1-3%	Yes	Native
Trifolium hybridum	Alsike clover	1-3%	Unknown	Non-native
Verbena hastata	Blue vervain	1-3%	Yes	Native

Appendix B: Site Photographs

Photo 1-1 Michaelson Dam project area. Photo taken by Mike Majeski on 7/23/2019.

Photo 1-2 Michaelson Dam showing re-graded side slopes with native vegetation establishment. Log grade control structures were installed within the restored stream channel of the unnamed tributary to Deer Creek. Photo taken by Mike Majeski on 7/23/2019.

Photo 1-3 Failed log grade control structures within the old dam impoundment. A headcut has advanced throughout the middle section of the project site in an area where sediment deposits were likely the deepest. Photo taken by Mike Majeski on 7/23/2019.

Photo 1-4 Log grade control structures near the confluence with Deer Creek. These structures are intercepting some sediment and are providing small pool habitat for aquatic organisms. Photo taken by Mike Majeski on 7/23/2019.

Photo 1-5 Dense native vegetation within the project site. This image shows a large colony of dark green rush with black-eyed Susan in the background. Photo taken by Mike Majeski on 7/23/2019.

2) Elm Creek Adam's Project

Project Background

Project Name: Adams Streambank Restoration

Project Site: Nashville Township – Elm Creek

Township/Range Section: Township T104N Range R29W Section 34

Project Manager / Affiliated Organization: Martin County SWCD

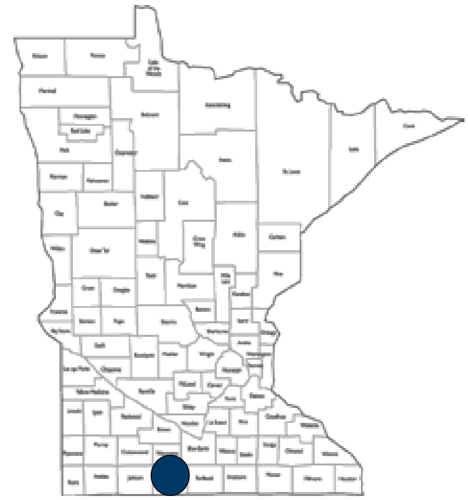
Fund: CWF ***Fiscal Year Funds:*** 2014

Project Start Date: July 2017

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest , Choose an item.

Project Status: Establishment Phase



County: Martin

Primary Activity: Stream/River Enhancement

Project Size: 90 Linear Feet of root wad revetment and 50 Linear Feet of riprap.

Project Completed: December 2017

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Two high priority locations on the Adams property were stabilized. Riprap over biodegradable geotextile fabric was used upstream of an existing bridge to address bank erosion. Rootwad revetment was used to divert current away from another eroding outside bend and provide a stable toe to fill in an outwash from the upland to the creek.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   - Elm Creek Restoration Evaluation, Adams Streambank Restoration – Martin SWCD.
   - Robert Adams Stream Bank Stabilization As-Built Plans, South Central Technical Service Area (SC TSA) – Blue Earth Soil & Water, December 2017.
3. ***What are the stated goals of the project?***
   Stream bank slope protection to protect bridge (downstream location) and farm field (upstream location). Fill erosion washout/gully at farm field (upstream location) and stabilize with revegetation.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Minimize bank erosion and protect bridge and farmland.
5. ***Were measures of restoration success identified in plans?*** *No*

If yes, list specific measurements.
Reductions in sediment load noted as a project goal but not quantified.

6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
If yes, provide in Appendix A and list Maps provided:
   - Robert Adams Stream Bank Stabilization As-Built Plans, South Central Technical Service Area (SC TSA) – Blue Earth Soil & Water, December 2017. Document includes project locations and estimated quantities, site specific plans, riprap installation details, root wad revetment installation details, and is overlaid with as-built drawings (dated December 2017).
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
Stabilization of streambanks with riprap placed over geotextile fabric is based on current practice in MN. In this instance riprap was used to protect infrastructure.
Root wad revetment installed with boulders is industry standard in MN. The vertical log pins are unique to this site.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
Yes.
One location identified in the plan set was not constructed due to lack of funding. Additional topsoil was added to the project during construction to top dress the washed-out area.

9. ***In what ways did alterations change the proposed project outcome?***
The alterations were made to meet the proposed project outcomes and provide a finished construction project.

Site Assessment

Field Review Date: **7/31/2019**

Field Visit Attendees: Ed Matthiesen – Wenck Associates, Gina Quiram – MN Department of Natural Resources, Robert Adams – property owner, Ashley Brenke – Martin County Soil and Water Conservation District, Jill Sackett– Minnesota Board Conservationist, Greg Johanson - Martin County Soil and Water Conservation District, and Jon Lore – Minnesota Department of Natural Resources

10. ***Surrounding Landscape Characteristics:***
The two project stabilization locations are surrounded by a forested buffer and cultivated land to the North and South. Elm Creek has an average forested buffer width on the Adam's property of 150 feet and is composed of trees between the channel banks with little ground cover.
11. ***Site Characteristics:***
    a. ***Soil Series:***
    Coland clay (1834), Coland clay (1833).

b. ***Topography:***

Elm Creek is a low gradient stream within a larger meander belt confined by a river valley.

c. ***Hydrology:***

Well drained.

d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***

Forest edge community along stream bank. Dominant overstory species included maple, American elm, and green ash. Dominant understory species were the native grasses Canada wildrye and slender wheatgrass; the invasive grass smooth brome; the native forbs black-eyed susan, giant goldenrod, wild cucumber; and the weedy forbs giant ragweed, sweetclover, and common ragweed. Invasive cover was 25-50%.

e. ***Vegetation B: Meander Search Species List (as appropriate for site)***

Refer to Appendix A, Table 2-1 for species list.

12. ***Is the plan based on current science?*** Yes

Protection of bridge abutments with riprap over geotextile fabric is based on current engineering practice.

The use of rootwad revetment is based on current science to protect and rebuild streambanks. The inclusion of tree pins to further reinforce the bank is unique to this project.

13. List indicators of project goals at this stage of project:

Restorative practices applied to both project areas are showing no signs of erosion. The gully restoration with native plants appears robust.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes, with minimal maintenance needs. Bank protection methods appear to have withstood storm flows and vegetation is being established.

15. Are corrections or modifications needed to achieving proposed goals?

Project goals are met.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

A written long-term management plan was provided with project documentation stating, “Site inspections will be completed at a minimum of one year after completion, then at year 5, year 10, and at the next to last year of effective life of the project. In addition, inspections will be performed on a case-by-case basis, such as after storms producing unusually heavy rainfall.” Clarification should be given to provide a date for the statement “next to last year of the effective life of the project” in the context of the site inspection.

17. Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.

No. The riprap protection of the bridge does not provide much habitat, but the rootwad revetment may provide improved habitat over pre-existing conditions.

18. Are follow-up assessments needed? Explain.

None needed other than the site inspections prescribed in the long-term management plan...

19. Additional comments on the restoration project.

None.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    Project has withstood several high water events since construction with no signs of erosion.
23. ***Site Assessor(s) Conducting Review:***
    Ed Matthiesen

Appendix A: Site maps, Project plans or Vegetation tables

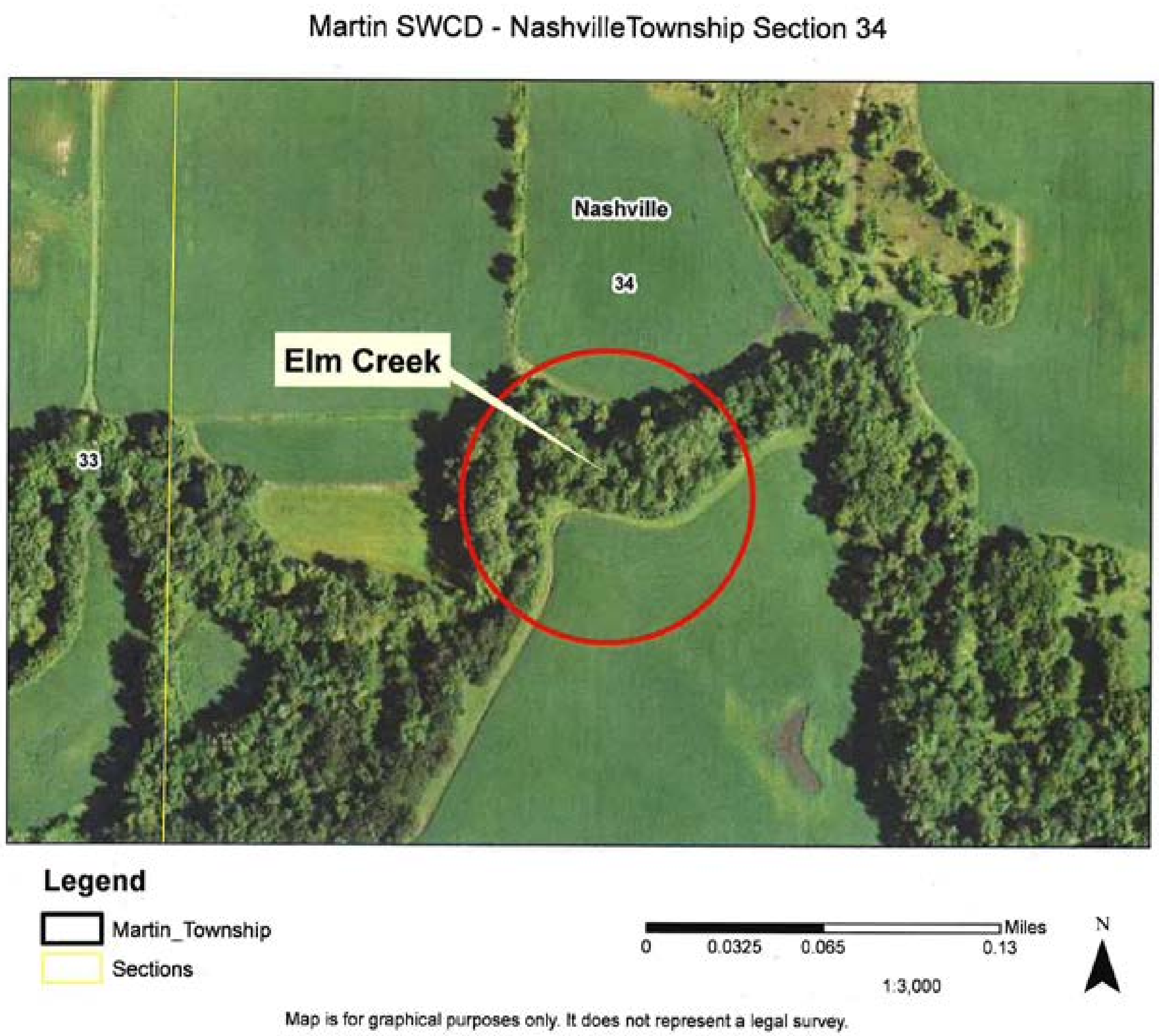


Figure 2-1 Adams Streambank Restoration – Site Map showing location of site on Elm Creek.

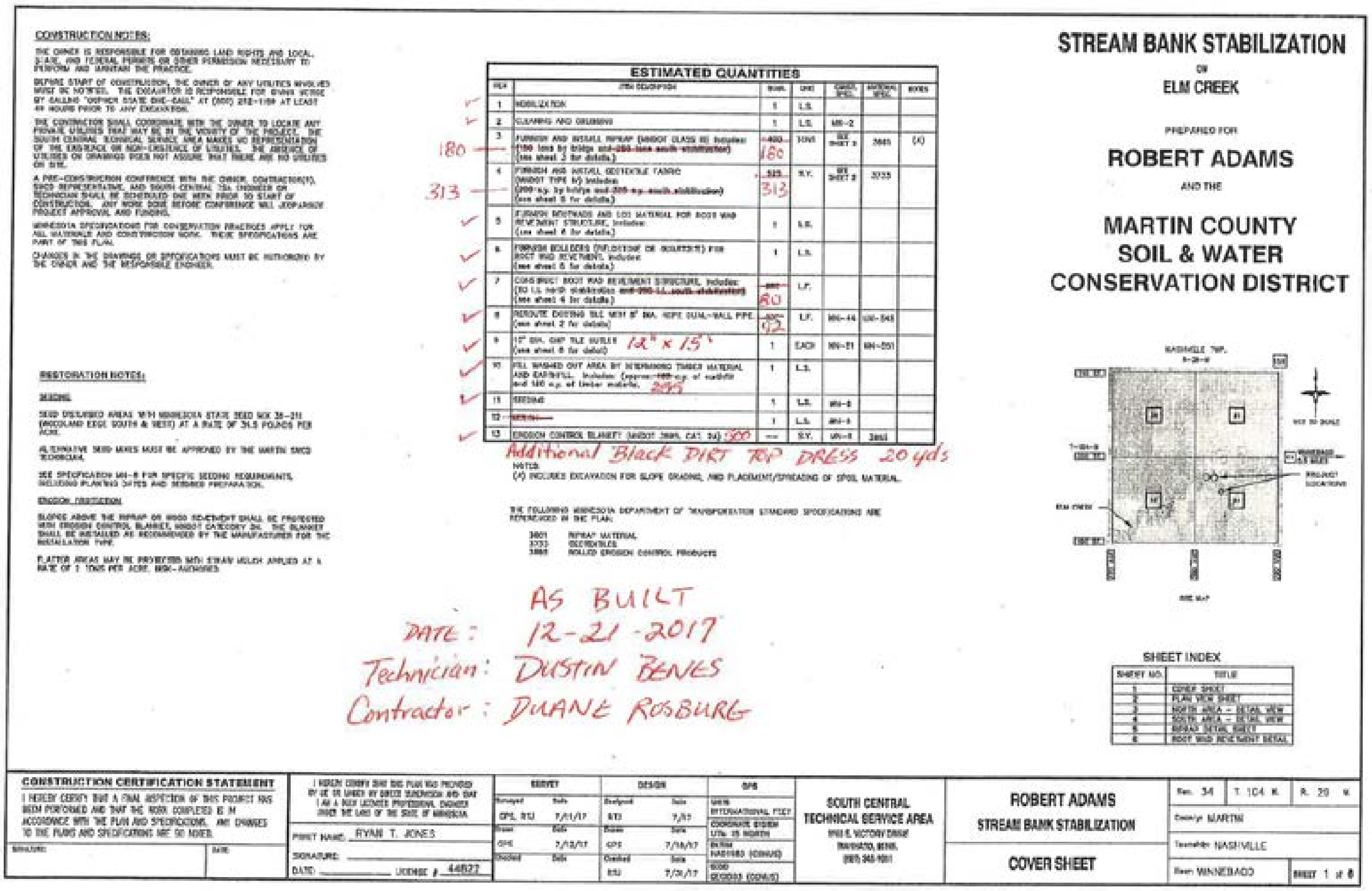


Figure 2-2 Adams Streambank Restoration Sheet 1 of 6. Cover Sheet.

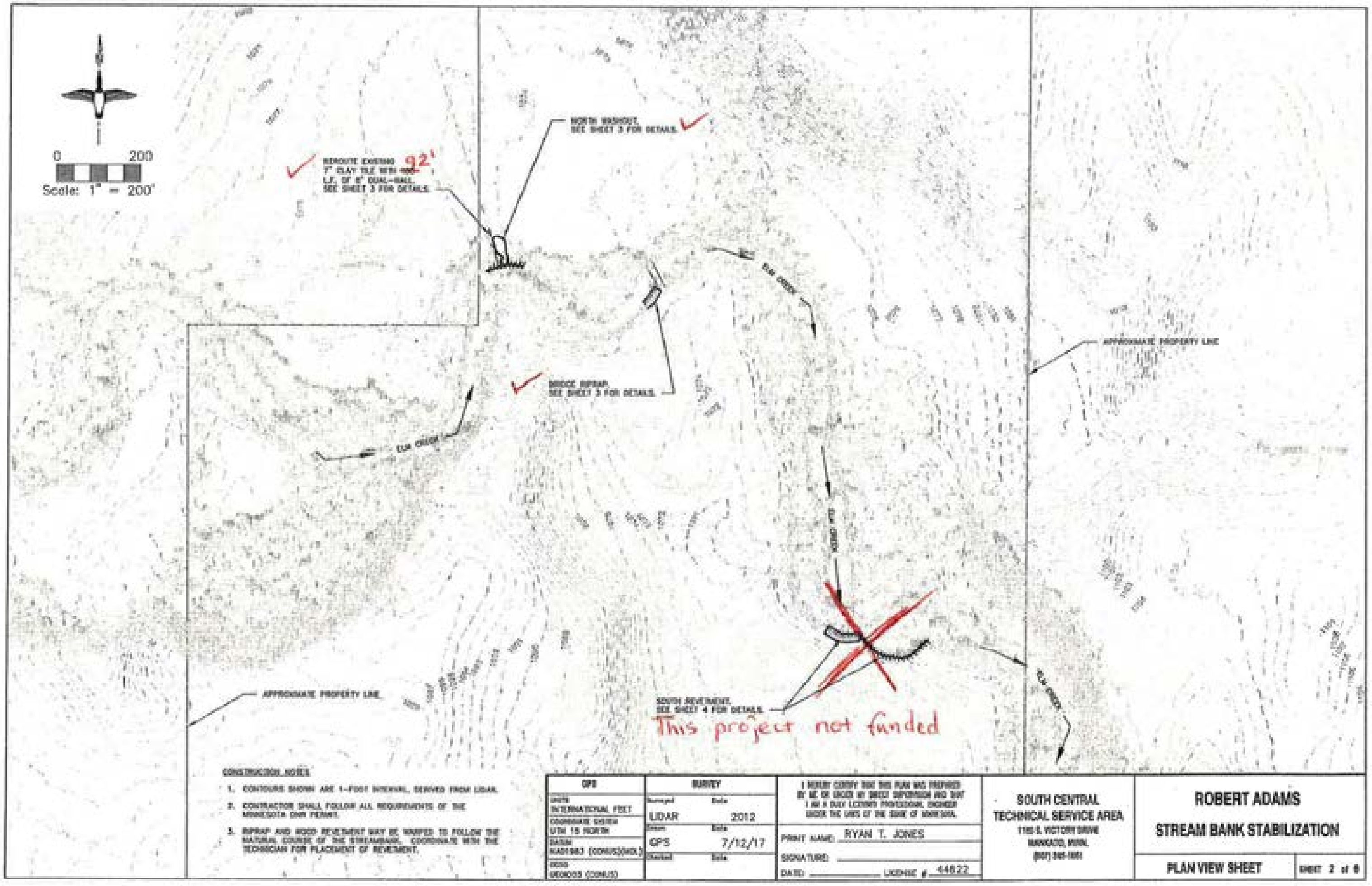


Figure 2-3 Adams Streambank Restoration Sheet 2 of 6. Plan View Sheet.

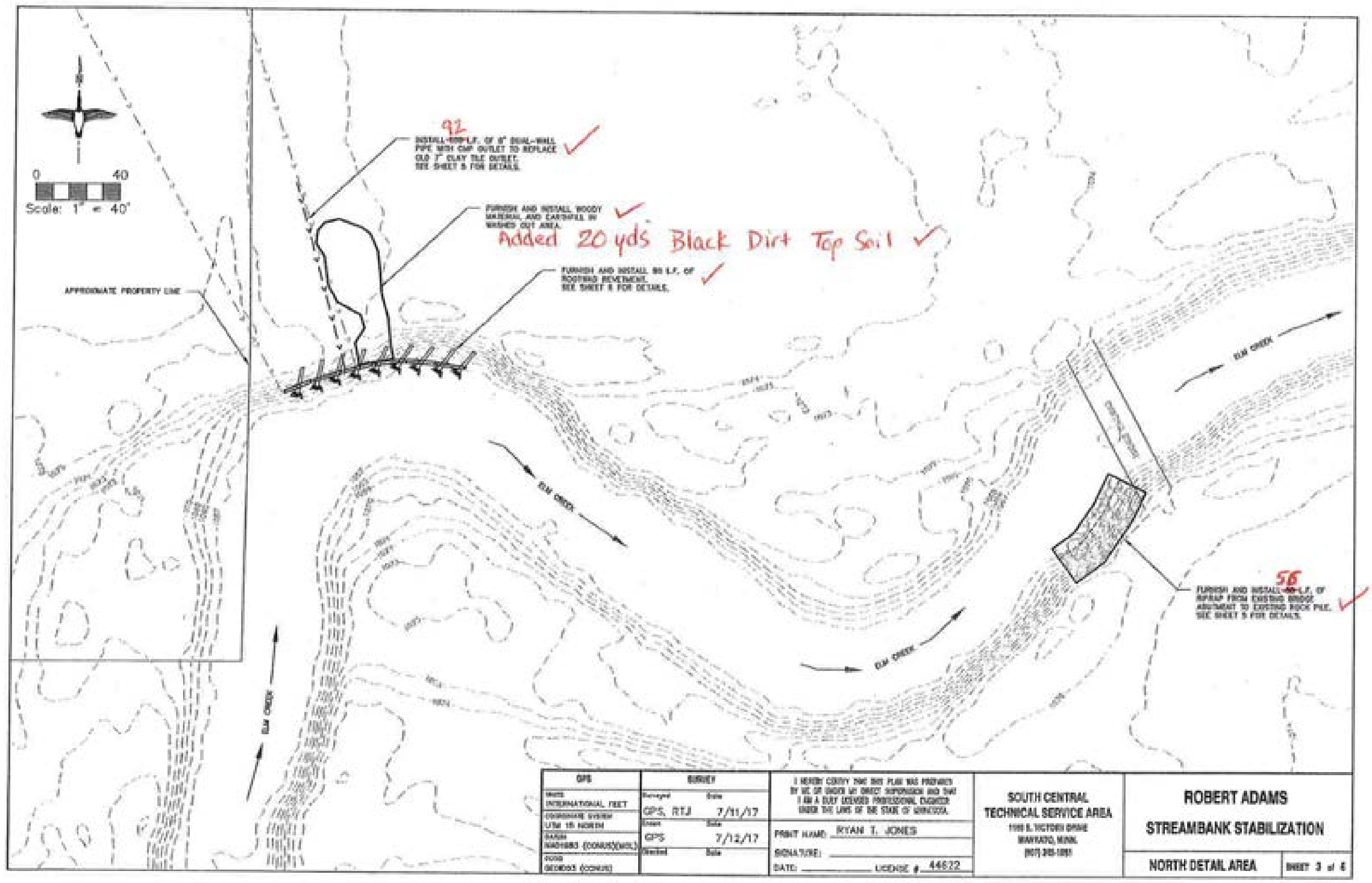


Figure 2-4 Adams Streambank Restoration Sheet 3 of 6. North Detail Area.

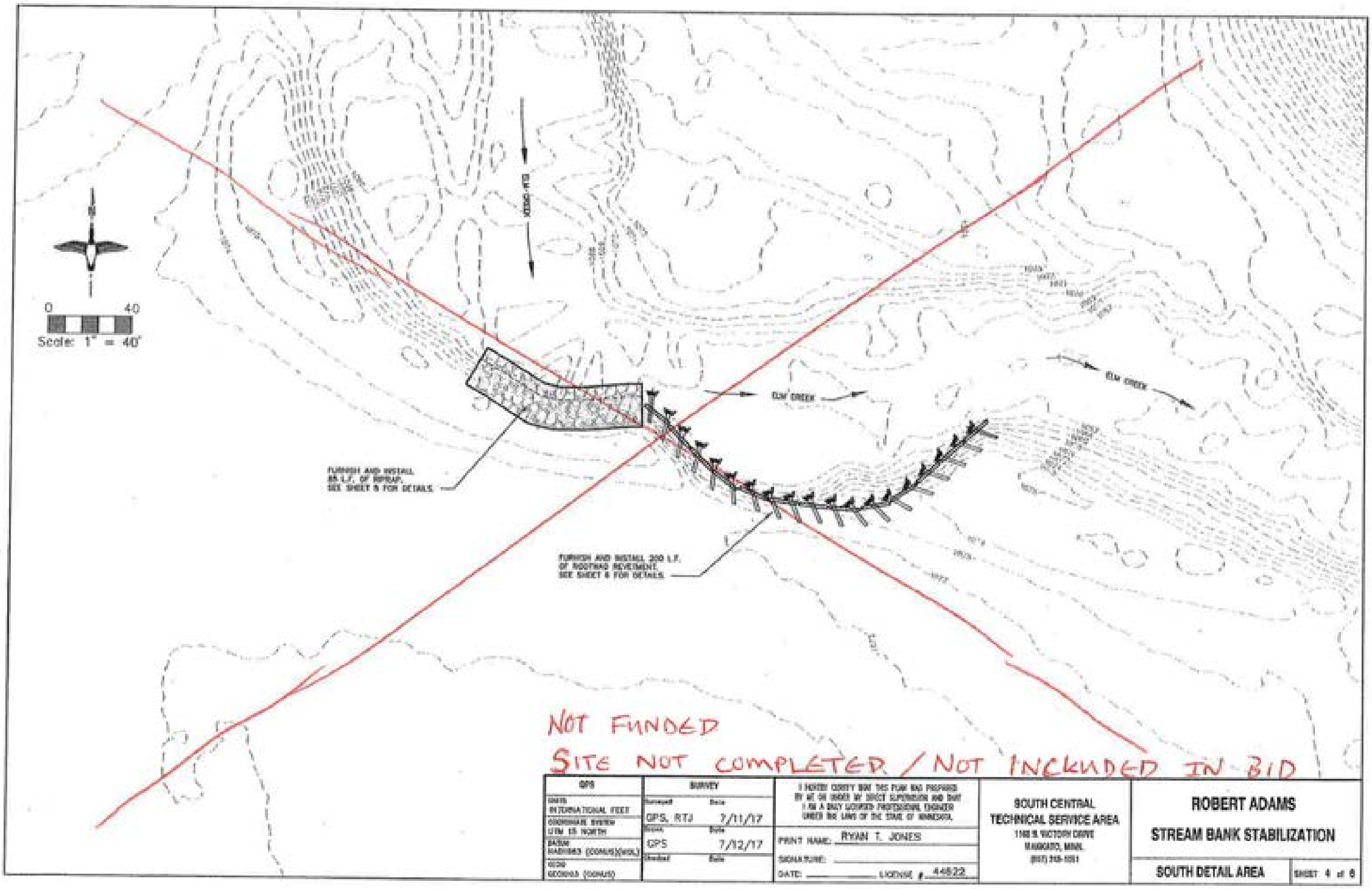


Figure 2-5 Adams Streambank Restoration Sheet 4 of 6. South Detail Area – not funded.

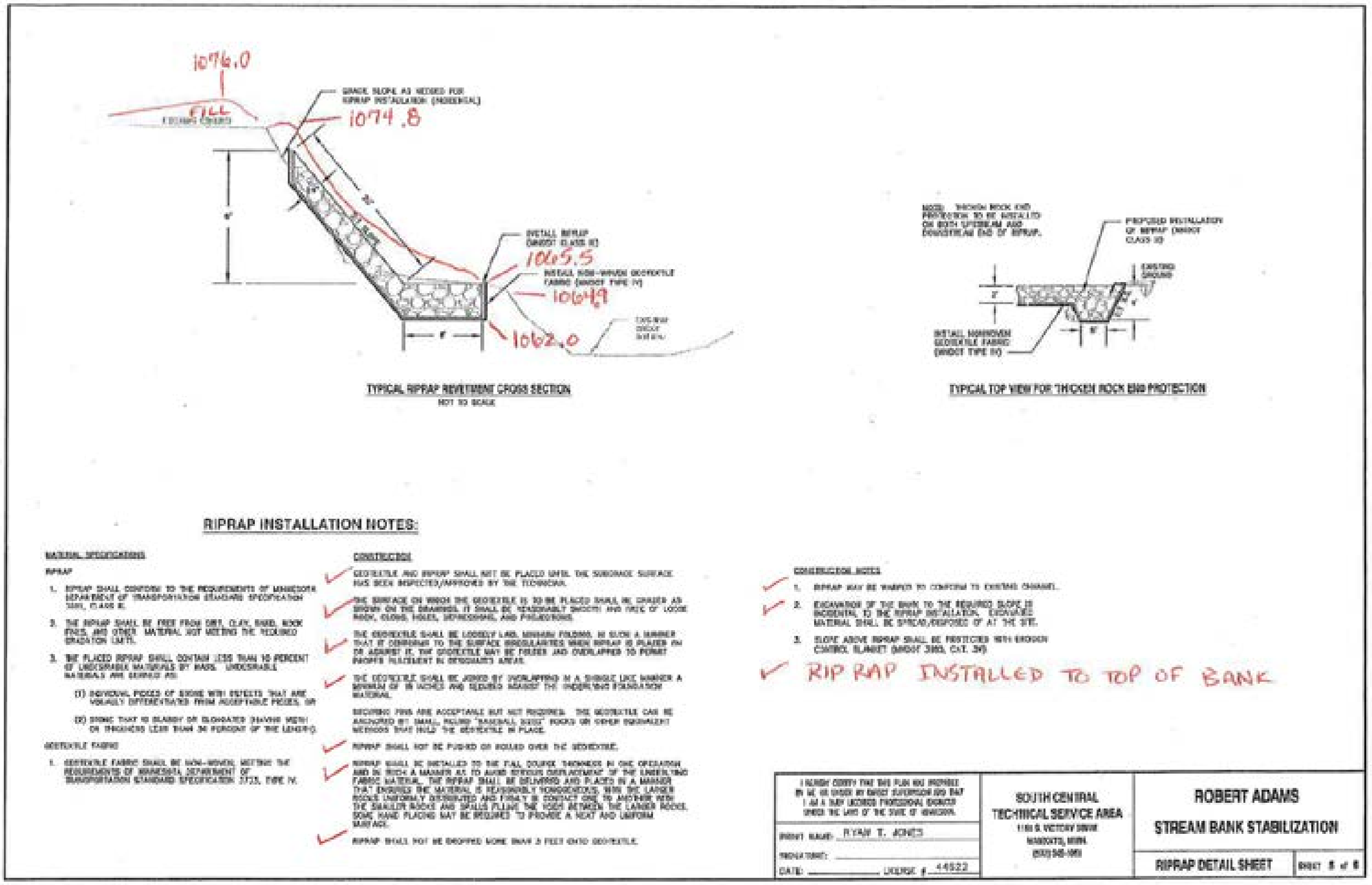


Figure 2-6 Adams Streambank Restoration Sheet 5 of 6. Riprap Detail Sheet.

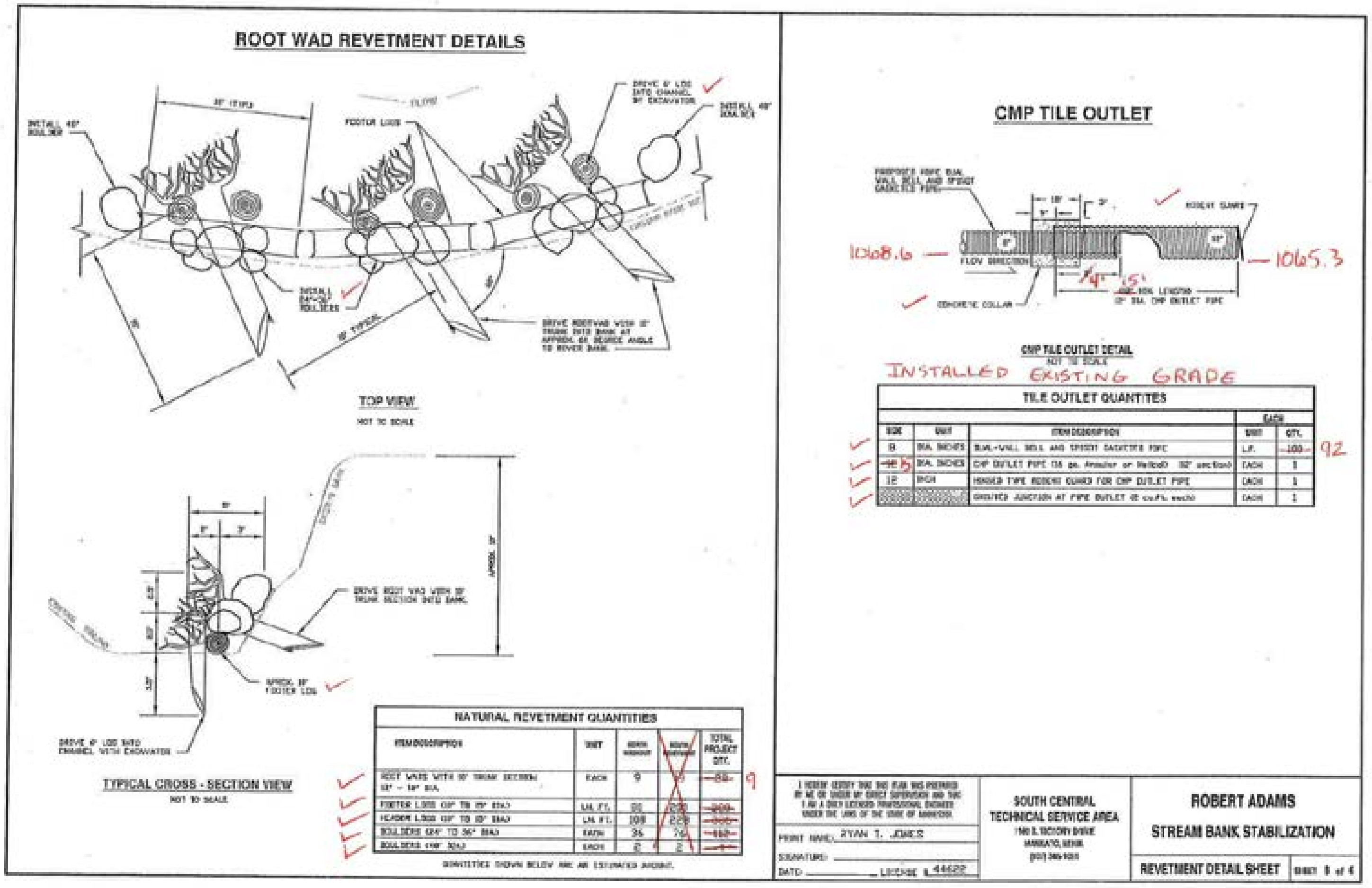


Figure 2-7 Adams Streambank Restoration Sheet 6 of 6. Revetment Detail Sheet.

Table 2-1 Plants observed from photos taken during site visit on 8/1/19. Photos were taken along a meander survey route for plant ID. Seed mix specified for disturbed areas was MN State Seed Mix 36-211 (Woodland Edge South & West) at a seeding rate of 34.5 pounds per acre.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Fraxinus pennsylvanica	Green ash	5-10, canopy		Native
Solidago gigantea	Giant goldenrod	5-10		Native
Elymus canadensis	Canada wildrye	10-25	Seeded	Native
Ambrosia trifida	Giant ragweed	10-25		Weedy
Acer sp.	Maple	5-25, canopy		Native
Echinocystis lobata	Wild cucumber	5-10		Native
Bromis inermis	Smooth brome	10-25		Invasive
Rudbeckia hirta	Black-eyed susan	10-25	Seeded	Native
Parthenocissus inserta	Woodbine	<5		Native
Asclepias syriaca	Common milkweed	<5		Native
Unknown, Brassicaceae family	Yellow-flowering mustard species	<5		Weedy
Elymus repens	Quackgrass	<5		Invasive
Elymus trachycaulus	Slender wheatgrass	5-10	Seeded	Native
Urtica dioica	Stinging nettle	1-10		
Verbena cf. hastata	Blue vervain	<5		Native
Fallopia convolvulus	Black bindweed	<5		Weedy
Melilotus sp.	Sweetclover	5-10		Invasive
Monarda fistulosa	Wild bergamot	1-10	Seeded	Native
Phleum pratense	Timothy	<5		Weedy
cf. Agastache foeniculum	Blue Giant Hyssop	1-10	Seeded	Native
Desmodium canadense	Canada tick trefoil	1-10	Seeded	Native
cf. Heliopsis helianthoides	Smooth Oxeye	5-10	Seeded	Native
Zizia aurea	Golden alexanders	1-10	Seeded	Native
Symphyotrichum lanceolatum	Panicled aster	<5		Native
Conyza canadensis	Canadian Horseweed	<5		Native
Rumex sp.	Dock	<5		-
Ulmus americana	American elm	5-10, canopy		Native
Cf. Ambrosia artemisiifolia	Common ragweed	5-10		Weedy
Trifolium pratense	Red clover	<5		Weedy
Cirsium arvense	Canada thistle	1-10		Noxious
Taraxacum officinale	Common dandelion	<5		Weedy
Arctium minus	Common burdock	<5		Invasive
Plantago sp.	Plantain	<5		Weedy
Phalaris arundinacea	Reed canarygrass	<5; one patch		Invasive

Appendix B: Site Photographs

Photo 2-1 View of Adams washout area before construction. Photo provided with project documentation.

Photo 2-2 Revegetated area at the top of the filled washout area after construction. Photo provided with project documentation.

Photo 2-3 View of Adams Washout. Boulders, rootwads and pins holding bank. Photo taken by Ed Matthiesen during site visit (8/13/19).

Photo 2-4 Close-up view of the rootwad stabilization at the toe of the Adams Washout slope. The rootwads installed vertically with the other rootwads and boulders are unique to this site. Photo taken during site visit (8/13/19).

Photo 2-5 View of Adams near Bridge. Riprap protection bank. Photo taken by Ed Matthiesen during site visit (8/13/19).

3) Elm Creek Channel Realignment

Project Background

Project Name: Elm Creek Channel Realignment

Project Site: County Road 36 – Stream Bank Restoration

Township/Range Section: Elm Creek Township 103N Range 33W Section 14

Project Manager / Affiliated Organization: Martin County SWCD

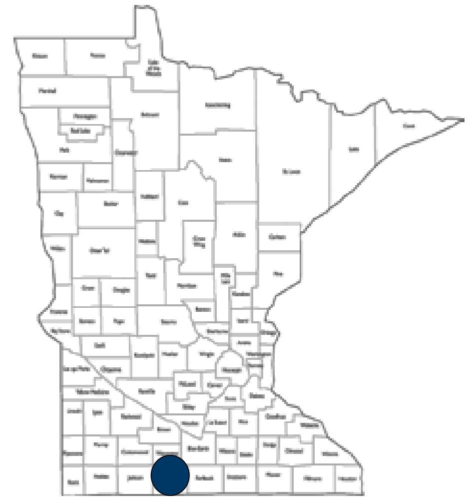
Fund: CWF ***Fiscal Year Funds:*** 2013

Project Start Date: 2014

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Prairie / Savana / Grassland , Choose an item.

Project Status: Establishment Phase



County: Martin

Primary Activity: Stream/River Restoration

Project Size: 1,100 Linear Feet

Project Completed: December 2014

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Channel realignment and streambank stabilization practices including willow cuttings, willow bundles, log and rock vanes, rootwads, and riprap riffles.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   - Elm Creek Channel Realignment Construction Plans, Martin County, February 2003.
3. ***What are the stated goals of the project?***
   Reduced streambank erosion and protect infrastructure by lengthening the stream channel to reduce flow velocity and increase storage.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Protect the County Highway 36 bridge and reduce streambank erosion in Elm Creek which is impaired for fish bioassessment, turbidity, and fecal coliform.
5. ***Were measures of restoration success identified in plans?*** *No*
   If yes, list specific measurements.
   General statement for measuring improvements in water quality trends such as a reduction in sediment load as a way to measure project success, but no quantifiable schedule or responsibility was identified.

6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   Elm Creek Channel Realignment Construction Plans, Martin County, February 2003. Documentation includes a project plan and profile, silt fence erosion control installation details, and channel realignment cross-sections.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Partially

   Channel realignment to lengthen the channel and reduce channel slope is an industry standard in MN to reduce channel flow velocity and streambank erosion.

   Channel widening for added storage capacity is not a common best practice. The project channel width although wider than the historic channel and existing channel upstream and downstream, provides storage. Over a watershed of 98.7 square miles (measured in Stream Stats) this is a very small storage addition.

   Rock grade control riffles to control channel grade and stabilize stream reaches is industry standard in MN. It is standard design practice to include riprap material from the rock riffle up the streambanks to the top of the channel to minimize the potential of the stream channel from migrating and cutting off the riffle.

   Installing rootwads as bank stabilization on outside bends of new channel alignments is industry standard in MN to protect the toe of the new banks while vegetation is established. Rootwads usually require foundational footer logs or riprap to supplement the rootwads and protect the entire toe of the stream bank.

   Revegetation of disturbed streambanks with native vegetation willow cuttings is industry standard in MN. For this project willow was added in two locations but was drowned out by high flow before the shrubs grew taller than high water levels.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No
9. ***In what ways did alterations change the proposed project outcome?***
   N/A

Site Assessment

Field Review Date: **7/31/2019**

Field Visit Attendees: Ed Matthiesen – Wenck Associates, Gina Quiram – MN Department of Natural Resources, Kevin Peymann, Gary Johanson – property owner, Ashley Brenke – Martin County Soil and Water Conservation District, Jill Sackett– Minnesota Board Conservationist, Greg Johanson - Martin County Soil and Water Conservation District, and Jon Lore – Minnesota Department of Natural Resources

10. ***Surrounding Landscape Characteristics:***
    This reach of Elm Creek is surrounded by a vegetated buffer then cultivated lands. The average buffer width in the project areas is 780 feet and matches the lowland meander valley width.
11. ***Site Characteristics:***
    a. ***Soil Series:***
       Coland clay (1833), occasionally flooded; Coland clay (1834), frequently flooded.
    b. ***Topography:***
       Elm Creek is a low gradient stream within a larger meander valley.
    c. ***Hydrology:***
       Well drained.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
       The site is a grassland stream bank dominated by a mix of grasses and forbs, with up to 75% cover of either smooth brome or reed canarygrass, both invasive species. About one-third to one-half of the site has a mix of reed canarygrass with the dominant forbs Canada tick trefoil, giant goldenrod, wild sunflowers, and golden alexanders (all of which are native and may have been planted), along with giant ragweed (weedy). Forb diversity is providing pollinator habitat from land owner seed collection, propagation and planting at the site. The edge of the site is along a wooded area, and a few tree seedlings and shrubs were observed, but these do not dominate cover.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
       Refer to Appendix A, Table 3-2 for species list.
12. ***Is the plan based on current science?*** Portions
    The plan to provide a better channel alignment for the bridge approach and to lengthen the existing channel to reduce flow velocity and erosion is based on current science. The plan to over widen the channel to provide water storage is not based on current science. The additional volume in the over-widened cross section is negligible in such a large watershed and the additional capacity will eventually be lost as sediment accumulates in the over-widened section and the channel returns to a natural and stable cross-section.
13. ***List indicators of project goals at this stage of project:***
    County bridge is protected and most banks are protected and not showing signs of erosion.
14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Yes. With future maintenance that was discussed during the evaluation to relocate some of the in-channel rock to outside bends with bare banks that are receive impinging flows. At the time of the evaluation there is no formal plan to complete the maintenance, but it was acknowledged that something should be done as time and budget allows.
15. ***Are corrections or modifications needed to achieving proposed goals?***
    The project outcomes were mixed:

a. The radius into the project area at the upstream end is approximately 90° resulting in an impinging flow. Additional stabilization measures are needed to protect this exposed bank. The landowner is interested in this if funding is available.

b. The channel redirection into the bridge is at a tight radius but the rock addition should prevent scour and erosion.

c. The rock grade control structures appear to be inundated with sediment and flow has gone around the sides of some of the structures making them ineffective for grade control.

16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

    Project documentation states that site inspections will be completed at a minimum of one year after completion, then at year 5, year 10, and at the next to last year of the effective life of the project. In addition, inspections will be performed on a case-by-case basis, such as after storms producing unusually heavy runoff. Clarification is needed on the expected project life to determine what, “next to last year of the project life” means. Long-term. Movement noted by inspections at year, 5 and 10 year and the next to last year of the project life.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***

    No. The stream remeandering and stabilization provides some structure for habitat. A bigger outcome for habitat will achieved if the project goal of reducing erosion and turbidity is met.

18. ***Are follow-up assessments needed? Explain.***

    Yes. Repair needed to first upstream bank.

19. ***Additional comments on the restoration project.***

    The project design was completed by the MN DNR. Final design, construction supervision, and inspection was provided by the Martin County Highway Department.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***

    achieved the stated goals.

21. ***The project will:***

    Meet proposed outcomes

    Confidence of outcome determination:

    Medium

22. ***Provide explanation of reason(s) for determination.***

    Project has been in place for six years and needs some maintenance to protect the first 90° bend on the upstream side. Recommend installation of riprap on that section of bank. The realignment and lengthening of the channel is largely successful. The is one area upstream that could use some touch up but is not currently detracting from the gains of realigning and lengthening the channel.

    Site Assessor(s) Conducting Review: Ed Matthiesen

Appendix A: Site maps, Project plans or Vegetation tables

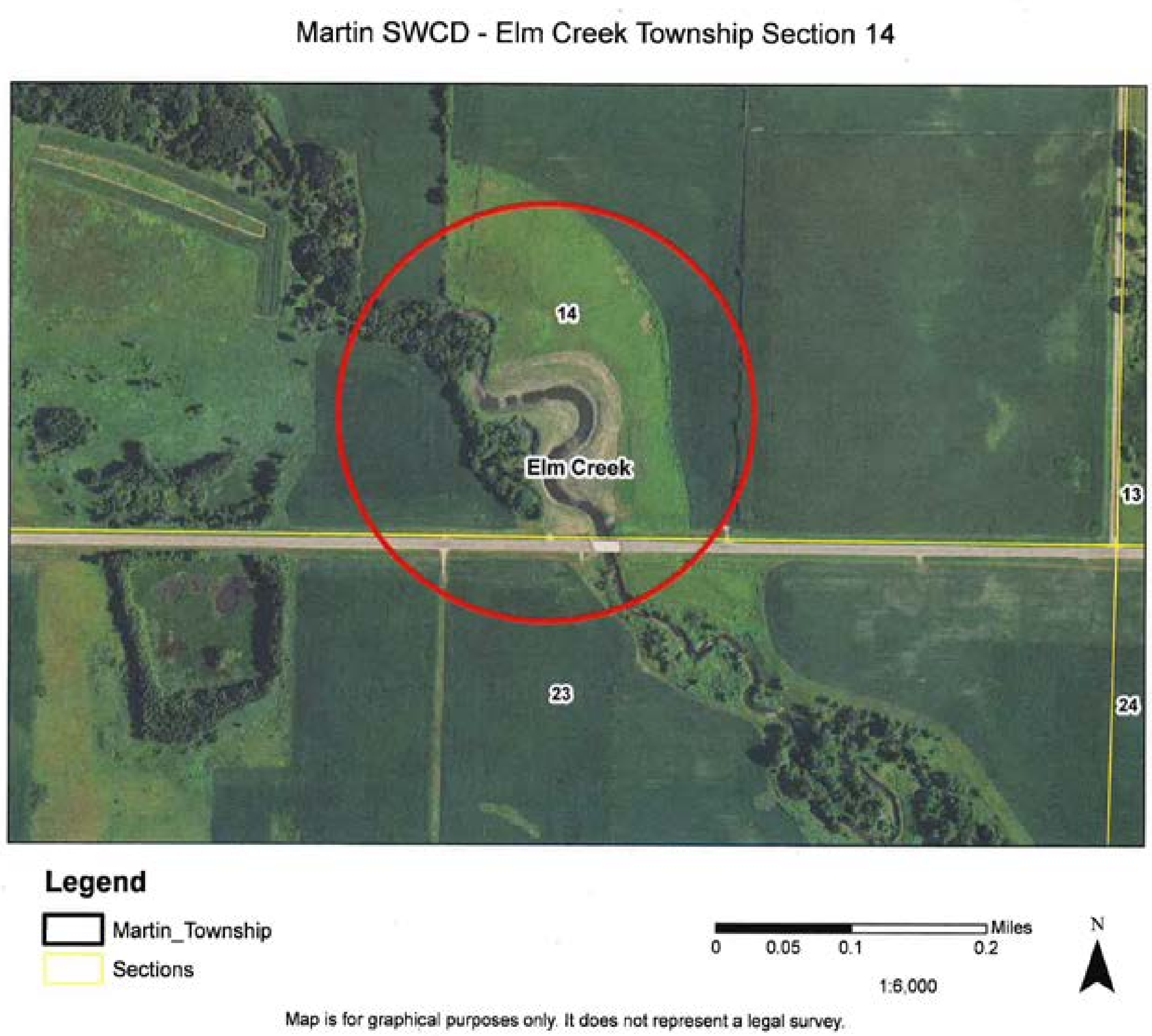


Figure 3-1 Elm Creek Channel Realignment – Site Map showing location of site on Elm Creek.

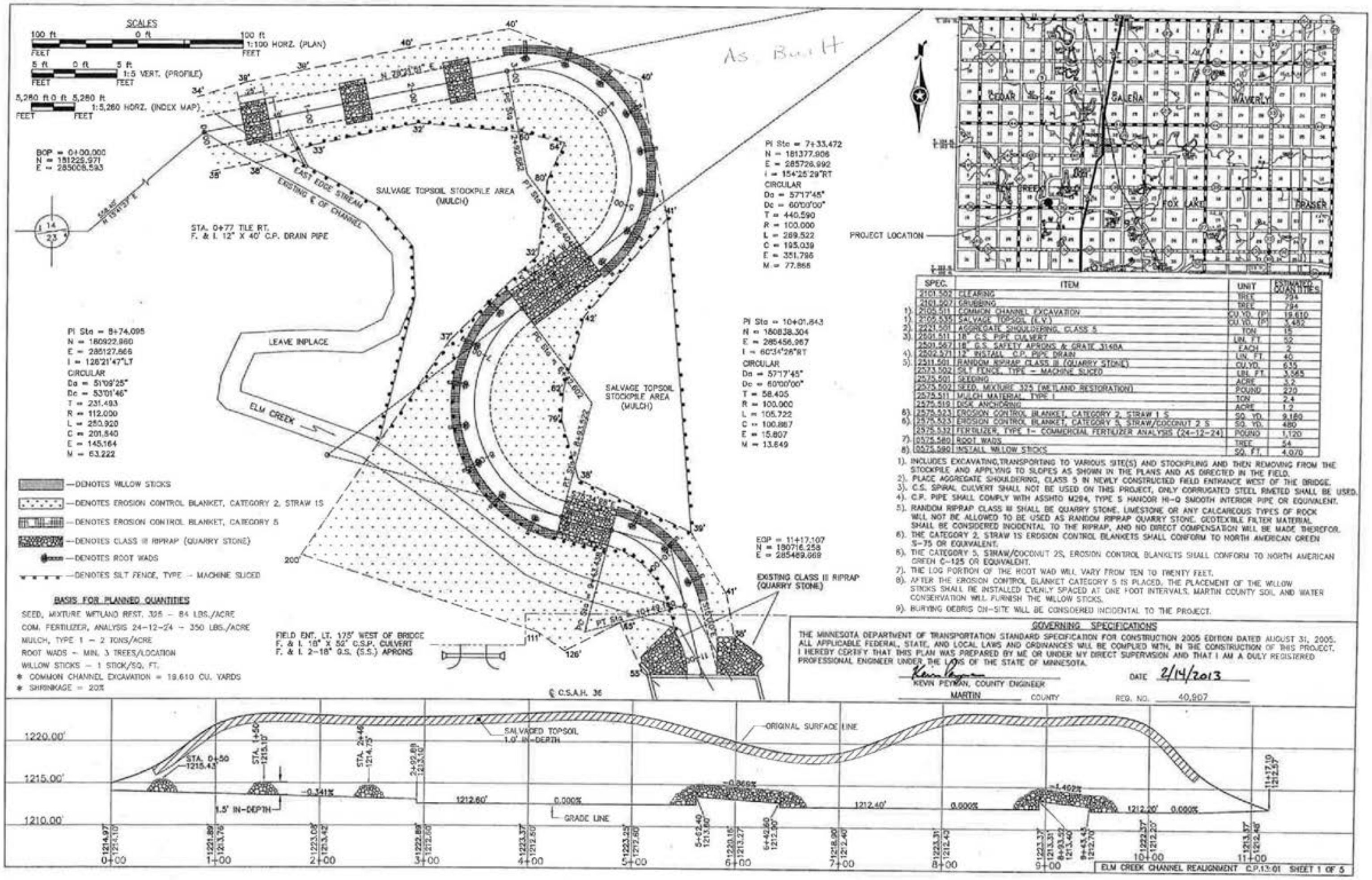


Figure 3-2 Elm Creek Channel Realignment Sheet 1 of 5. Cover Sheet.

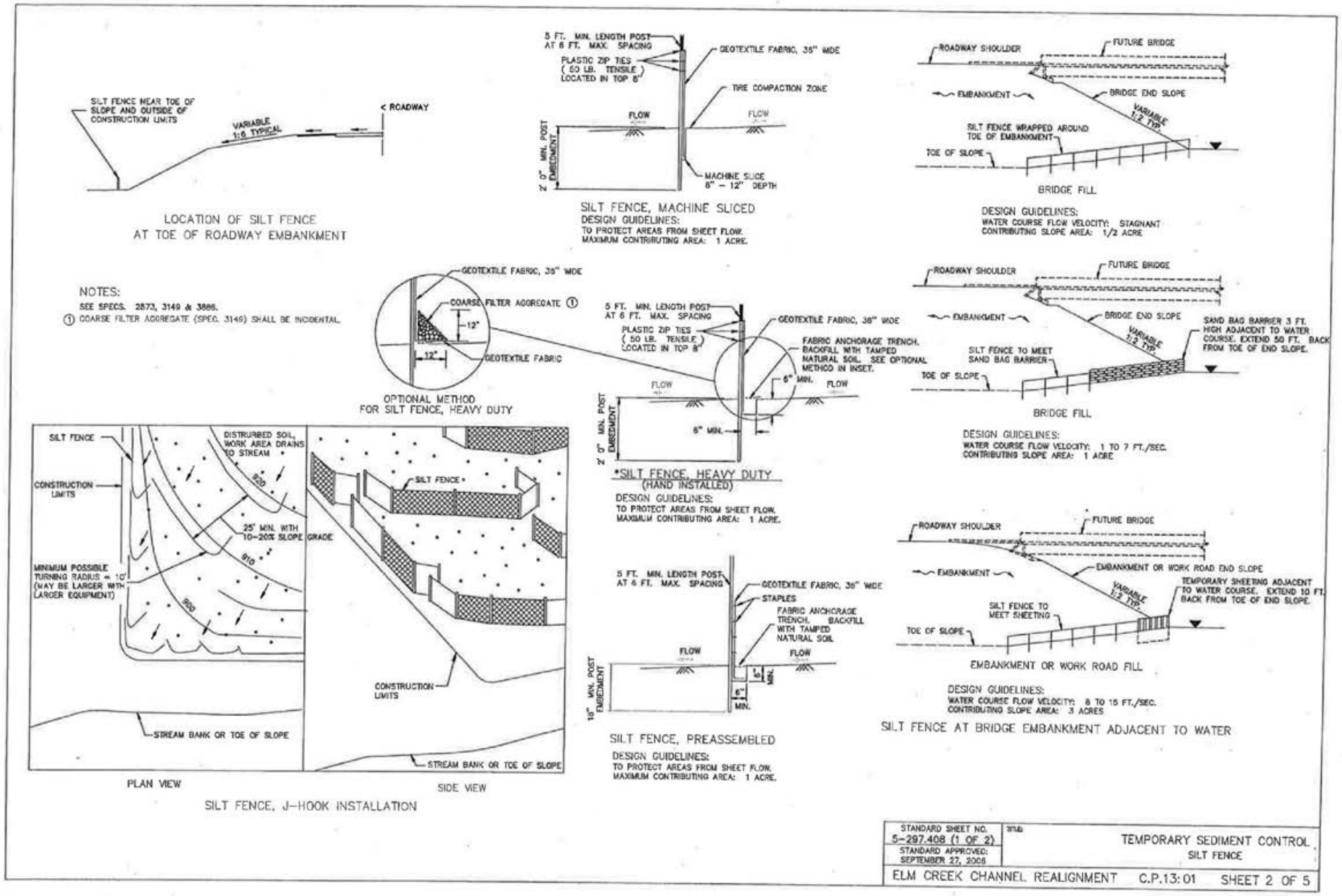


Figure 3-3 Elm Creek Channel Realignment Sheet 2 of 5. Temporary Sediment Control.

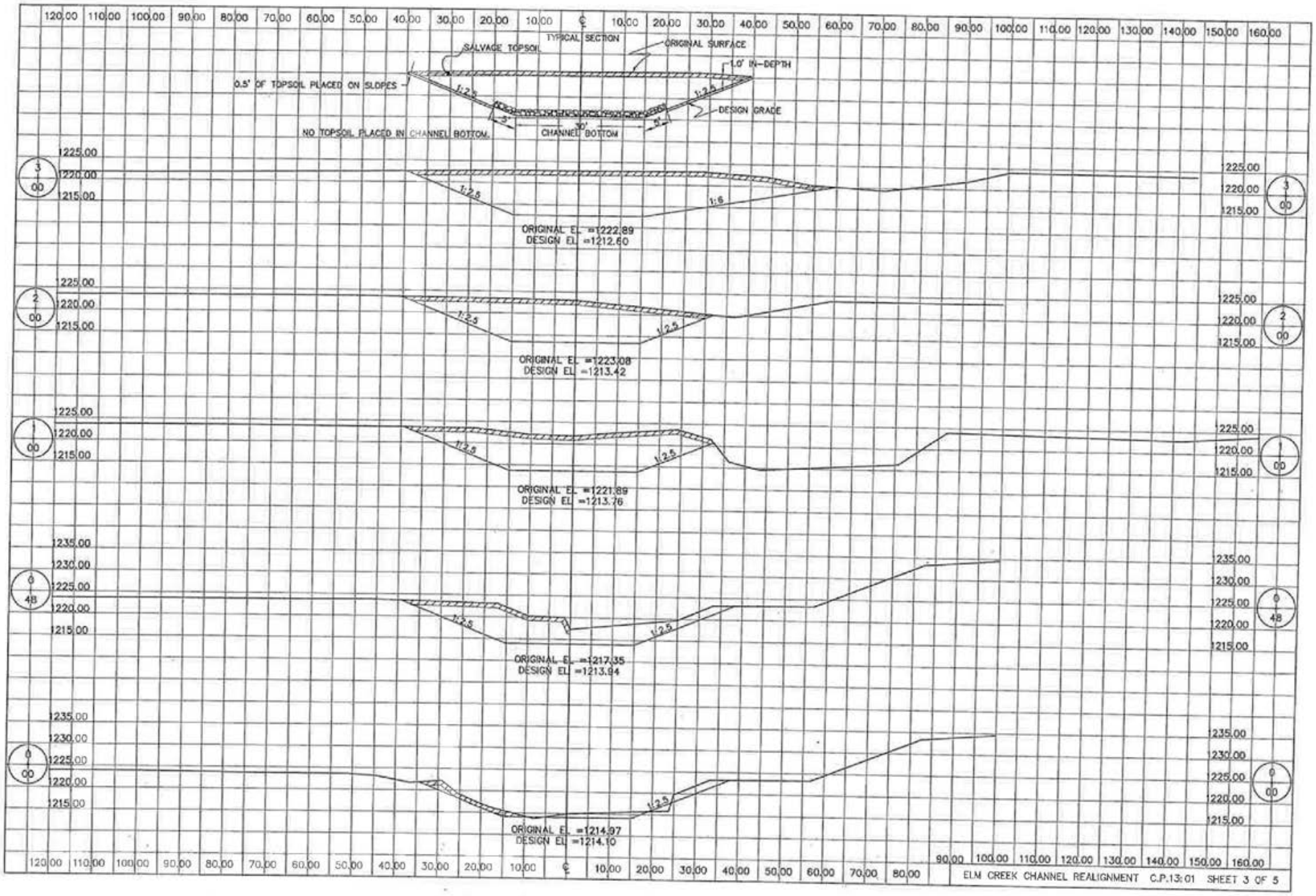


Figure 3-4 Elm Creek Channel Realignment Sheet 3 of 5. Cross-sections.

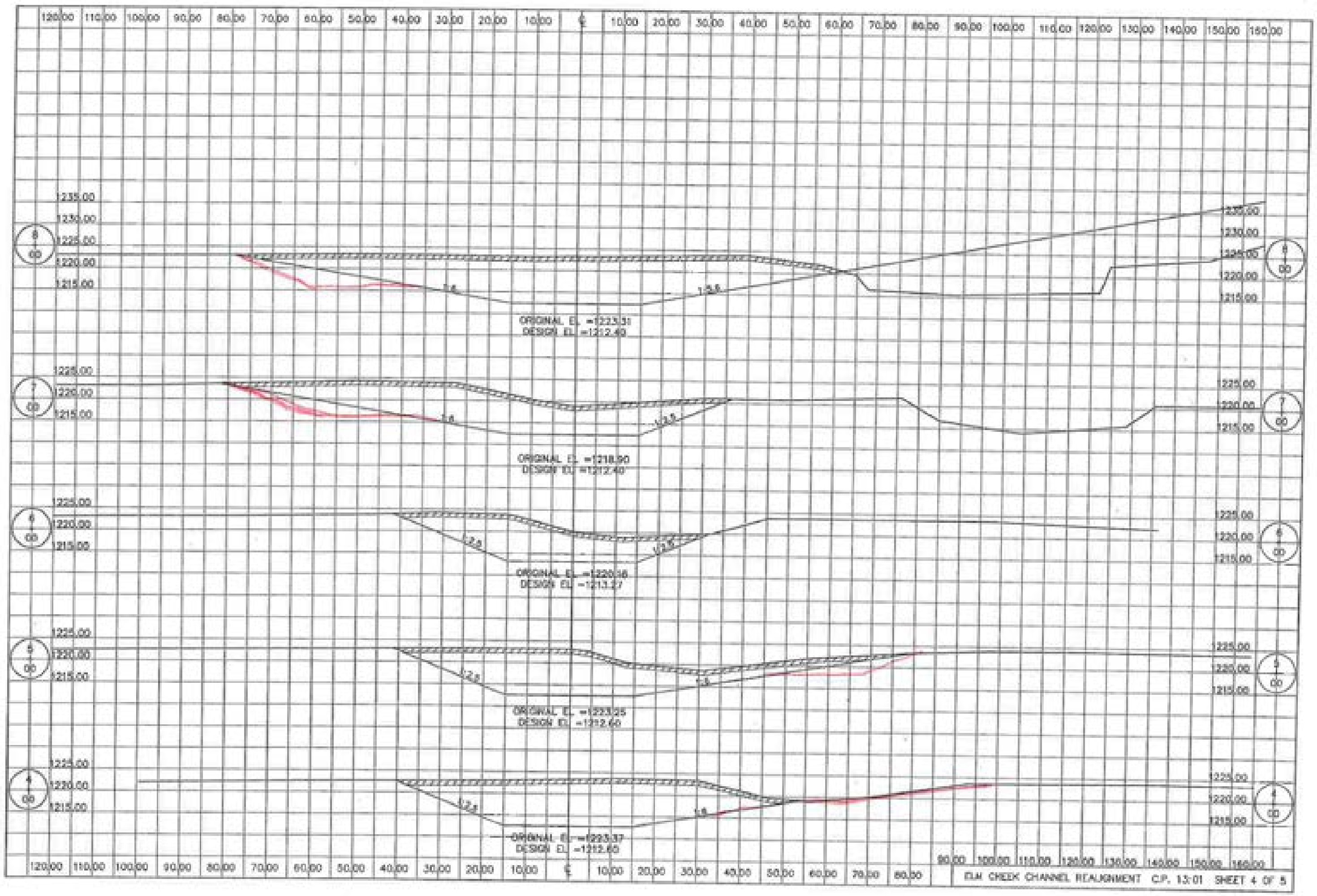


Figure 3-5 Elm Creek Channel Realignment Sheet 4 of 5. Cross-sections.

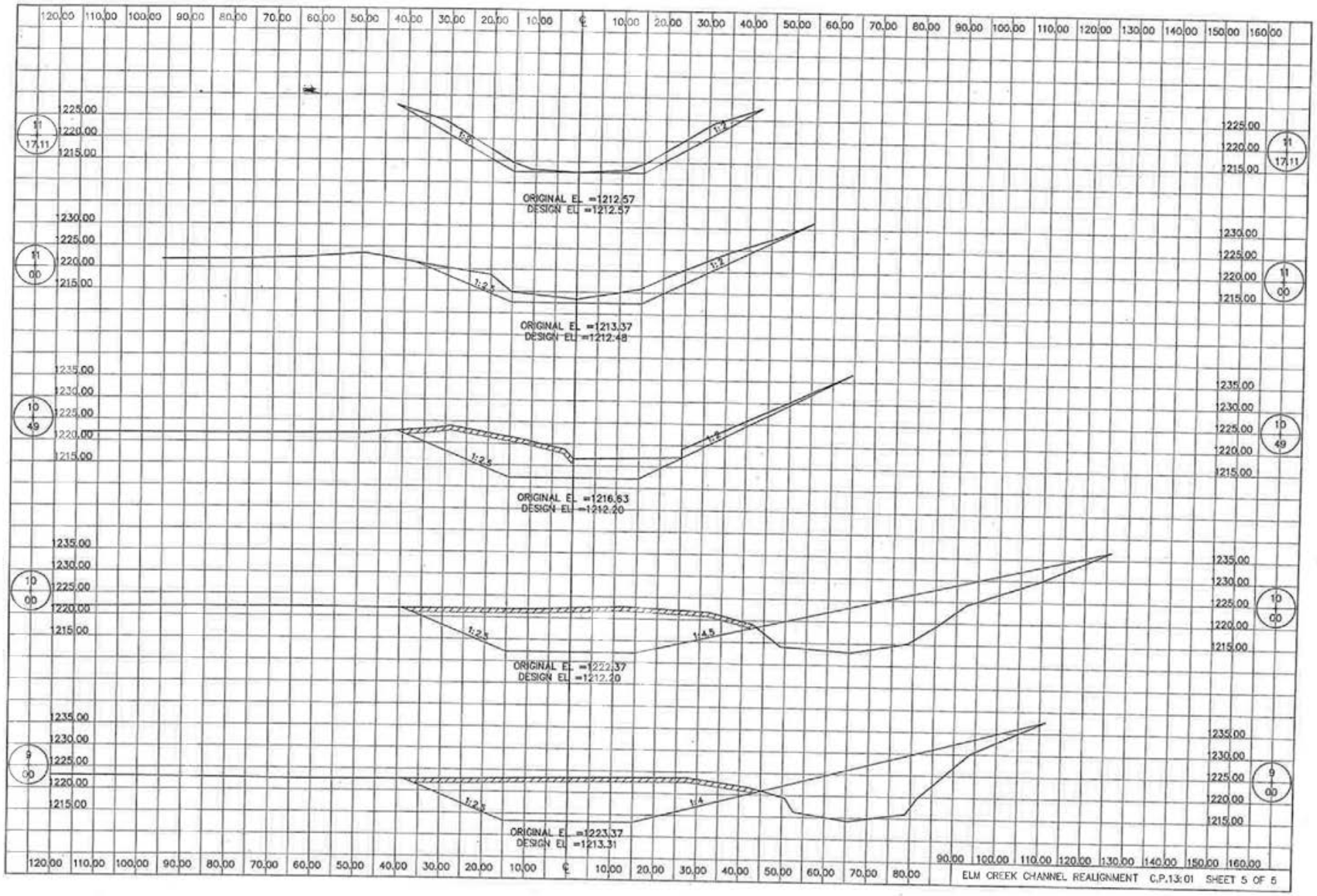


Figure 3-6 Elm Creek Channel Realignment Sheet 5 of 5. Cross-sections.

Table 3-1 Local seed was hand collected in the project area and was used for restoration.

Scientific Name	Common Name
Silphium perfoliatum	Cup Plant
Astragalus canadensis	Canada Milkvetch
Rudbeckia hirta	Black-eyed Susan
Echinacea pallida	Pale Coneflower
Ratibida pinnata	Yellow Coneflower
Asclepias tuberosa	Butterfly Weed
Symphyotrichum Laeve	Smooth Aster
Desmodium canadense	Showy Tick-trefoil
Aptisia Bracteata	Cream Indigo
Dalea purpurea	Purple Prairie Clover
Liatris pucnostachya	Prairie Blazing Star
Liatris aspera	Rough Blazing Star
Liatris punctata	Dotted Blazing Star
Asclepias viridiflora	Green Milkweed
Trifolium repens	White Clover
Euthamia graminifolia	Grass leaved Goldenrod
Scrophularia lanceolata	Lance-leaf Figwort
Phlox pilosa	Prairie Phlox
Lespedeza capitata	Round-headed Bush Clover
Sisyrinchium campestre	Prairie Blue-eyed Grass
Eryngium yuccifolium	Rattlesnake Master
Asclepias incarnata	Swamp Milkweed
Asclepias Syriaca	Common Milkweed
Symphyotrichum movae-angliae	New England Aster
Zizia aurea	Golden Alexander
Monarda fistulosa	Wild Bergamot
Veronicastrum virginicum	Culvers Root

Table 3-2 Plants observed from photos taken during site visit on 7/31/19. Photos were taken along a meander survey route for plant ID.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Solidago gigantea	Giant goldenrod	5-25		Native
Asclepias syriaca	Common milkweed	5-10	Seeded	Native
Panicum virgatum	Switchgrass	1-10		Native
Dalea purpurea	Purple prairie clover	5-10	Seeded	Native
Solidago canadensis	Canada goldenrod	5-25		Native
Bromis inermis	Smooth brome	10-75		Invasive
Elymus cf. virginicus	Virginia wildrye	<5		Native
Phalaris arundinacea	Reed canarygrass	10-75		Invasive
Zizia aurea	Golden alexanders	5-25	Seeded	Native
Phlox pilosa	Prairie phlox	1-10	Seeded	Native
Calystegia sepium	Hedge bindweed	1-10		Native, Weedy
Desmodium canadense	Canada tick trefoil	5-25	Seeded	Native
Melilotus sp.	Sweetclover	5-10		Invasive
Populus deltoides	Cottonwood	<5; Seedlings		Native
Ambrosia trifida	Giant ragweed	5-25		Weedy
Symphyotrichum cf. novae-angliae	New England aster	1-10	Seeded	Native
Andropogon gerardii	Big bluestem	5-10		Native
Liatris sp.	Blazing star	<5	Seeded	Native
cf. Heliopsis helianthoides	Smooth Oxeye	5-10		Native
Silphium perfoliatum	Cup Plant	<5	Seeded	Native
Euthamia graminifolia	Grass leaved Goldenrod	1-10	Seeded	Native
cf. Silene sp. (Silene cf. virginica or cultivar)	Catchfly, red-flowered	<5		-
cf. Helianthus tuberosus	Jerusalum artichoke	2-25		Native
Anemone sp.	Anemone, leaves only	<5		Native
Asclepias tuberosa	Butterfly-weed	<5	Seeded	Native
Cirsium arvense	Canada thistle	<5		Noxious
Verbena cf. urticifolia	White Vervain	<5		Native
Lactuca sp.	Lettuce	<5		-
Lotus corniculatus	Birdsfoot trefoil	1-10		Noxious
Sonchus arvensis	Field Sowthistle	1-10		Weedy
Monarda fistulosa	Wild bergamot	<5	Seeded	Native
Unknown tree	Edge of project area	<5, canopy		-
Plantago sp.	Plantain	<5		Weedy
Rudbeckia hirta	Black-eyed susan	<5	Seeded	Native
Medicago lupulina	Black medick	<5		Weedy
Trifolium sp.	Clover	<5	Seeded	Weedy
Xanthium strumarium	Cocklebur	1-10		Weedy
Unknown Cyperaceae	Sedge family	<5		Native

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
cf. Echinochloa sp.	Barnyard grass	<5		-
Eleocharis sp.	Spikerush	<5		Native
Scirpus/Schoenoplectus sp.	Bulrush	<5		Native
Carex sp.	Sedge	<5		Native
Unknown shrub *(cf. Lonicera sp.)*	Honeysuckle sp.	<5		Invasive
Ratibida pinnata	Gray-headed Coneflower	<5	Seeded	Native
Asclepias incarnata	Swamp milkweed	<5	Seeded	Native
Verbena hastata	Blue Vervain	1-10		Native
Acer negundo	Boxelder, seedlings	1-10		Native

Appendix B: Site Photographs

Photo 3-1 View of Elm Creek project from County Highway 36 bridge after construction and before vegetation establishment. Site evaluator questions the intended effect of rootwad placement in riprap and the elevation that the rootwads were installed. Photo taken during construction (2014).

Photo 3-2 View of Elm Creek project showing a single exposed rootwad. Evaluator recommends rock/boulders on both sides of the rootwad near station 7+00 to prevent bank scour behind the rootwad. Photo taken by Ed Matthiesen during site visit (8/13/19).

Photo 3-3 View of Elm Creek downstream of the project area from the County Highway 36 bridge as a reference of the natural channel width outside of the project area. Photo taken by Ed Matthiesen during site visit (8/13/19).

Photo 3-4 View of Elm Creek upstream of the project area at station 0+00 as a reference of the natural channel width outside of the project area. Photo taken by Ed Matthiesen during site visit (8/13/19).

Photo 3-5 View of Elm Creek. Looking downstream to 10+00. Sediment deposition covering rock. Photo taken by Ed Matthiesen during site visit (8/13/19).

4) Knife River Toewood Bank Stabilization (Revisit)

Legacy Fund Restoration Evaluations

See Appendix C for Project Background and Initial Project Evaluation

Project Name: Knife River Toewood Stabilization Project

Project Manager / Affiliated Organization:

South St Louis Soil and Water Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2010

County: St. Louis

Primary Activity: Stream/River Enhancement

Project Size: ~150 linear foot reach

Project Completed: 2011

Revisit Site Assessment

Field Review Date: 10/1/2019

Field Visit Attendees: *Karen Tucker–Lake Co SWCD; Ann Thompson –South St. Louis SWCD; Karl Koller–MnDNR; Wade Johnson–MnDNR; Gina Quiram; Cory Goldsworthy–MnDNR; Dean Paron–MnDNR; Jeff Hrubes–BWSR; Erin Loeffler–BWSR; Keith Anderson–Northeast SWCD Technical Services; and Kevin Biehn-EOR*

1. ***What are the stated goals of the project?***
   The benefits from a stable bluff/channel in this location include reduced sediment downstream, less sediment pollution into Lake Superior, and protection of native riparian plant communities. Toe wood will decrease bluff erosion and create beneficial fisheries habitat through the introduction of woody debris.

2. ***What are the desired outcomes of achieving the stated goals of the project?***
   Specific/Measureable outcomes were not identified, but a reduction in total suspended solids (TSS) can be inferred.

3. ***Please note any substantive changes to the site characteristics since last site assessment.***
   Based on anecdotal feedback from project stakeholders, no substantial inputs or alterations have occurred since initial construction.

4. ***Is the plan based on current science?*** Yes

   Toe Wood is a preferred practice to stabilization/restore streams as it is intended to provide both stability and habitat returns.

5. ***List indicators of project goals at this stage of the project.***

   The stream bank of interest is well vegetated, stable and has been tested by multiple channel forming flows. Flood flows are readily accessing the floodplain bench created as part of the Toe Wood installation.

6. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project outcomes?***

   Yes – the project has been in place for 8 years and has been tested by multiple substantial flood events.

7. ***Are corrections or modifications needed to meet proposed outcomes?***

   None at this time – the site is stable and on a positive trajectory.

8. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

   No future steps are planned or necessary at this time.

9. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***

   No detractions are apparent to evaluator according to cursory evaluation.

10. ***Are follow-up assessments needed? Explain.***

    This project is given a low priority for repeat evaluation. The installation has been in place for 8 years and has remained stable over this period.

11. ***Additional comments on the restoration project.***

    There is a minor instability immediately downstream of the terminus of the Toe Wood installation. This transition in roughness can frequently be problematic if stabilization measure are not carried far enough through the bend. Via review of historic aerial photography and field photographs the bank is not rapidly expanding and may currently be providing unique backwater habitat(s). This spot should however, be further monitored.

Revisit Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

12. ***The project has:***

achieved the stated goals.

13. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium

14. ***Provide explanation of reason(s) for determination.***
    The installation has been in place for 8 years and remained stable over this period, during which multiple and substantial flood events have occurred.

15. ***Site Assessor(s) Conducting Review:***
    Kevin Biehn-EOR

Appendix A: Revisit Site maps, Project plans or Vegetation tables

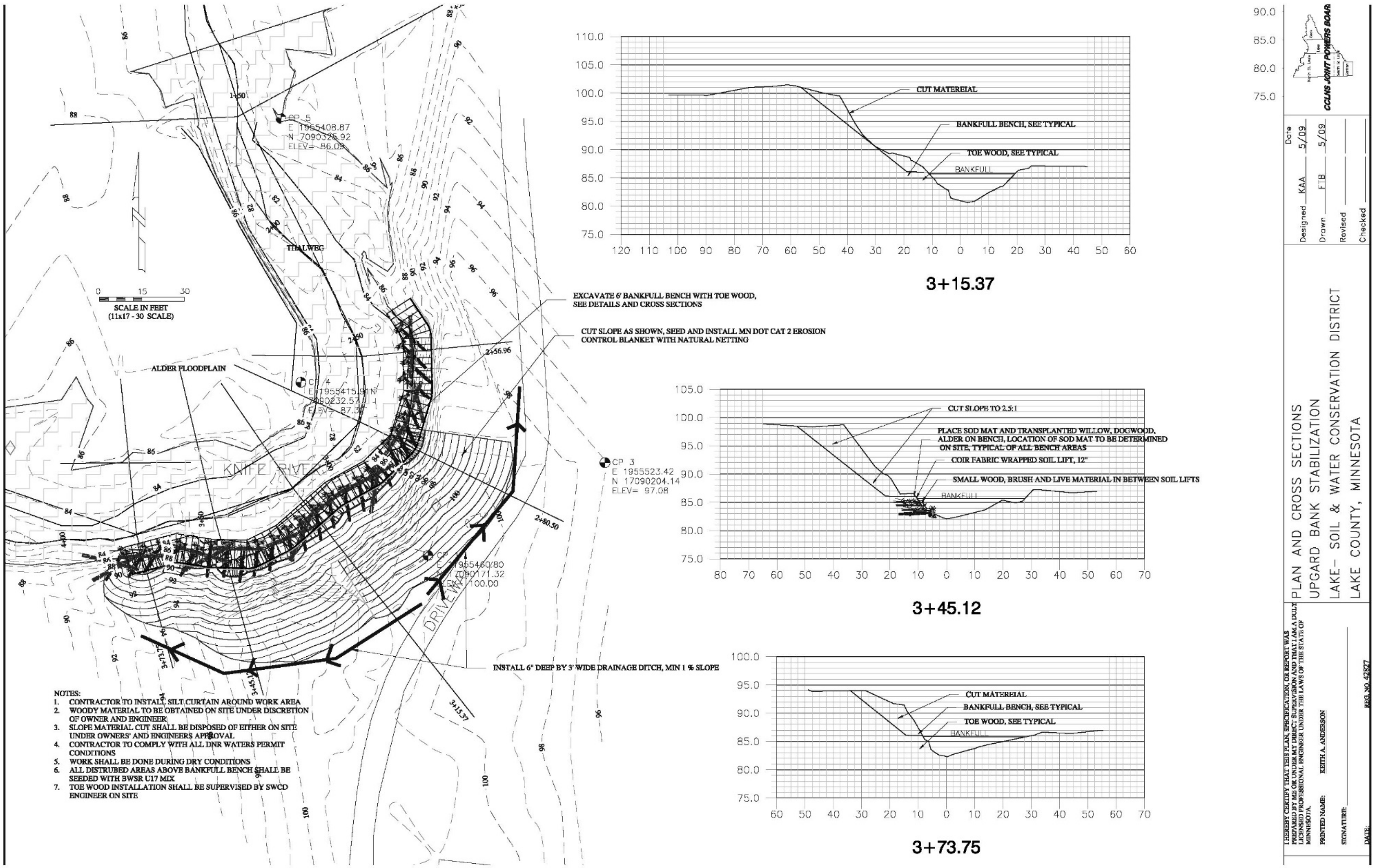


Figure 4-1 Select, construction plan sheet of Toe Wood stabilization provided by South St. Louis SWCD.

Table 4-1 Meander Search Species List compiled by Kevin Biehn on 10/1/2019 site visit.

Scientific Name	Common Name	Cover Range	Species Status
Alnus incana	Speckled alder	25-50%	Native
Aster spp.	Aster spp. (possibly purple-stemmed)	0-1%	Native
Cirsium arvense	Canada thistle	0-1%	Invasive
Cornus sericea	Red-osier dogwood	5-25%	Native
Echinacea angustifolia	Purple coneflower	0-1%	Non-native
Equisetum spp.	Horsetail spp.	0-1%	Native
Eutrochium maculatum	Spotted joe-pye weed	0-1%	Native
Geranium maculatum	Wild geranium	0-1%	Native
Heliopsis helianthoides	Smooth oxeye	0-1%	Native
Melilotus spp.	Sweet clover spp.	0-1%	Non-native
Phalaris arundinacea	Reed canary grass	5-25%	Invasive
Rubus spp.	Raspberry spp.	5-25%	Native
Rudbeckia hirta	Black-eyed Susan	0-1%	Native
Salix interior	Sandbar willow	1-5%	Native
Solidago spp.	Goldenrod spp.	1-5%	Native
Sorghastrum nutans	Indian grass	0-1%	Native
Spiraea alba	White meadowsweet	0-1%	Native
Symphoricarpos albus	Snowberry	0-1%	Native
Symphyotrichum laeve	Smooth blue aster	0-1%	Native
Tanacetum vulgare	Common tansy	1-5%	Invasive

Appendix B: Revisit Site Photographs

Photo 4-1 Pre-project image of Toewood Stabilization site looking upstream (north). South St Louis SWCD, 2008.

Photo 4-2 Representative image of Toewood stabilization. Photograph taken looking upstream at a period of high (near bankfull) river stage; Toewood installation is on right stream bank. Photograph taken by Kevin Biehn during 10/1/2019 site visit.

Photo 4-3 Representative image of Toewood stabilization. Photograph taken looking downstream at a period of high (near bankfull) river stage; Toewood installation is on the near bank. Photograph taken by Kevin Biehn during 10/1/2019 site visit.

Photo 4-4 Minor instability immediately downstream of the terminus of the Toe Wood installation.

Appendix C: Initial Project Evaluation

*Fields in original evaluation form may vary. Information was translated to newest version as applicable.

Project Background

Project Name: Knife River Stabilization Project

Project Location: Lake County

Township/Range Section: Township 53N Range 11W Section 33

Project Manager / Affiliated Organization: Kate Kubiak, South St. Louis County SWCD

Fund: CWF ***Fiscal Year Funds:*** 2010

Project Start Date: 2011

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

16. ***What are the specific project components and treatments?***
    - Question not a part of prior evaluation or not addressed by previous reviewers -

17. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
    - Question not a part of prior evaluation or not addressed by previous reviewers -

18. ***What are the stated goals of the project?***
    - Address eroding clay banks at the site and stop contribution of sediment to river;
    - Address eroding clay stream banks that are contribution to sediment in the stream

19. ***What are the desired outcomes of achieving the stated goals of the project?***
    Reduction/elimination of in bank erosion at the site; Quantifiable objectives of the restoration banks are no longer eroding

20. ***Were measures of restoration success identified in plans? Choose an item.***
    If yes, list specific measurements.
    - Question not a part of prior evaluation or not addressed by previous reviewers -

21. ***Are plan Sets available?*** Choose an item. ***Have project maps been created?*** Choose an item.
    If yes, provide in Appendix A and list Maps provided:
    - Question not a part of prior evaluation or not addressed by previous reviewers -

22. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
    - Question not a part of prior evaluation or not addressed by previous reviewers -

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

23. ***Were alterations made to the plan during project implementation?***
    No
    The finished product seem to concur with the plan-view design provided

24. ***In what ways did alterations change the proposed project outcome?***
    - Question not a part of prior evaluation or not addressed by previous reviewers -

Site Assessment

Field Review Date: 8/24/2012

Field Visit Attendees: Reviewers: Kelly McQuiston (MN DNR-Fisheries), Jason Butcher (Superior National Forest), Wade Johnson (MN DNR-EWR) - Project managers: Kate Kubiak (South St Louis Soil and Water Conservation District)

25. ***Surrounding Landscape Characteristics:***
    - Question not a part of prior evaluation or not addressed by previous reviewers -

26. ***Site Characteristics:***
    a. ***Soils:***
        - mixed till with clay;
        - clay with gravel
    b. ***Topography:***
        Alluvial valley
    c. ***Hydrology:***
        - North Shore stream, snowmelt dominated, slightly above base flow conditions at time of site visit; after a 500yr flood event in mid-summer '12;
        - Low water at the time of inspection, 50 to 100 year flood event happened two months prior
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
        - Floodplain species- alder/ash/spruce in riparian areas; Aspen/birch/balsam/spruce in uplands; high outside bank was vegetated with grasses with very little woody vegetation
        - No invasives noted. Upland banks grasses and brush, alder, sedge and grasses in the transplanted shoreline. Native tree cover on the opposite shoreline

   - High outside bank was vegetated with grasses with very little woody vegetation; inside bank alder dominated -- Forested on the right bank, tall grasses and trees on the left bank riparian area

   e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
   - Question not a part of prior evaluations or not address by prior evaluators -

27. ***Is the plan based on current science?*** Yes
    Use of a bankfull bench at toe of the high bank; stabilized with alder clumps rood wads and plantings. Used natural vegetation and bank sloping rather than rip-rap.

28. ***List indicators of project goals at this stage of project:***
    - Project was under extreme flood conditions shortly after completion and remains intact. Some erosion from nearby upstream and downstream banks has occurred in untreated areas; it is possible that this may have been minimized by extending the project and tying it into natural floodplain upstream and downstream; however it is also possible that the large flood event had a substantial effect on adjacent untreated areas.
    - Banks at the site are no longer eroding, banks downstream do have a little erosion unknown if that was the case before the project or was the result of the record flooding. For the project to remain intact during a record flood event lends to the sound science the project was based upon.

29. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    - Yes
    - Yes. A more concise plan would have eased the evaluation, possibly some pictures before the project, as I was not familiar with the site conditions then.

30. ***Are corrections or modifications needed to achieve proposed goals?***
    - Yes - Make them measureable. Erosion is often ranked based on a Rosgen bank Erosion hazard index (BEHI) rating. Characteristics of this BEHI rating include bank height, root depth, root density, bank angle, and surface protection.

31. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    No

32. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No

33. ***Are follow-up assessments needed? Explain.***
    No. Although Project manager or land owner should keep an eye on erosion if this is indeed a post flood occurrence to make sure it does not impact the project area

34. ***Additional comments on the restoration project.***
    According the CWL rules a CWL sign should have been posted on site.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

35. ***The project has:***
    achieved the stated goals.

36.
    a. ***The project will:*** (question does not appear on initial evaluation form)
        Choose an item.
    a. ***Confidence of outcome determination:***
        High

37. ***Provide explanation of reason(s) for determination.***
    - This project appears to have been built according to design and appears intact after a major flood event. Using natural material and design will allow the stream to adjust overtime while maintaining the integrity of the bank.
    - The modification survived a major flood event, after relatively new construction, it should last a long time and become more stable as the shoreline plants root systems develop.

38. ***Site Assessor(s) Conducting Review:***
    Jason T. Butcher, Superior National Forest

Site Photographs

Photo 4-5 Eroding bank 04/12/2011 increasing sediment load and threatening access road and structure above. Photo South St Louis SWCD.

Photo 4-6 Toewood completed 09/13/2011. Top layer of toewood is live sod mats from nearby patches of Willow, Dogwood and Alder. Photo South St Louis SWCD.

Photo 4-7 Toewood rootwads and vegetation growth, facing downstream during low water conditions. Site visit 08/24/2012.

Photo 4-8 Toewood rootwads and first year's vegetation growth on slope. Facing upstream during low water conditions. Site visit 08/24/2012.

5) Knife River Bank Stabilization (Revisit)

Legacy Fund Restoration Evaluations

See Appendix C for Project Background and Initial Project Evaluation

Project Name: Knife River Bank Stabilization Project

Project Manager / Affiliated Organization:

Lake County Soil and Water Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2012

County: Lake County

Primary Activity: Stream/River Restoration

Project Size: 1000 linear feet

Project Completed: 2015

Revisit Site Assessment

Field Review Date: 10/1/2019

Field Visit Attendees: *Karen Tucker–Lake Co SWCD; Ann Thompson –South St. Louis SWCD; Karl Koller–MnDNR; Wade Johnson–MnDNR; Gina Quiram; Cory Goldsworthy–MnDNR; Dean Paron–MnDNR; Jeff Hrubes–BWSR; Erin Loeffler–BWSR; Keith Anderson–Northeast SWCD Technical Services; and Kevin Biehn-EOR*

1. ***What are the stated goals of the project?***
   Reduce sediment loading and improve trout habitat on the Knife River, a river that is listed as impaired for excess turbidity by the MPCA.

2. ***What are the desired outcomes of achieving the stated goals of the project?***
   Excerpt from Original CWF Abstract:

   This project will restore two severely eroding streambank sites on the Knife River, a river that is listed as impaired for excess turbidity by the Minnesota Pollution Control Agency. Combined, the two sites are 1,000 feet in length with 50 to 70-foot high clay banks. Annually, the sites generate 697 pounds of phosphorus and contribute 606 tons of sediment to the TMDL turbidity impairment. With an average annual sediment delivery amount of 3,630 tons for the Knife River, stabilizing these sites will reduce the sediment load by approximately 17 percent.

Hydrology: Maintain current hydrology (duration, magnitude, and timing of flows); improve baseflow conditions for trout;

Geomorphology: Restore the appropriate channel form (dimension, pattern, and profile) to create a stable channel (neither aggrading nor degrading, while maintaining its form); provide a diversity of habitat and cover;

Connectivity: Restore appropriate connectivity to the floodplain and improve vertical connectivity of stream to groundwater; Re-establish the riparian zone where needed;

Water Quality: Reduce sediment input by minimizing stream bank erosion (a reduction of 574 tons per year);

Improve water temperatures through shading, improved baseflow and narrowing of the channel width;

Biology: Increase the amount and quality of habitat and cover for all life stages of trout and other aquatic organisms; improve temperature and water quality for trout;

3. ***Please note any substantive changes to the site characteristics since last site assessment.***
   Per anecdotal stakeholder input, portions of the project have been rebuilt and additional vegetation inputs have occurred since the initial 2015 construction. The changes, which include but may not be limited to grade control structure adjustments (geometry modifications and additional rock), were in response to observed failures or potential instabilities. Plans/records of these changes are not available or have not been made available to the evaluator.
4. ***Is the plan based on current science?***
   Yes
   Natural Channel Design (NCD) methodology was implemented to inform analysis and design. NCD is a practice that works to emulate a natural system by using dimension, pattern, and profile measurements from a stable "reference" reach. The practices employed, such as Toe-wood, are common practices used in stream restoration/stabilization in Minnesota and suitable to "North Shore" streams
5. ***List indicators of project goals at this stage of the project.***
   Given the cursory nature of these evaluations, the complexity of stream restoration, and the very recent and substantial repairs to this project, it is not prudent to confidently or accurately predict outcomes at this time. Furthermore, the stream was at or near bankfull discharge during the evaluation – a coincidence that both limited the evaluation (physically and visually obstructed) and provided a testing opportunity for the project. Therefore, these limited indicators were available at the time of the evaluation:
   - Connectivity: near bankfull event had accessed a portion of the floodplain;
   - Water Quality: relocation of stream away from high, unstable banks will decrease sediment contribution;
   - Biology: the addition of wood, large rock and pool forming/holding structures should increase the amount and quality of habitat and cover for trout and other aquatic organisms
6. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project outcomes?***
   The design and executed project can reasonably address the core hydrology, geomorphology, connectivity, water quality, and biology criteria. The intended long-term monitoring program express by stakeholders should be sufficient in documenting success and any shortcomings.
7. ***Are corrections or modifications needed to meet proposed outcomes?***

No warranted corrections or modifications are apparent.

8. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
   Project partners are continuing to maintain and bolster vegetation establishment to provide further stability and ecological value.
9. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
   No detractors to habitat are apparent to the evaluators per the cursory review.
10. ***Are follow-up assessments needed? Explain.***
    Yes, a follow up assessment(s) is warranted given the considerable local and State-wide interest in this project. Thus, there is value in reevaluating this project in 3-5 years.
11. ***Additional comments on the restoration project.***
    Establishing vegetation on these bluffs on the north shore has been problematic to date. Many projects, such as this one, have limited or eliminated vegetation inputs on the bluff itself, as vegetation establishment on the extreme conditions as proved to be exceptionally challenging. The resulting/remaining unvegetated bluff may appear alarming, but this project and others have dramatically reduced sediment yields by relocating the stream thalweg and actively eroding toe away from the bluff and creating a bench to capture sedimentation from the bluff (see Photo 5-2). Discrete areas of concentrated surface flow, when they occur on the bluff (see Photo 5-3), should be the focus of vegetation and erosion control inputs where needed. The example in photo 5-3 was addressed in the initial project design with a small vegetated settling basin.

Revisit Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

12. ***The project has:***
    achieved the stated goals.
13. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium
14. ***Provide explanation of reason(s) for determination.***
    The project has been in place for 4 years and experienced multiple floods and channel forming flows during that period, with only a minor adjustment within the first year of completion. The goal of reducing sediment input from the large slumping bank has been achieved, most objectives have been met and the project is on a positive trajectory.
15. ***Site Assessor(s) Conducting Review:***
    Kevin Biehn-EOR

Appendix A: Revisit Site maps, Project plans or Vegetation tables

Table 5-1 Meander Search Species List compiled by Kevin Biehn on 10/1/2019 site visit.

Scientific Name	Common Name	Cover Range	Species Status
Acer rubra	Red maple	0-1%	Native
Alnus incana	Speckled alder	5-25%	Native
Andropogon gerardii	Big bluestem	1-5%	Native
Cornus sericea	Red-osier dogwood	1-5%	Native
Elymus canadensis	Canada wild rye	1-5%	Native
Equisetum spp.	Horsetail spp.	5-25%	Native
Eutrochium maculatum	Spotted Joe-pye weed	0-1%	Native
Glyceria canadensis	Rattlesnake manna grass	1-5%	Native
Lycopus spp.	Bugleweed spp.	0-1%	Native
Phalaris arundinacea	Reed canary grass	5-25%	Invasive
Pinus strobus	White pine	1-5%	Native
Plantago spp.	Plantain spp.	5-25%	Unknown
Salix interior	Sandbar willow	1-5%	Native
Salix spp.	Willow spp. (possibly autumn)	5-25%	Native
Scirpus spp.	Woolgrass spp.	1-5%	Native
Solidago spp.	Goldenrod spp.	5-25%	Native
Spartina pectinate	Prairie cordgrass	1-5%	Native
Symphyotrichum puniceum	Purple-stemmed aster	0-1%	Native
Tanacetum vulgare	Common tansy	5-25%	Invasive
Thuju occidentalis	White cedar	1-5%	Native
Trifolium repens	White clover	5-25%	Non-Native
Verbena hastata	Blue vervain	1-5%	Native
Viburnum opulus var. americanum	American highbush cranberry	1-5%	Native

Appendix B: Revisit Site Photographs

Photo 5-1 Pre project view of the project site July 10, 2012. Slumping and mass wasting of the large clay bank was contributing significant sediment loads to the Knife River.

Photo 5-2 View of the project site with installed bankfull bench, July 10, 2018, two and a half years after installation.

Photo 5-3 Panoramic of project from upstream end of the project, with bluff in question on the left. Photograph taken by Kevin Biehn on 10/1/2019 site evaluation.

Photo 5-4 Represenative image of created floodplain bench (1) and bluff (2) the river was actively moved away from. Photograph taken by Kevin Biehn on 10/1/2019 site evaluation.

Photo 5-5 Representative image of concentrated runoff within the project reach following a previous day storm, which is yielding sediment to the Knife River. Photograph taken by Kevin Biehn on 10/1/2019 site visit.

Appendix C: Initial Project Evaluation

*Fields in original evaluation form may vary. Information was translated to newest version as applicable.

Project Background

Project Name: Knife River Bank Stabilization Project

Project Location: Lake County

Township/Range Section: T52N R10W Sec 19

Project Manager / Affiliated Organization: Lake County Soil and Water Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2012

Project Start Date: 2015

Predominant Habitat type: Forest

Additional Habitat types: Aquatic , Choose an item.

Project Status: Establishment Phase

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

16. ***What are the specific project components and treatments?***

    Bluff stabilization via channel alignment alteration and the introduction of toe wood and instream structures.

17. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
    Environmental Assessment Worksheet (2/2015); Construction Plan Set (4/2015); Cultural Resource Reconnaissance Survey (6/2015); As-Built Plan & Profile (9/21/2015) and Project Overview (dated 9/2015).

18. ***What are the stated goals of the project?***
    Excerpt from Original CWF Abstract:

    > This project will restore two severely eroding streambank sites on the Knife River, a river that is listed as impaired for excess turbidity by the MPCA. Combined, the two sites are 1,000 feet in length with 50 to 70-foot high clay banks. Annually, the sites generate 697 pounds of phosphorus and contribute 606 tons of sediment to the TMDL turbidity impairment. With an average annual sediment delivery amount of 3,630 tons for the Knife River, stabilizing these sites will reduce the sediment load by approximately 17 percent.

Hydrology: maintain current hydrology (duration, magnitude, and timing of flows); improve baseflow conditions for trout

Geomorphology: restore the appropriate channel form (dimension, pattern, and profile) to create a stable channel (neither aggrading nor degrading, while maintaining its form); provide a diversity of habitat and cover

Connectivity: restore appropriate connectivity to the floodplain and improve vertical connectivity of stream to groundwater; re-establish the riparian zone where needed

Water Quality: reduce sediment input by minimizing stream bank erosion (a reduction of 574 tons per year); improve water temperatures through shading, improved baseflow and narrowing of the channel width;

Biology: Increase the amount and quality of habitat and cover for all life stages of trout and other aquatic organisms; improve temperature and water quality for trout.

19. What are the desired outcomes of achieving the stated goals of the project?

- Question not previously addressed -

20. Were measures of restoration success identified in plans? Yes
If yes, list specific measurements.

From a stand point of evaluating the project & stream health project managers intend to execute a monitoring plan. The following is an excerpt of the provided plan:

> The completed stabilization reach will be inspected for structural and vegetative components at the end of the first year and every three years thereafter throughout the duration of the effective life. The goal is to create a project that does not need maintenance and will work with river dynamics and sediment transport in a way that the solutions are long term and sustainable. Lake SWCD will establish permanent cross-sections that will be marked and re-surveyed in the future to ensure the stream channel remains stable and to estimate erosion rates. Bank Erosion Hazard Index (BEHI) and Near Bank Shear Stress (NBSS) assessments have been performed and will continue to be assessed after restoration is complete to determine erosion rates and amounts of sediment entering the river.
>
> The comprehensive inspection schedule and protocol is intended to more thoroughly evaluate the long-term effectiveness of the channel modifications for North Shore streams. The overall success of the project will be formally assessed by the TSA 3 conservation engineer.

21. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No
If yes, provide in Appendix A and list Maps provided:
Figure 5-1 - Project Overview from construction plan set (sheet 2 of 15)
Figure 5-2 - Representative Bank Stabilization Profile (Sheet 5 of 12)
Figure 5-3 - As-Built Plan
Figure 5-4 - As-Built Profile
Figure 5-5 - Representative image of stabilization (bankfull bench)
Figure 5-6 - Representative image of stabilization (bluff)

22. Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?

1. Natural Channel Design (NCD) methodology was reportedly implemented to inform analysis & design. NCD is a standard industry methodology for stream restoration, most associated with Wildland Hydrology Consultants and Dave Rosgen.
2. The practices employed, such as Toe-wood, are common practices used in stream restoration/stabilization in Minnesota and suitable to "North Shore" streams.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

23. ***Were alterations made to the plan during project implementation?***
    No
    Click here to enter text.
24. ***In what ways did alterations change the proposed project outcome?***
    N/A

Site Assessment

Field Review Date: 9/24/2015

Field Visit Attendees: Kevin Biehn – EOR Wade Johnson – MnDNR. Other attendees not recorded.

25. ***Surrounding Landscape Characteristics:***

    Current land use is privately owned, undeveloped forest land. Private homes are present on each of the three parcels of land. The dwellings are outside of the construction limits. Future land use will be preservation and recreation.

    Land type of the project area is Laurentian Mixed Forest. Vegetation at the project site consists of hardwood trees and conifers. Riparian vegetation is made up of grasses, sedges, willow and alder. The

    Knife River is a designated trout stream. Brook trout and steelhead yearling are present in this reach as well as creek chub, blacknose dace, and redbelly dace. Beaver, deer, reptiles and amphibians are common in the stream corridor.

    The Natural Heritage Review determined that the entire project site is within an area the Minnesota

    Biological Survey (MBS) has identified as a Site of Moderate Biodiversity Significance. This means that the site contains occurrences of rare species and/or moderately disturbed native plan communities, and/or landscapes that have a strong potential for recovery.

26. ***Site Characteristics:***
    - ***f. Soils:***
      The unstable clay bank in question is primarily a Miskoaki-Cuttre complex 5-45 percent slope, 25 percent area; 60% Firm clay till, well drained, HSG =D, less than 5% organic matter 30% Firm clay till, very poorly drained HSG =D, less than 5% organic matter 10% Firm clay till, moderately well drained HSG =D, less than 5% organic matter Increasing clay with depth, 15% sand
    - ***g. Topography:***
      High gradient stream

h. ***Hydrology:***
Stream flow is flashy due to prevalence of tight soils, shallow depth to bedrock and steep topography

i. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
The following vegetation establishment measures were completed prior to the evaluation: Native seeding (three custom native mixes with cover crop), via hydroseeding and live staking of Black Willow and Willow spp. cuttings. Additional specified plantings are scheduled for 2016. Overall, it is too soon after installation and late in the year to estimate survivorship and vegetation establishment. Project managers should monitor plant establishment throughout 2016 & 2017, paying particular attention to project & site challenges, such as: harvest and transplanting of material outside of dormancy and the general difficulty of establishing cover on the bankfull bench (rocky, low-organic soils) as well as the bluff (red clay slopes exceeding 1H:1V, with compounding failure mechanisms).

j. ***Vegetation B: Meander Search Species List (as appropriate for site)***
- Question not previously addressed -

27. ***Is the plan based on current science?*** Yes
Click here to enter text.

28. List indicators of project goals at this stage of project:
Summary: It is too early to confidently predict outcomes at this time (see #33 below). Furthermore the stream was at or near bankfull discharge during the evaluation – a coincidence that both limited the evaluation (physically & visually obstructed) and provided a testing opportunity for the project. Therefore, these limited indicators were available at the time of the evaluation:

- Connectivity: near bankfull event had accessed a portion of the floodplain;
- Water Quality: relocation of stream away from bluff should decrease sediment contribution;
- Biology: the addition of wood, large rock and pool forming/holding structures should increase the amount and quality of habitat and cover for trout and other aquatic organisms.

29. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?
The design and executed project can reasonably address the core hydrology, geomorphology, connectivity, water quality, and biology criteria. The intended long-term monitoring should be sufficient and documenting success and any shortcomings.

30. Are corrections or modifications needed to achieve proposed goals?
No warranted corrections/modifications apparent this early in the establishment phase.

31. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?
No foreseeable issues with the core project.

32. Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.
No long-term detraction apparent.

33. Are follow-up assessments needed? Explain.

Yes – there would be significant value in reevaluating this project in 3-5 years. This evaluation was completed within 3± weeks of substantial completion, when vegetation inputs were not fully completed and temporary and permanent vegetation had yet to establish. A follow up evaluation after vegetation has established and the project has experienced ≥ 2 channel forming discharges will be more telling of probable outcome, especially if the monitoring plan is executed as planned (see #20 above).

34. Additional comments on the restoration project.

Establishing permanent and desirable vegetative cover on North Shore red clay bluffs via seeding and/or planting has posed to be challenging. The more successful and cost-effective attempts in providing stability have resulted from investment in providing a stable bluff toe (as this project addresses) along with vegetative inputs or allowing the bluff to naturally colonize (albeit a slow process).

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

35. The project has:

Choose an item.

36. The project will:

Minimally meet proposed outcomes

Confidence of outcome determination:

Medium

37. Provide explanation of reason(s) for determination.

Given that the project is in the very early stages of establishment, reviewer evaluation is conservative. The designed and executed project has indicators of success, but it is premature to determine whether goals have been met.

38. Site Assessor(s) Conducting Review:

Kevin Biehn, Consultant, Emmons & Olivier Resources, Inc. on 9/24/2015.

Site Maps

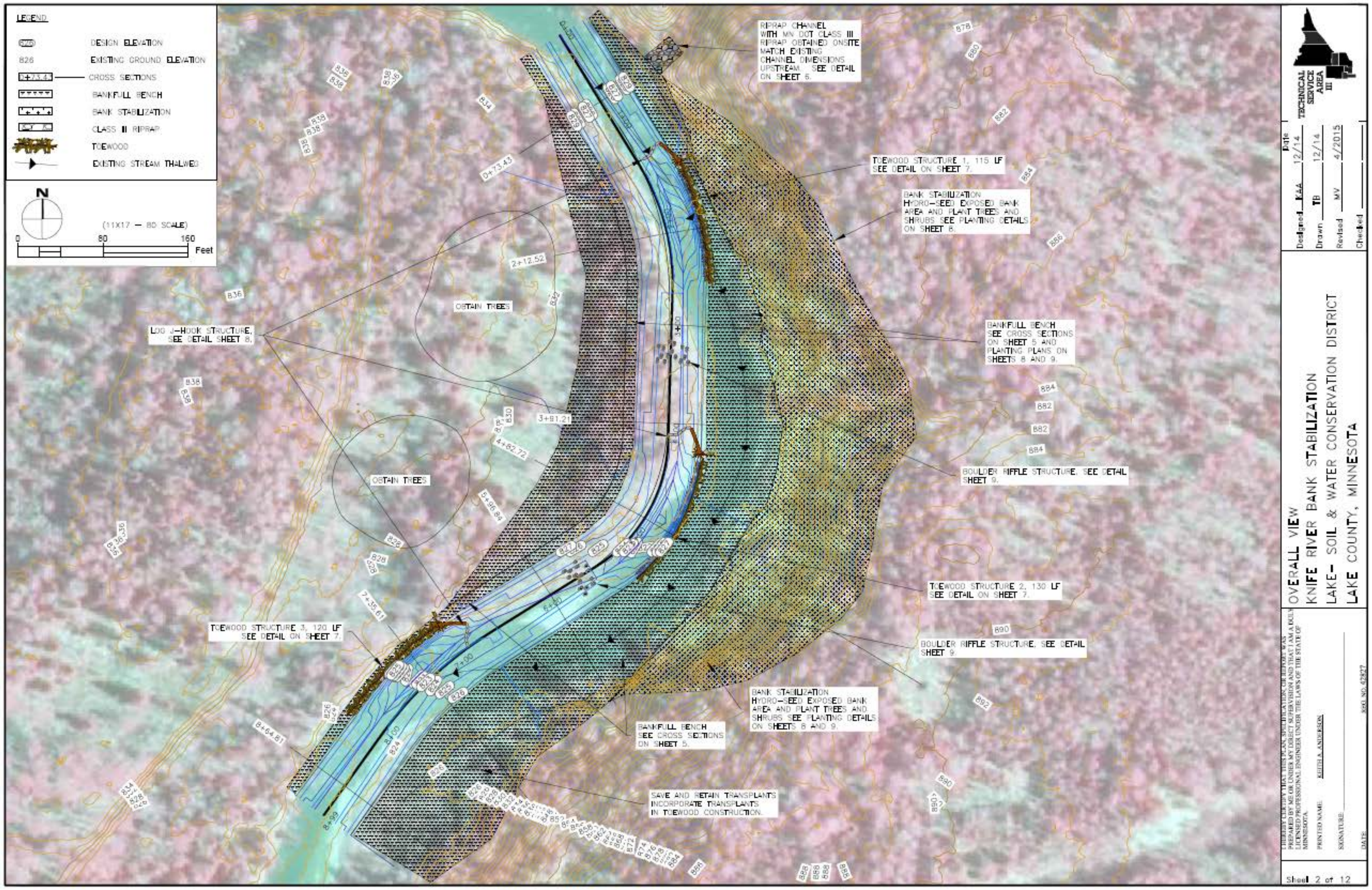


Figure 5-1 - Project Overview from construction plan set (sheet 2 of 12)

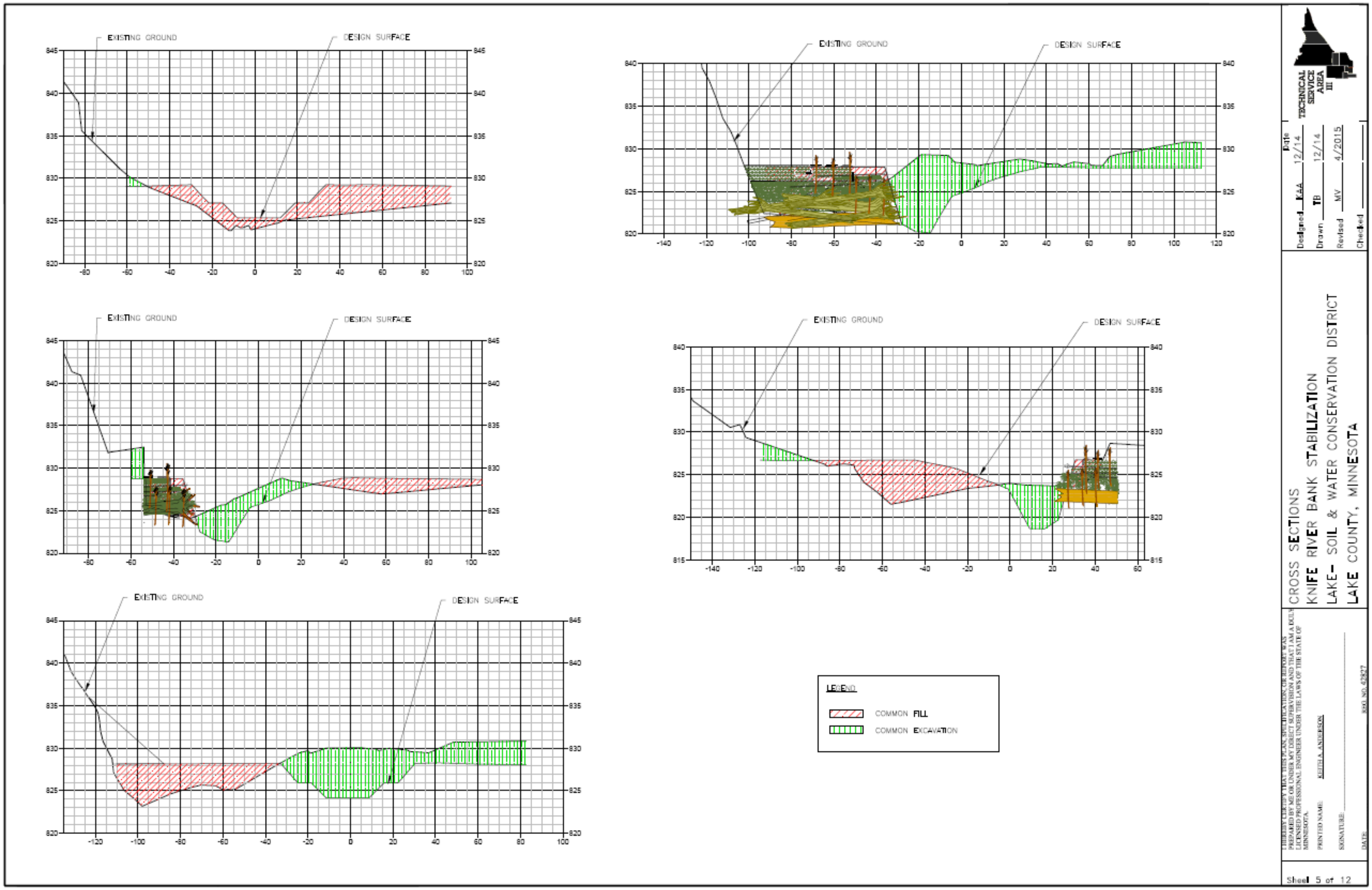


Figure 5-2 - Representative Bank Stabilization Profile (Sheet 5 of 12)

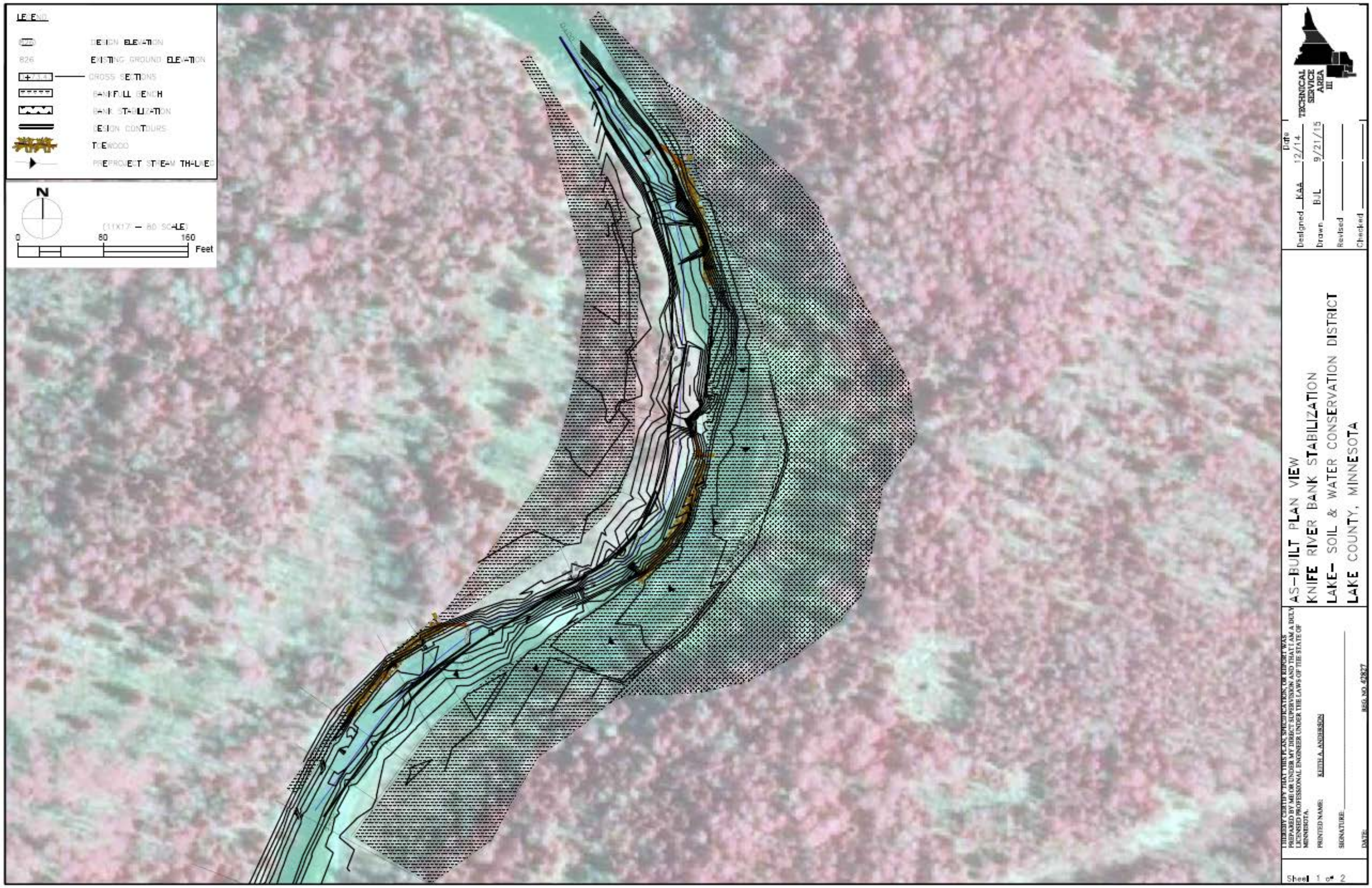


Figure 5-3 - As-Built Plan

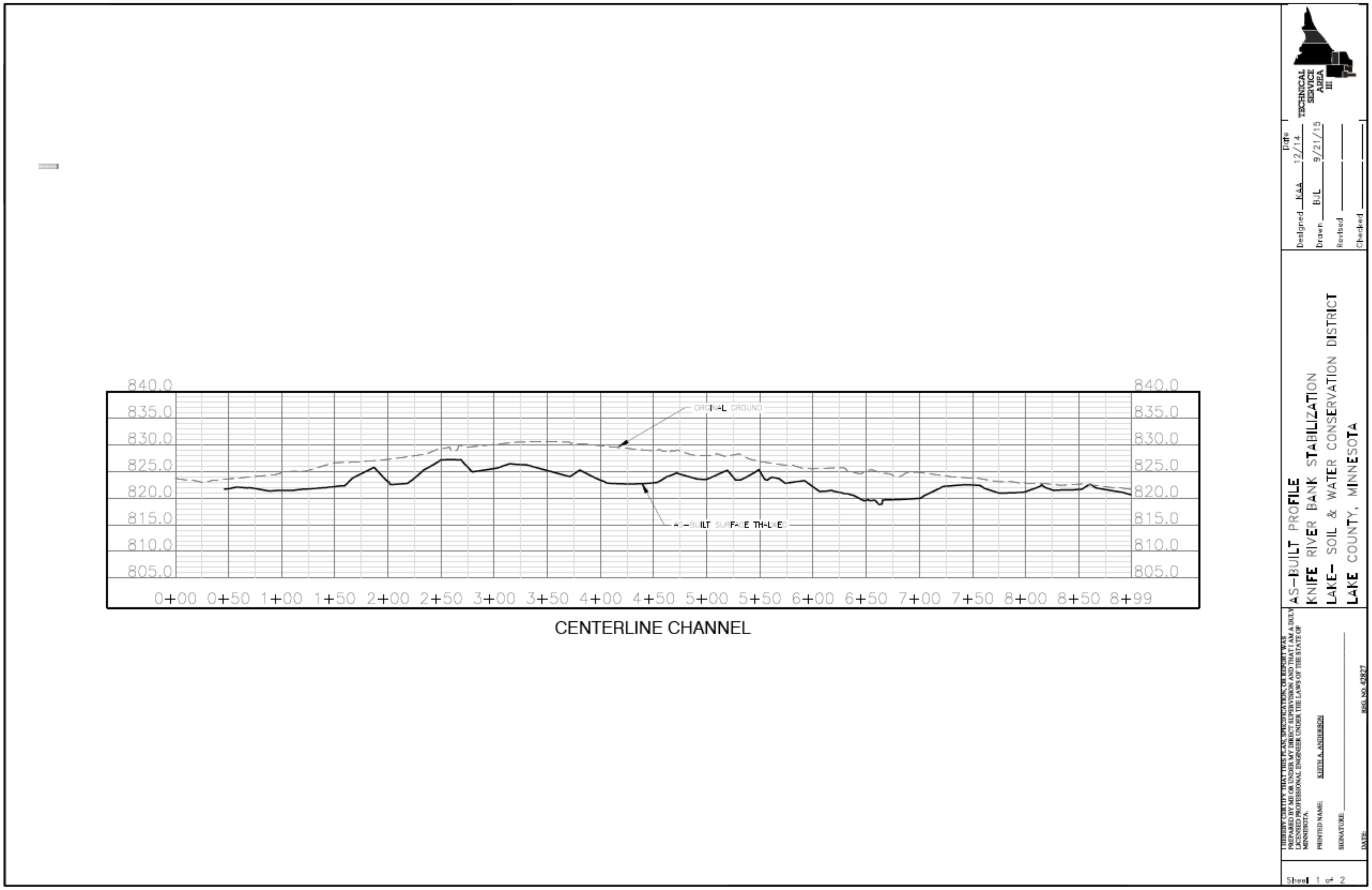


Figure 5-4 - As-Built Profile

Site Photographs

Figure 5-5 - Representative image of stabilization (bankfull bench). As illustrated in the photograph the created bankfull bench was appropriately being accessed (over-topped) by a near bankfull flow event. Date 09/24/2015.

Figure 5-6 - Representative image of stabilization (bluff). As visible in photograph, the attempt to establish vegetated cover on the clay bluff in question (right side of image) via hydroseeding is showing early signs of failure. It is acknowledged though that the primary project means for reducing sediment from the bluff is the realignment of the stream away from the bluff and the creation of a stable bluff toe and associated bankfull bench. Date 09/24/2015.

6) Lambert Creek Kohler Enhancement

Project Background

Project Name: Lambert Creek Koehler Rd Stream Bank Restoration

Project Site: Ramsey County

Township/Range Section: Township 30N Range 22W Section 21-22

Project Manager / Affiliated Organization Ann WhiteEagle / Ramsey Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2015

Project Start Date: 3/2015

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest

Project Status: Post Establishment Phase

County: Ramsey County

Primary Activity: Stream/River Enhancement

Project Size: 210 lin ft

Project Completed: 12/2018

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   - Clearing of most vegetation
   - Installing of soil lifts via the utilization of coir block products
   - Installation of turf reinforcement mat (TRM) and erosion control blanket
   - Native seeding, native planting and live staking
   - Installation of a drop structure and associated storm sewer to stabilize a problematic instability caused by local runoff

2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Lambert Creek Stabilization. Construction plan set authored by Ramsey Conservation District in Partnership with Vadnais Lake Area Watershed Management Organization. 7.26.2016.

3. ***What are the stated goals of the project?***

   The goals of the project where to reduce sediment and phosphorus loading to the creek and to improve habitat value.

4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Lambert Creek is of great significance being a contributor to East Vadnais Lake, a drinking water supply for thirteen municipalities. Lambert Creek is listed as impaired for fecal coliform and it has levels of total phosphorus above the state standard. The desired outcomes of stabilizing the stream banks are a reduction in bank erosion and nutrient loading into Lambert Creek.

5. ***Were measures of restoration success identified in plans?*** Yes
   If yes, list specific measurements.
   BWSR grant application stated reductions in phosphorus (TP) and sediment (TSS) discharges by 8.04 lb/yr and 9.46 tons/yr respectively.

6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   Sheets L1.01 and L1.09 (pages 2 and 10 of 11) from the aforementioned 7.26.2016 plan set are included in Appendix A

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   The streambank stabilization means and measures employed (see below) are commonly used in urban stream restoration projects.
   - Clearing of most vegetation (invasive species removal and construction preparation)
   - Installing of soil lifts via the utilization of coir block products
   - Installation of turf reinforcement mat (TRM) and erosion control blanket
   - Native seeding, native planting and live staking
   - Installation of a drop structure and associated storm sewer to stabilize a problematic instability caused by local runoff

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No

9. ***In what ways did alterations change the proposed project outcome?***
   N/A

Site Assessment

Field Review Date: 9/11/2019

Field Visit Attendees: Michael Schumann–Ramsey County; Stephanie McNamara–VLAWMO; Dawn Tanner–VLAWMO; Wade Johnson–MnDNR and Kevin Biehn-EOR

10. ***Surrounding Landscape Characteristics:***

The project site is located on Lambert Creek just south of the Koehler Street crossing in the City of Vadnais Heights, MN. Vadnais Heights is in the north central metropolitan area 10 miles due north of St. Paul. The western reach of Lambert Creek, where the project is located, is situated in a suburban neighborhood and its riparian corridor is characterized by steep banks overgrown with a mix native and invasive shrubs and vines along with a broken canopy of native deciduous trees.

11. ***Site Characteristics:***
    a. ***Soil Series:***
    Soils at this location are composed of Dundas and Nessel fine sandy loams. Both soils are formed from till. Nessel, which makes up a majority of the site, is a well-drained soil with a moderately high infiltration rate typical or moraine plains. Dundas is hydric soil of moraine drainageways that is poorly drained and has sandy clay loam in lower horizons.
    b. ***Topography:***
    The stream banks are approximately 10-12 feet deep toe to top and moderately steep, 30% to 70% slopes.
    c. ***Hydrology:***
    Lambert Creek is a flowage that drains Goose Lake and Rice Lake into Vadnais Lake. From Vadnais Lake, surface flow is directed south and east via ditches and culverts through Gervais Lake, Phalen Lake and into the Mississippi River via Battle Creek and Pigs Eye Lake. Lambert Creek lies near the top of it's watershed. According to StreamStats approximately 7.5 square miles drains to the project site, and of that area about 70% is classed as urban based on NLCD 2011 classes.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
    The floodplain has been filled and the stream has been straightened for most of its length within the vicinity of the project area. The resulting narrow corridor with steep stream banks make it challenging to establish high quality native vegetation, both pre and post project. Project vegetation inputs and planting/seeding locations can be seen in Appendix A. The Lambert Creek floodplain and flow path have been highly altered and manipulated.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
    See Appendix A for species identified via 9/11/2019 meander search.

12. ***Is the plan based on current science?*** Yes
    Stream bank stabilization via the use of natural fiber coir blocks is a current practice that is based on sound science.

13. ***List indicators of project goals at this stage of project:***
    The project site was stable with no substantial instabilities or bank erosion witnessed during the evaluation.

14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    The project does not reasonably allow for achieving the stated load reductions, as it appears that the pre-project annual loading may have been over predicted. Based on professional judgment and cursory review of pre-project conditions (See Photo 6-1 for reference) an annual phosphorus (TP) reduction of 8.04 lbs and annual sediment (TSS) reduction of 9.46 tons is unlikely from this 210 linear foot stream stabilization project.

15. ***Are corrections or modifications needed to achieving proposed goals?***
    While the project may fall short of achieving load reductions, the shortfall is likely a product of over-predicting pre-project loading based on the BWSR Pollution Reduction Estimator. The site appeared to be mostly stable during the evaluation with no apparent need for further stabilization inputs at this time.   The need for vegetation management was apparent as the current vegetative cover is dominated by invasive species and 'weedy' species.

16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    No future phases/steps are known to the evaluator. As discussed previously vegetation condition is trending in a poor condition and will require maintenance to improve condition. Managers with the Vadnais Lake Area Water Management Organization indicated they plan to bolster vegetation maintenance and invasive control on this site this year and coming years.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    N/A

18. ***Are follow-up assessments needed? Explain.***
    This project is a low priority for follow-up assessment. The project is straightforward and the trajectory is relatively predictable.

19. ***Additional comments on the restoration project.***
    Vegetation management is lacking and warranted. Given the aforementioned site constraints, vegetation management will remain a challenge. Managers from the Vadnais Lake Area Water Management Organization plan to bolster vegetation maintenance and invasive control on this site this year and coming years with the goal of allowing the planted native species to thrive.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    minimally achieved the stated goals.
21. ***The project will:***
    Minimally meet proposed outcomes
    Confidence of outcome determination:
    Medium
22. ***Provide explanation of reason(s) for determination.***

The ‘minimally achieve’ designation is based on the perceived challenge in achieving stated load reduction goals. The current trajectory of the vegetation condition is also challenged by invasive plants that diminish the ability of planted native species persist and thrive.

23. ***Site Assessor(s) Conducting Review:***

    Kevin Biehn – EOR

Appendix A: Site maps, Project plans or Vegetation tables

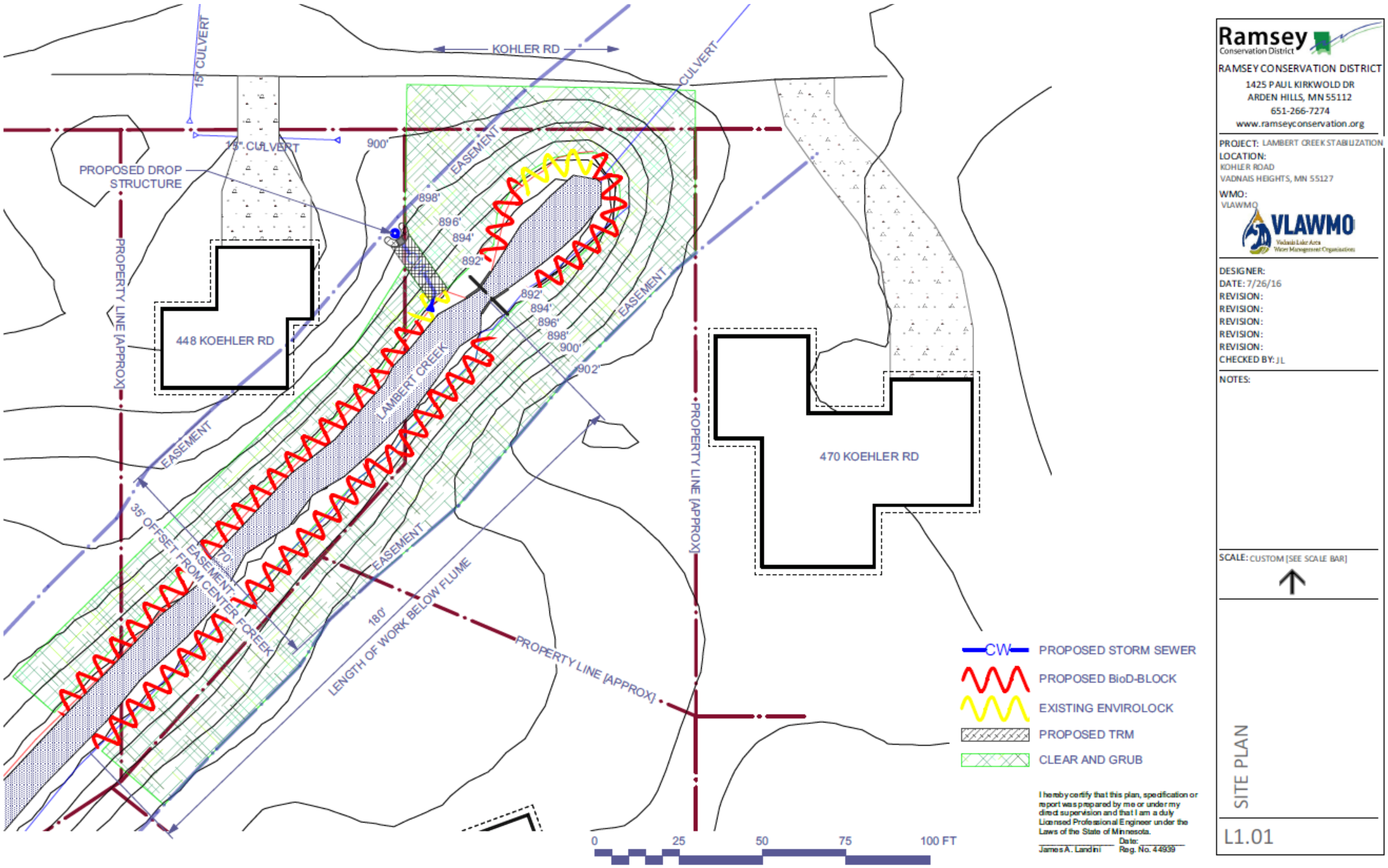
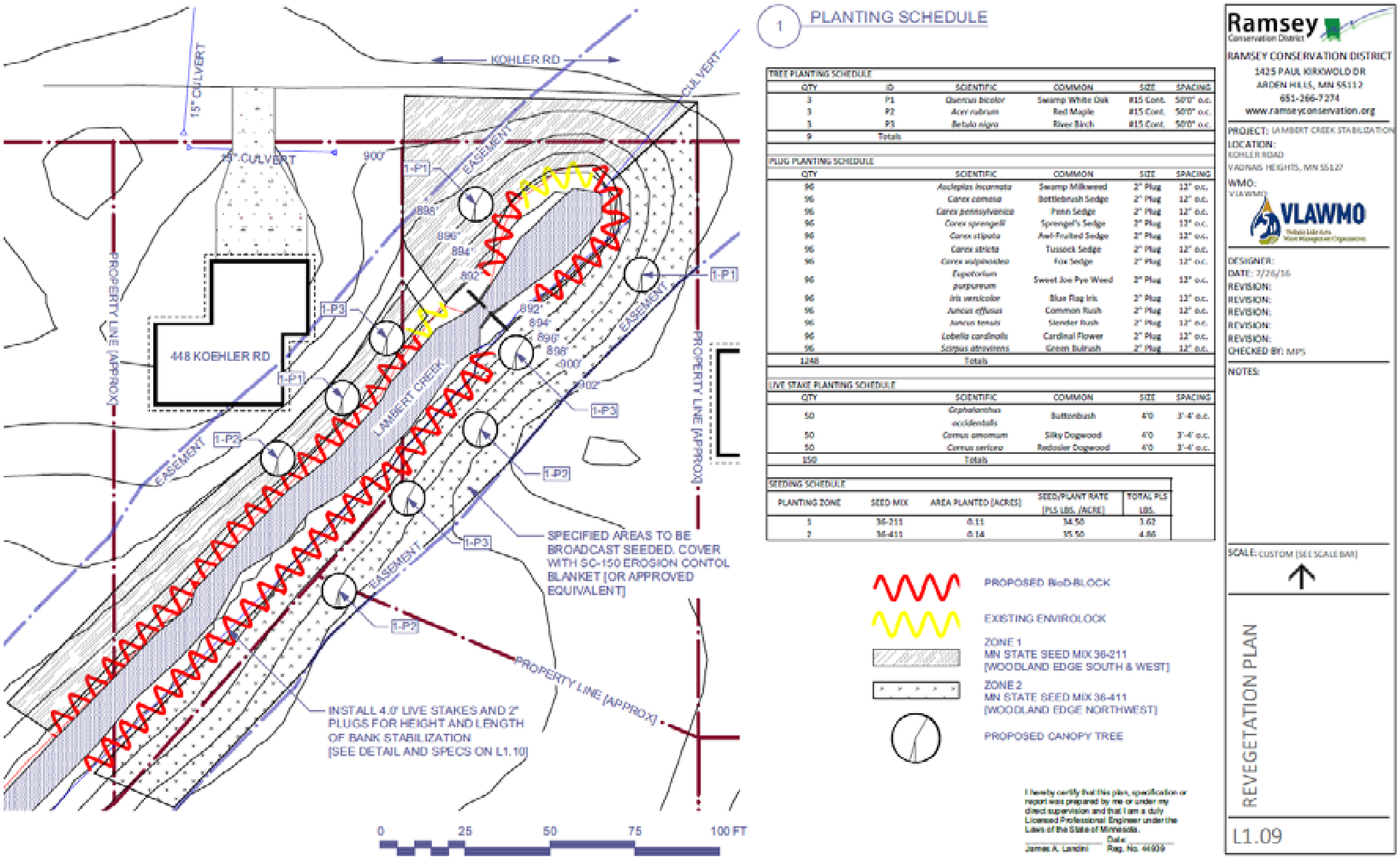


Figure 6-1 – Site Plan (Sheet L1.01) from 7.26.2016 construction plan set.



TREE PLANTING SCHEDULE

QTY	ID	SCIENTIFIC	COMMON	SIZE	SPACING
3	P1	*Quercus bicolor*	Swamp White Oak	#15 Cont.	50'0" o.c.
3	P2	*Acer rubrum*	Red Maple	#15 Cont.	50'0" o.c.
3	P3	*Betula nigra*	River Birch	#15 Cont.	50'0" o.c.
9	Totals				

PLUG PLANTING SCHEDULE

QTY	SCIENTIFIC	COMMON	SIZE	SPACING
96	*Asclepias incarnata*	Swamp Milkweed	2" Plug	12" o.c.
96	*Carex comosa*	Bottlebrush Sedge	2" Plug	12" o.c.
96	*Carex pennsylvanica*	Penn Sedge	2" Plug	12" o.c.
96	*Carex sprengelii*	Sprengel's Sedge	2" Plug	12" o.c.
96	*Carex stipata*	Awl-Fruited Sedge	2" Plug	12" o.c.
96	*Carex stricta*	Tussock Sedge	2" Plug	12" o.c.
96	*Carex vulpinoidea*	Fox Sedge	2" Plug	12" o.c.
96	*Eupatorium purpureum*	Sweet Joe Pye Weed	2" Plug	12" o.c.
96	*Iris versicolor*	Blue Flag Iris	2" Plug	12" o.c.
96	*Juncus effusus*	Common Rush	2" Plug	12" o.c.
96	*Juncus tenuis*	Slender Rush	2" Plug	12" o.c.
96	*Lobelia cardinalis*	Cardinal Flower	2" Plug	12" o.c.
96	*Scirpus atrovirens*	Green Bulrush	2" Plug	12" o.c.
1248	Totals			

LIVE STAKE PLANTING SCHEDULE

QTY	SCIENTIFIC	COMMON	SIZE	SPACING
50	*Cephalanthus occidentalis*	Buttonbush	4'0	3'-4' o.c.
50	*Cornus amomum*	Silky Dogwood	4'0	3'-4' o.c.
50	*Cornus sericea*	Redosier Dogwood	4'0	3'-4' o.c.
150	Totals			

SEEDING SCHEDULE

PLANTING ZONE	SEED MIX	AREA PLANTED [ACRES]	SEED/PLANT RATE [PLS LBS. /ACRE]	TOTAL PLS LBS.
1	36-211	0.11	34.50	3.62
2	36-411	0.14	35.50	4.86

Figure 6-2 Revegetation Plan (Sheet L1.00) from 7.26.2016 construction plan set.

Table 6-1 Meander Search Species List compiled by Kevin Biehn on 9/11/2019.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Acer negundo	Box elder	1-5%		Native
Amphicarpaea bracteata	Hog Peanut	1-5%		Native
Arcitum minus	Common Burdock	25-50%		Invasive
Asteraceae altissima	White Snakeroot	5-25%		Native
Avena sativa	Common oats	5-25%	Yes	Non-Native
Carex pennsylvanica	Penn Sedge	1-5%	Yes	Native
Carex vulpinoidea	Fox Sedge	1-5%	Yes	Native
Cephalanthus occidenatalis	Buttonbush	1-5%	Yes	Native
Cornus sericea	Red-osier Dogwood	1-5%	Yes	Native
Cornus amomun	Silky Dogwood	1-5%	Yes	Native
Echinocystis lobata	Cucumber vine	1-5%		Native
Glechoma hederacea	Creeping Charlie	1-5%		Non-Native
Impatiens capensis	Spotted Touch-me-not	1-5%		Native
Lonicera tatarica	Tatarian Honeysuckle	1-5%		Invasive
Quercus bicolor	Swamp White Oak	1-5%	Yes	Native
Rhamnus cathartica	Common buckthorn	5-25%		Invasive
Rubus occidentalis	Black Raspberry	1-5%		Native
Solidago canadensis	Canada Goldenrod	1-5%		Native
Vitis riparia	Grape Vine	1-5%		Native

Appendix B: Site Photographs

Photo 6-1 Image of project area on Lambert Creek from Koehler Road looking downstream (South). Photograph taken after vegetation clearing was completed, but prior to the start of stabilization measures. Photograph provided by Ramsey County – date unknown. Note: The visible restriction in the photograph is a flume intended to aid in water quality and quantity monitoring. This channel narrowing may have contributed to local stream instability,

Photo 6-2 Image of project area on Lambert Creek from similar perspective as Photo 6-1. Photograph taken during 9/11/2019 site visit.

Photo 6-3 Facing downstream, immediately downstream of flume. Photograph taken by Kevin Biehn during 9/11/2019 site visit

7) Lambert Creek Oakmeade Enhancement

Project Background

Project Name: Lambert Creek Stream Bank Restoration – Oakmede

Project Site: Ramsey County

Township/Range Section: Township 30N Range 22W Section 22

Project Manager / Affiliated Organization Michael Goodnature – Ramsey Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2013

Project Start Date: 2013

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Prairie / Savana / Grassland

Project Status: Post Establishment Phase

County: Ramsey County

Primary Activity: Stream/River Enhancement

Project Size: ~125 lin ft

Project Completed: 2013

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***

   The following is a project page excerpt from the from Minnesota Legacy website: Streambank erosion and degraded buffers are factors that have contributed to the degradation of Lambert Creek and the increase of nutrient loading. Invasive vegetative species, overland flow and steep cut banks has led to erosion. The VLAMWO has completed several ground surveys along the creek to identify degraded streambank and buffer areas for restoration. The section of Lambert Creek that was targeted as a high priority for streambank and buffer restoration is located downstream of one of VLAWMO's permanent water monitoring station and flume. The restoration of this area would include the removal of invasive species, stabilization and native vegetation planting, and redirection of creek flow.

2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Lambert Creek Restoration (construction documents), authored by Vadnais Lake Area Water Management Organization and Ramsey Conservation District, dated 8/17/2019.

3. ***What are the stated goals of the project?***
   Reduce sediment and phosphorus loading to the creek and to improve aquatic habitat.

4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Lambert Creek is of particular significance being a contributor to East Vadnais Lake, a drinking water supply for thirteen municipalities. Lambert Creek is listed as impaired for fecal coliform and it has levels of total phosphorus above the state standard. The desired outcomes of stabilizing the stream banks are a reduction in bank erosion and nutrient loading into Lambert Creek.
5. ***Were measures of restoration success identified in plans?*** No
   If yes, list specific measurements.
   N/A

6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   Select plan sheets included in Appendix A

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   The streambank stabilization means and measures employed are commonly used in urban stream restoration projects.
   - Clearing of most vegetation (invasive species removal and construction preparation)
   - Installing of soil lifts via the utilization of coir block products
   - Installation of erosion control blanket
   - Native seeding, native planting and live staking

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No

9. ***In what ways did alterations change the proposed project outcome?***
   N/A

Site Assessment

Field Review Date: 9/11/2019

Field Visit Attendees: Michael Schumann–Ramsey County; Stephanie McNamara–VLAWMO; Dawn Tanner–VLAWMO; Wade Johnson–MnDNR and Kevin Biehn-EOR

10. ***Surrounding Landscape Characteristics:***

The project site is located on Lambert Creek immediately downstream (west) of the Oakmede Lane crossing in the City of White Bear Lake, MN. This reach of Lambert Creek is situated in a suburban neighborhood and its riparian corridor is characterized by shallow banks with a mix native and invasive shrubs and vines along with a broken canopy of native deciduous trees.

11. ***Site Characteristics:***
    a. ***Soil Series:***
    The two primary soil types are Zimmerman fine sand (upstream), which transitions to Markley muck (downstream) as Lambert Creek flows into a wetland.
    b. ***Topography:***
    The stream banks are approximately 4-6 feet high from toe to top of bank and moderately shallow, 30% to 50% slopes.
    c. ***Hydrology:***
    Lambert Creek is a flowage that drains Goose Lake and Rice Lake into Vadnais Lake. From Vadnais Lake, surface flow is directed south and east via ditches and culverts through Gervais Lake, Phalen Lake and into the Mississippi River via Battle Creek and Pigs Eye Lake. According to StreamStats approximately 3.4 square miles drains to the project site.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
    A portion of the floodplain has been filled and the stream has been straightened for most of its length within the vicinity of the project area. The Lambert Creek floodplain and flow path have been highly altered and manipulated.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
    See Appendix A for species identified via 9/11/2019 meander search.

12. ***Is the plan based on current science?*** Yes
    Stream bank stabilization via the use of natural fiber coir blocks is a current practice that is based on sound science.

13. ***List indicators of project goals at this stage of project:***
    The project site appears relatively stable with no substantial instabilities or bank erosion witnessed during the evaluation.

14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Yes – the project has been in place for 6 years and during these relatively wet years, the project has experience numerous ‘testing’ channel forming flows. The stream banks are stable, the vegetation is of adequate floristic quality and as such, the project is on a positive trajectory.

15. ***Are corrections or modifications needed to achieving proposed goals?***
    No

16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

No future phases/steps are known to the evaluator. As with any urban restoration project with a small footprint, maintaining vegetation quality will require ongoing and indefinite inputs.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    N/A

18. ***Are follow-up assessments needed? Explain.***
    This project is a low priority for follow-up assessment. The project is straightforward and the trajectory is relatively predictable & positive.

19. ***Additional comments on the restoration project.***
    Given the aforementioned site constraints, vegetation management will remain a challenge. Additionally, the former dense tree & shrub canopy and subsequent limited herbaceous understory likely contributed to bank instability and as such, woody vegetation will need to be managed to address the likely woody progression and cycle of instability. Managers from the Vadnais Lake Area Water Management Organization plan to bolster vegetation maintenance and invasive control on this site this year and coming years with the goal of allowing the planted native species to thrive. It is understood that the existing flume was not a part of this project, but it is worth noting that flume appears to be inadequately sized for the stream and may be a significant contributor to reach instability.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.

21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium

22. ***Provide explanation of reason(s) for determination.***
    The project has been in place for 6 years and during these relatively wet years, the project has experience numerous 'testing' channel forming flows. The stream banks are stable, the vegetation is of adequate floristic quality and as such, the project is on a positive trajectory.

23. ***Site Assessor(s) Conducting Review:***
    Kevin Biehn – EOR

Appendix A: Site maps, Project plans or Vegetation tables

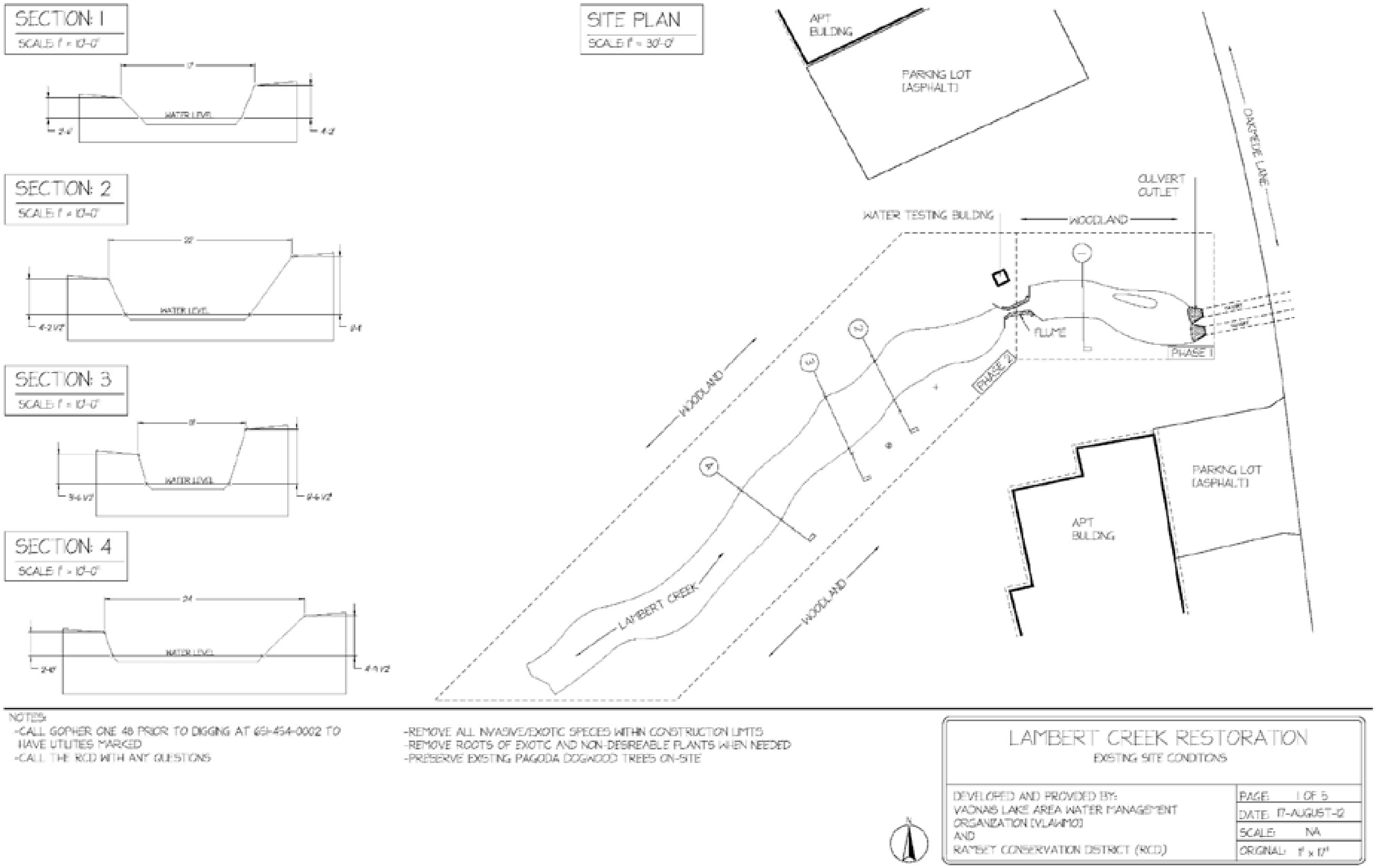


Figure 7-1 Construction Documents –Existing Conditions Plan Sheet, dated 8/17/2012

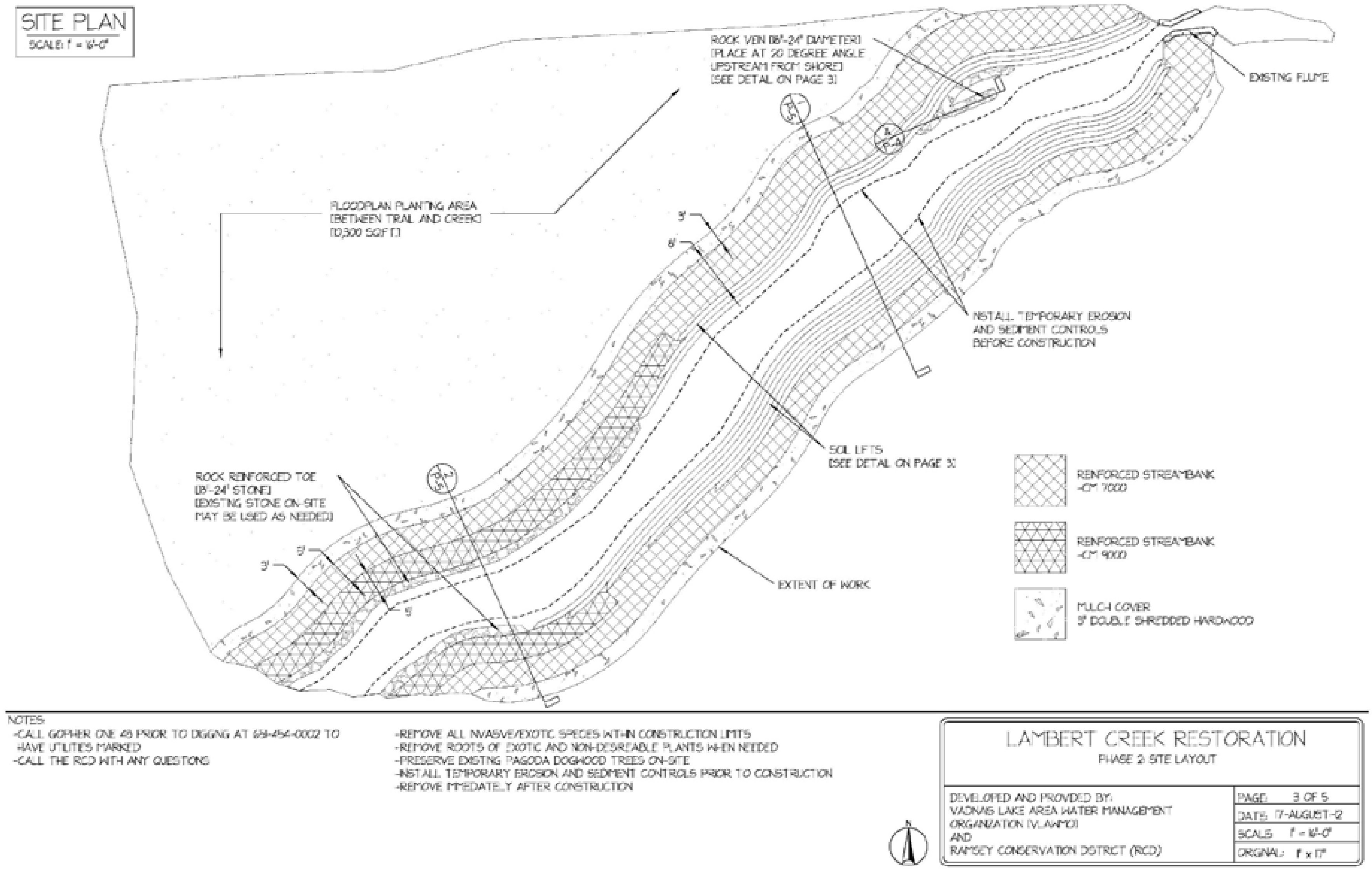


Figure 7-2 Construction Documents –Representative Site Layout Sheet for section downstream of existing flume, dated 8/17/2012

Table 7-1 Meander Search Species List compiled by Kevin Biehn on 9/11/2019.

Scientific Name	Common Name	Cover Range	Species Status
Acer ginnala	Amur maple	1-5%	Invasive
Acer negundo	Box elder	1-5%	Native
Amphicarpaea bracteata	Hog peanut	1-5%	Native
Arcitum minus	Common burdock	1-5%	Invasive
Asteraceae altissima	White snakeroot	5-25%	Native
Betula nigra	River birch	1-5%	Native
Calamagrostis canadensis	Canada bluejoint	1-5%	Native
Carex pennsylvanica	Penn sedge	1-5%	Native
Carex spp.	Sedge	1-5%	Native
Carex vulpinoidea	Fox sedge	1-5%	Native
Carpinus caroliniana	Blue beach	1-5%	Native
Cornus sericea	Red-osier dogwood	1-5%	Native
Echinocystis lobata	Cucumber vine	1-5%	Native
Fraxinus pennsylvanica	Green ash	1-5%	Native
Glechoma hederacea	Creeping charlie	1-5%	Non-Native
Impatiens capensis	Spotted touch-me-not	1-5%	Native
Lonicera tatarica	Tatarian honeysuckle	1-5%	Invasive
Poa pratensis	Bluegrass	5-25%	Non-Native
Quercus bicolor	Swamp white oak	1-5%	Native
Rhamnus cathartica	Common buckthorn	1-5%	Invasive
Rubus occidentalis	Black raspberry	1-5%	Native
Rudbeckia hirta	Black-eyed susan	1-5%	Native
Solidago canadensis	Canada goldenrod	1-5%	Native
Solidago flexicaulis	Zigzag goldenrod	5-25%	Native
Vernonia fasciculate	Ironweed	1-5%	Native
Vitis riparia	Grape vine	1-5%	Native

Appendix B: Site Photographs

Photo 7-1 Before project image immediately downstream (west) of existing flume. Photograph provided by VLAWMO, dated May 8 2007.

Photo 7-2 Image of completed project from similar location and perspective as Photo 6-1. Photograph provided by VLAWMO, September 2013.

Photo 7-3 Image of project from similar location and perspective as Photo 7-1 & Photo 7-2 taken during project evaluation, Photograph taken by Kevin Biehn during 9/11/2019 site visit.

8) Rum River West Branch Stabilization

Project Background

Project Name: Rum River – West Branch (Miscowik) Streambank Stabilization

Project Site: Miscowik Property, 2636 105th Ave., Princeton, MN 55371

Township/Range Section: Township 36N Range 26W Section 30

Project Manager / Affiliated Organization: Lynn Gallice - Shoreland Technician / Mille Lacs Soil and Water Conservation District

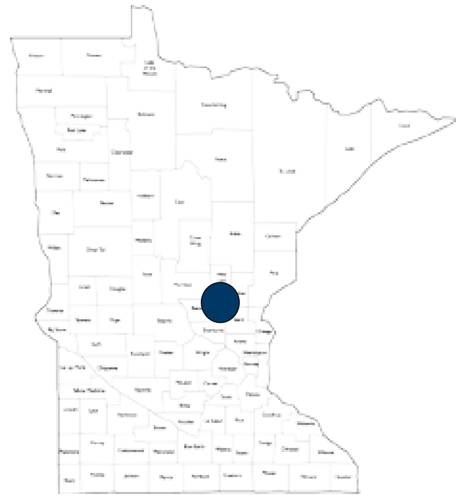
Fund: CWF ***Fiscal Year Funds:*** 2010

Project Start Date: January 2010

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Prairie / Savana / Grassland , Forest

Project Status: Post Establishment Phase



County: Mille Lacs

Primary Activity: Stream/River Enhancement

Project Size: 160 Linear Feet

Project Completed: August 2010

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Restore a steep, 1:1 (horizontal: vertical) eroding slope on the outside bend of the West Branch of the Rum River by regrading and terracing the slope to be less steep, excavating a point bar by-pass channel, installing tree floodplain log jams, installing tree revetment at the toe of the new slope, installing living fascines on the first terrace, revegetating the remainder of the slope, and establish a 25' vegetated buffer at the top of the slope.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***

   FY 2010 Clean Water Fund Water Quality Comprehensive Project Narrative, Mille Lacs County Soil & Water Conservation District, June 2010.
   Miscowik Shoreline Restoration Project Summary, Mille Lacs County Soil & Water Conservation District, Not Dated.
   Miscowik Streambank Stabilization Design Plans, Mille Lacs County Soil & Water Conservation District, June 2010.

Miscowik Streambank Stabilization As-Built Plans, Mille Lacs County Soil & Water Conservation District, August 2010.
Landowner Operation and Maintenance Agreement, Mille Lacs County Soil & Water Conservation District, August 2010.
Miscowik Streambank Stabilization Planting Plan, Mille Lacs County Soil & Water Conservation District, Not Dated.
Miscowik Streambank Stabilization Construction and Material Specifications, Mille Lacs County Soil & Water Conservation District, June 2010.

3. ***What are the stated goals of the project?***
Stabilize the actively eroding, 30' tall, outside bend to reduce the resulting estimated pollutant load of approximately 142 lbs. of phosphorus and 167 tons of sediment per year. Work with the existing driveway alignment as the extent of resloping work since an existing horse barn and pasture, and landowner willingness, prohibits relocation. Re-vegetate the slope and create a shoreline and top of slope buffer for stabilization and provide habitat for pollinators.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
In addition to sediment erosion and phosphorus load reduction, this project will improve wildlife and fish habitat by providing food, shelter and shade for fish and wildlife through the planting of local eco-type native grasses, forbs and shrubs on the restored riverbank and upland buffer. Revegetating the side slopes and creating an upland buffer with hardy native grasses and shrubs will hold the sandy soil in place, as well as infiltrate runoff from upland areas.
5. ***Were measures of restoration success identified in plans? Yes***
If yes, list specific measurements.

"This project will be successful when approximately 110 linear feet x 30 vertical feet of eroded shoreline is restored and a 25 foot native plant buffer is installed along the shoreline to reduce nutrient and sediment runoff. The success of this project will also be measured by documenting participation in a workshop to educate the community on the value of shoreline restorations and shoreline buffers."

6. ***Are plan Sets available?*** **Yes** ***Have project maps been created?*** **Yes**
If yes, provide in Appendix A and list Maps provided:
Miscowik Streambank Stabilization Design Plans and As-Built Plans, Mille Lacs County Soil & Water Conservation District, June 2010. Documents include a plan and location map, construction plan, and typical sections and details.
Miscowik Streambank Stabilization Planting Plan, Mille Lacs County Soil & Water Conservation District, Not Dated. Documents include a written plan prescribing seed, plugs and shrubs to be installed by terrace elevations.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
Regrading and revegetating streambanks is industry standard in Minnesota on low energy channels. And regrading and terracing bluff* slopes to be less steep to increase stability is a geotechnical engineering standard in Minnesota.

*A bluff is defined by the MN DNR Shoreland Management Program as:

Part or all of the feature is located in a shoreland area;

The slope rises at least 25 feet above the toe of bluff;

The grade of the slope from the toe of the bluff to a point 25 feet or more above the toe of the bluff averages 30 percent or greater, except that an area with an average slope of less than 18 percent over a distance of at least 50 feet shall not be considered part of the bluff; and

The slope must drain toward the waterbody.

Excavating a point bar by-pass channel through an inside bend of a meandering channel to allow high flow to short-cut across the inside bend instead of the natural flow path through the outside bend is not a current stream stabilization practice. This practice effectively straightens the channel, increasing channel slope and flow velocity which can cause channel instability downstream which contradicts natural channel design practices promoted by the MN DNR River Ecology Unit.

Installation of bars and vanes in streams and rivers is common practice in MN to deflect flow energy away from the toe of riverbanks. Typically these practices are constructed with rock according to NRCS and other agency details. Using trees and branches to create floodplain log jams as stream barbs is not common practice and more temporary to a rock installation.

Installing of tree revetment and living fascines (brush bundles) at the toe of eroded streambanks is industry standard in MN with details and installation procedures provided by the Natural Resources Conservation Services (NRCS) and several Soil and Water Conservation Districts in MN.

Revegetation of disturbed and regraded streambanks with native vegetation is industry standard in Minnesota.

Establishing a 25' vegetated buffer at the top of the slope is industry standard. Minnesota's current buffer law requires perennial vegetative **buffers** of up to 50 feet along lakes, rivers, and streams with the deadline for implementation of **buffers** on public waters by November 1, 2017.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes.
   One of the tree floodplain log jams was not installed. The extents of grading increased to tie the new terraces into the upstream and downstream side slopes at a more gentle, 2:1 slope (horizontal : vertical). And the location of the upslope ditch to intercept and redirect overland flow from going over the top of the regarded slope was adjusted.
   There was no plan to irrigate the revegetated slope, but the landowner provided irrigation for the 1st growing season, moving irrigation heads and hoses around the project area to ensure full irrigation coverage.
9. ***In what ways did alterations change the proposed project outcome?***

Construction alterations made to the project were adjustments made based on field locations and did not change the project outcomes. The irrigation provided by the landowner was a benefit and increased the success of vegetation establishment of the project.

Site Assessment

Field Review Date: **9/19/2019**

Field Visit Attendees:

Randy Miscowik – Landowner, Lynn Gallice – Mille Lacs Soil & Water Conservation District, Lucius Jonett – Wenck Associates, Gina Quiram – MN Department of Natural Resources

10. ***Surrounding Landscape Characteristics:***
    The West Branch Rum River flows through floodplain forest in the river valley and is surrounded by agricultural lands on the uplands of the valley.
11. ***Site Characteristics:***
    a. ***Soil Series:***
       Zimmerman fine sand (D60E), 12 to 30 percent slopes; Zimmerman fine sand (D60B), 1 to 6 percent slopes; Fordum-Winterfield complex (1011A), 0 to 2 percent slopes, frequently flooded.
    b. ***Topography:***
       The West Branch Rum River meanders through a steep-sided, fine-sand, river valley. The project area changes in topography from the river bank up to the top of the side slope with approximately 30' in elevation change.
    c. ***Hydrology:***
       The Rum River watershed includes 212 lakes that are over 10 acres in size. Land use in the Rum River watershed is 39% agricultural, 24% forested, 18% grass/shrub/wetland, and 15% water, MPCA website.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
       The site was a slope of planted prairie grasses and forbs and scattered shrubs, surrounded by woodland. The dominant species appeared to include the grasses Canada wildrye, smooth brome, little bluestem, big bluestem, Indiangrass, sideoats grama, and other bunchgrasses with cumulative cover between 50-75%; the forbs wild bergamot and several goldenrod species contributing the majority of total forb cover between 25-50%; and several shrubs including red-osier dogwood, smooth sumac, possibly bush honeysuckle, and others for a total cover between 25-50%. Invasive and introduced species cover was less than 25% overall, comprised mainly of smooth brome.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
       Refer to Appendix A, Table 8-1 for species list.
       During revegetation, shrub planting was spread throughout but did not establish as hoped. It was observed during the site assessment that almost all of the shrubs on the flat parts of the terraces have failed. Any only shrubs planted, and pioneering shrubs and trees, have survived or established on the slopes of the terraces. During the site assessment it seemed that there were more volunteer than planted shrub species. It was observed during the site visit that some of this slopes were bare soil and eroding where the natural fiber erosion control blanket installed during the project has deteriorated. The reason for the lack of establishment of the shrubs on the terraces is not obvious

and seems counter-intuitive that shrubs are establishing on the slopes. Is there a difference in the soil? Maybe a difference in moisture?

12. ***Is the plan based on current science?*** Portions

Stabilization of channels with steep bluff side slopes by regrading, terracing and revegetation is based on current science. Reusing trees and woody material from onsite to provide revetment at the toe and creating stabilization brush bundles or fascines to prevent erosion from overland flow is also based on current science. Reusing trees and woody material for floodplain log jams as stream barbs and excavating a point bar by-pass channel to short-cut flow across the inside bend is not based on current science. The bypass excavation practice effectively straightens the channel, increasing channel slope and flow velocity which can cause channel instability downstream which contradicts natural channel design practices promoted by the MN DNR River Ecology Unit.

13. List indicators of project goals at this stage of project:

Based on grant application language, the landowner historically was mowing turf grass up to the edge of the stream bank side slope for approximately 20 years. During the site assessment visit it was observed that the vegetation on the slope and the buffer is intact.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes. The project goals of increased stability and vegetation are being met. There are no measurements or records on any improve wildlife and fish habitat associated with the project.

15. Are corrections or modifications needed to achieving proposed goals?

No modifications to the project are needed to maintain the achieved goal of reducing erosion and increasing slope stability.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

Proposed long-term inspections and maintenance is described in the grant narrative and landowner Operation and Maintenance Plan agreement which requires that the landowner will keep the stream barbs and tree revetments in good repair. Noxious weeds will be required to be controlled in the project area and the landowner will be required to keep native trees, shrubs and plants established on the appropriate project area for a time of at least 10 years (Landowner’s agreement expires after 2020).

17. Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.

The project implementation improves buffer habitat with the establishment of native plants on a previously bare slope and provides some woody material in the river channel that could provide cover and habitat for fish, macroinvertebrates and other organisms.

18. Are follow-up assessments needed? Explain.

A follow-up visit should review the streambank below the bare slope area downstream of the project limit to see if there is any instability at the toe and to verify there is no bank erosion being caused by the excavated point bar by-pass channel. The bare slope area downstream of the project limit should be revegetated to make sure there is no instability or erosion from the top of the bluff slope.

19. Additional comments on the restoration project.

Project limits were established based on working within the existing non-vegetated portion of the failing side slope to minimize tree clearing. In hindsight, the project designer and landowner both wish that they would have gone further downstream to stabilize a bare slope area. The bare slope wasn't a concern at the time of project implementation, but after 6 years since, the landowner is becoming concerned that the slope is not vegetated and may become a future issue. The SWCD shared a plant & seed list based on the existing project that the landowner can use to try to revegetate the bare slope. And the landowner has stated that he is interested in doing the revegetation work by himself, but it has not happened. The SWCD stated that it is possible that this is an opportunity for a Conservation Crop project if the landowner is willing to purchase the materials.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    The flow in the river was up slightly during our site assessment, but we could still see the wood revetment intact at the toe of the slope. And the terracing of the resloped bluff remains defined and intact with well-established vegetation. The vegetation may have sorted naturally with the shrubs and trees establishing on the slopes of the terraces, but overall the density and diversity remain high enough to keep the highly erodable sand soil in place.
23. ***Site Assessor(s) Conducting Review:***
    Lucius Jonett

Appendix A: Site maps, Project plans or Vegetation tables

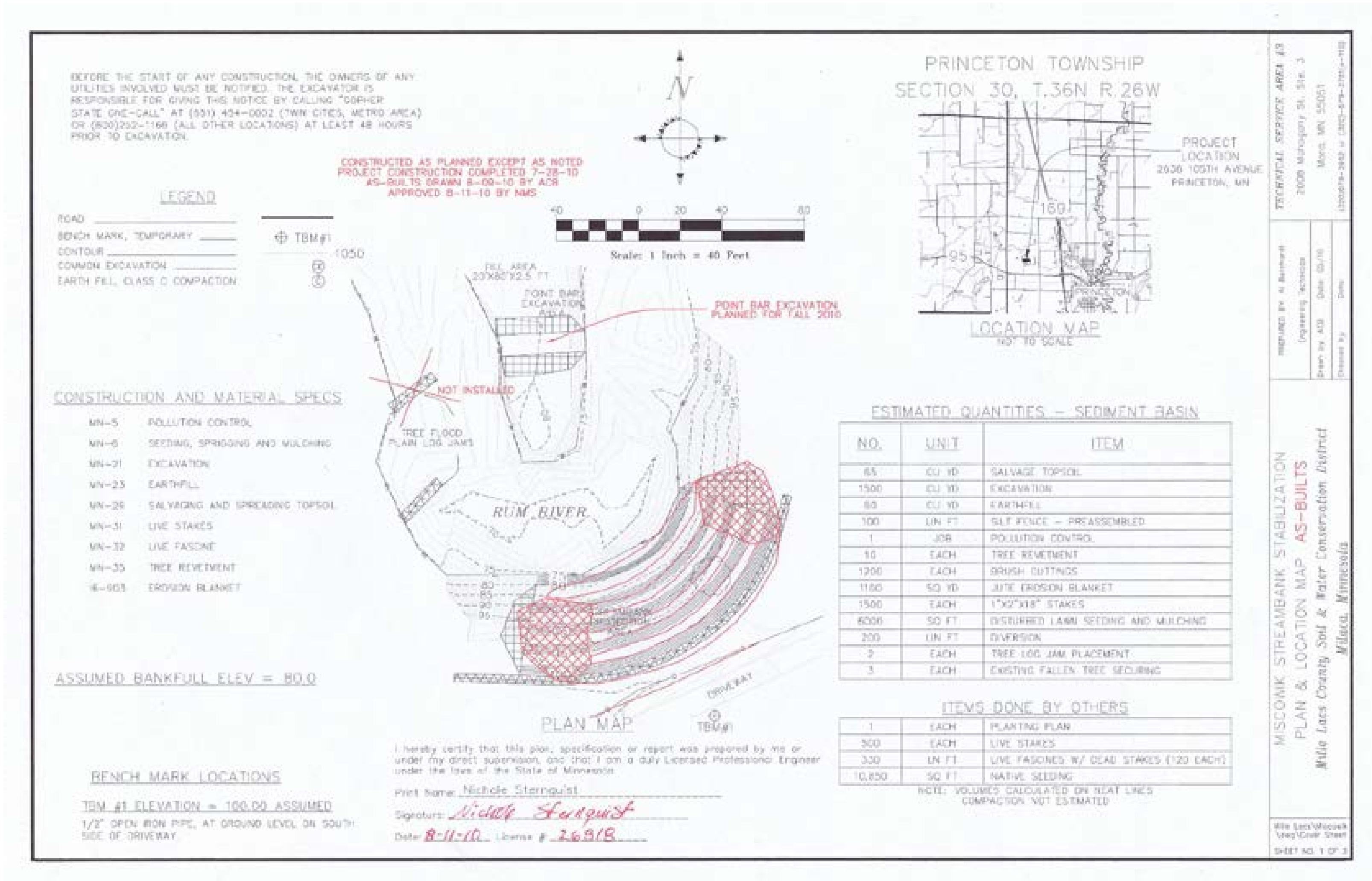


Figure 8-1 As-Built Plan Sheet 1 showing the location of the project in the township and the location of the project practices.

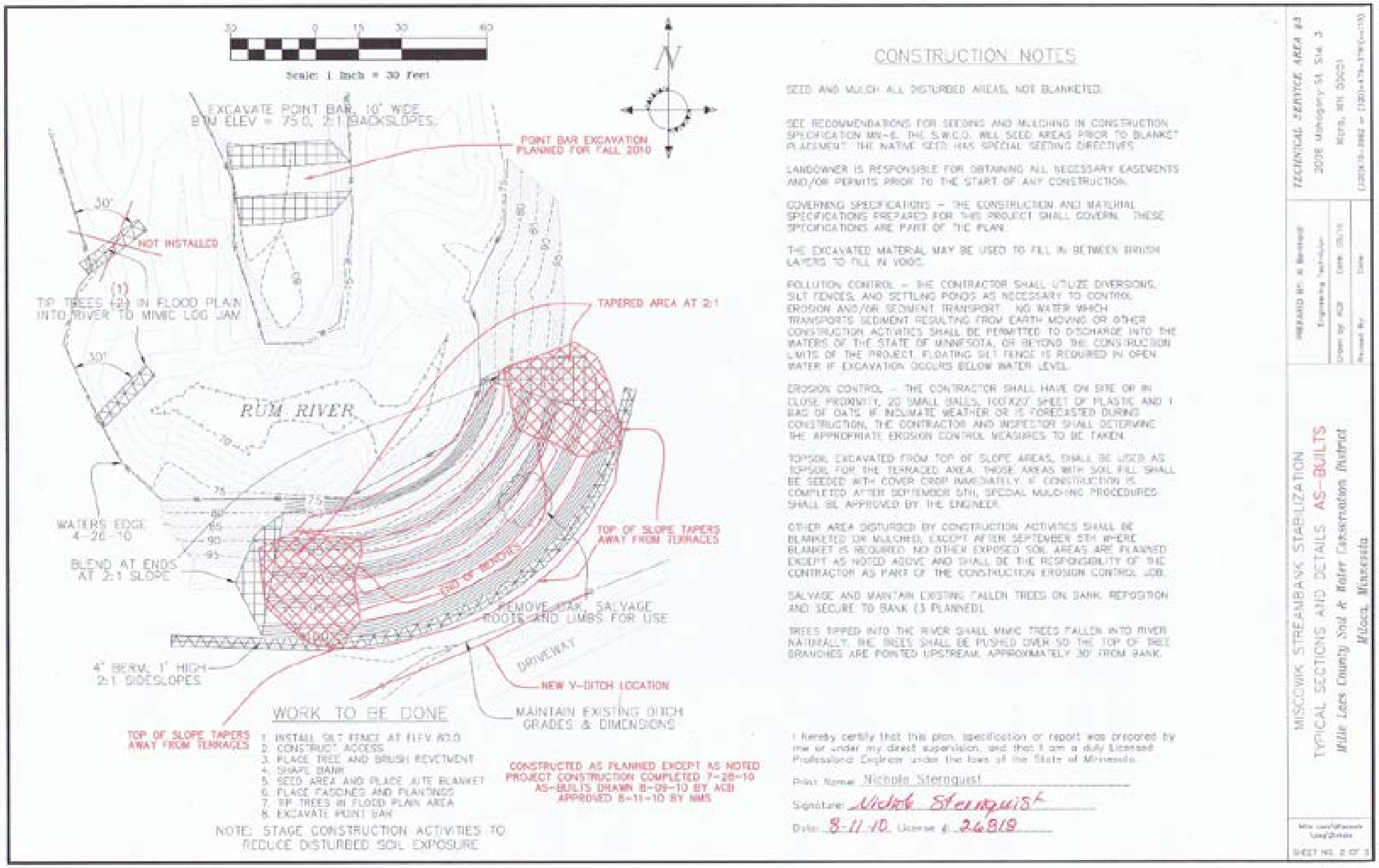


Figure 8-2 As-Built Plan Sheet 2 showing the location of the project practices as they were built during construction.

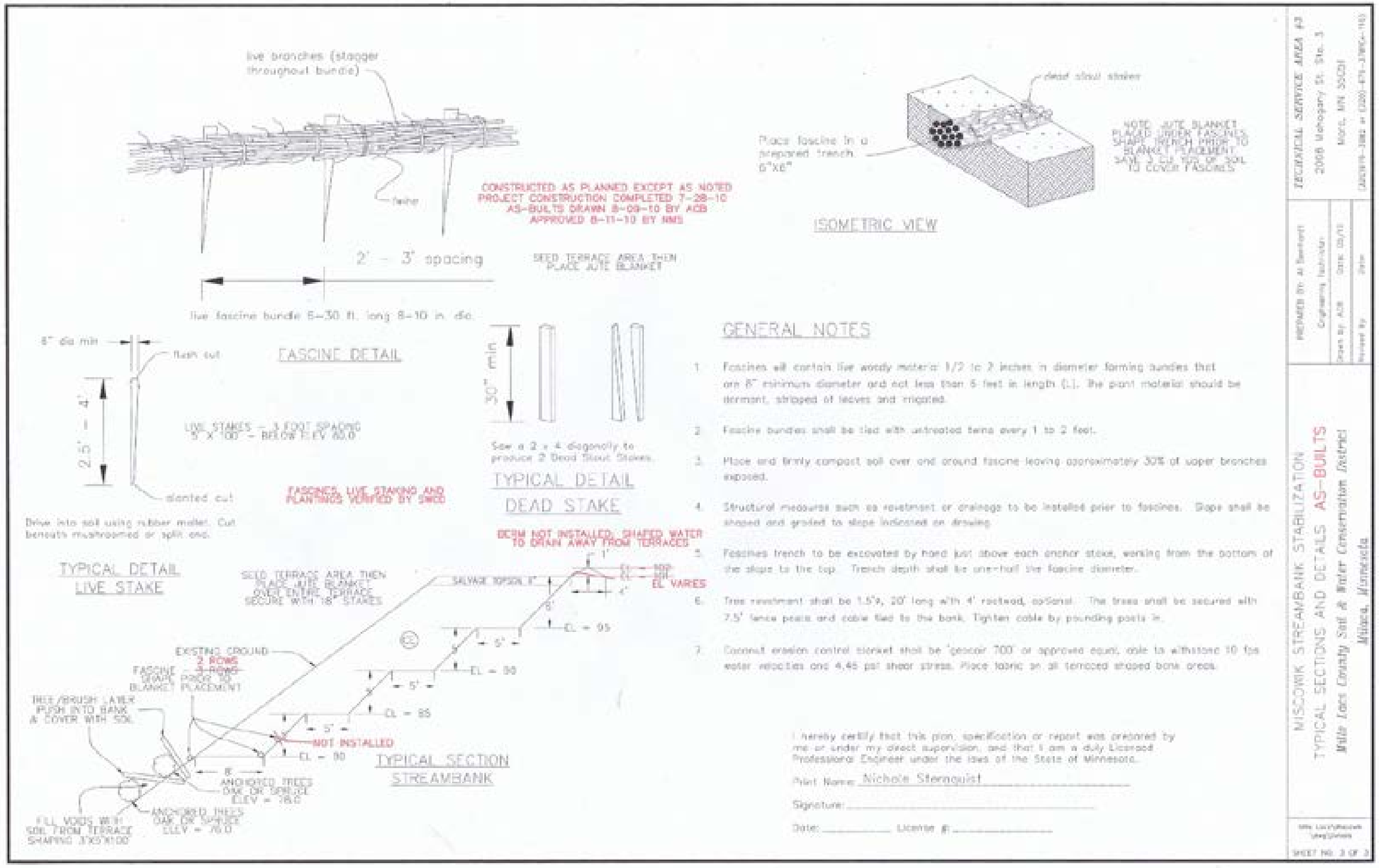


Figure 8-3 As-Built Plan Sheet 3 showing the details of how the bluff slope is to be terraced and how the fascines are fabricated and installed.

Mixed Height/Mesic Native Wildflower Mixture

Lot Number MHFO 4A 2010

Species	Pure Seed %	Total Germination (includes Dorm.) %	Dormant Seed %	Grown In	Species	Pure Seed %	Total Germination (includes Dorm.) %	Dormant Seed %	Grown In
Black-eyed Susan	15.97	96.00	19.00	IA	Golden Alexander	2.95	71.00	60.00	MN
Hoary vervain	14.03	83.00	83.00	MN	Azure aster	2.00	90.00	90.00	WI
Purple prairie clover	13.90	92.00	14.00	MN	Bush clover	1.91	74.00	36.00	MN
White prairie clover	2.96	93.00	86.00	MN	Upland goldenrod	1.59	34.00	17.00	MN
Common ox-eye	5.97	92.00	46.00	MN	Yarrow	0.90	65.00	65.00	MN
Leadplant	5.78	50.00	42.00	MN	Heath aster	0.97	96.00	96.00	IA
Wild bergamot	3.80	59.00	3.00	MN	Stiff tickseed	0.89	90.00	0.00	MN
Stiff goldenrod	3.78	69.00	2.00	MN	Canada tick trefoil	0.94	45.00	2.00	MN
Fragrant giant hyssop	2.79	67.00	5.00	MN	Prairie cinquefoil	0.81	68.00	53.00	MN
Smooth aster	2.40	31.00	0.00	MN	Gray goldenrod	0.82	55.00	0.00	MN
Tall blazing star	2.83	79.00	65.00	MN	Common milkweed	0.49	94.00	94.00	MN
Showy goldenrod	1.78	46.00	1.00	MN	Stiff sunflower	0.43	75.00	75.00	MN

Weed seed % 0.10
Other Crop Seed % 0.04
Inert Matter % 9.07
Total % 100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371
Test Date: 9/18/2009

Net WT. 2 oz.

Noxious Weed Seeds/#: 9.90 Hoary alyssum

Short/Dry Native Wildflower Mixture

Lot Number SDFO 3A 2010

Species	Pure Seed %	Total Germination (includes Dorm.) %	Dormant Seed %	Grown In	Species	Pure Seed %	Total Germination (includes Dorm.) %	Dormant Seed %	Grown In
Purple prairie clover	17.99	92.00	14.00	MN	Wild bergamot	1.90	59.00	3.00	MN
Hoary vervain	16.37	83.00	83.00	MN	Showy penstemon	1.71	93.00	93.00	MN
Black-eyed Susan	15.97	96.00	19.00	IA	Yarrow	0.95	93.00	93.00	MN
Leadplant	7.71	50.00	42.00	MN	Fragrant giant hyssop	0.93	67.00	5.00	MN
White prairie clover	3.38	93.00	86.00	MN	Heath aster	0.97	96.00	96.00	IA
Stiff tickseed	2.79	73.00	40.00	MN	Prairie cinquefoil	0.81	88.00	53.00	MN
Bush clover	2.87	38.00	0.00	MN	Stiff goldenrod	0.94	69.00	2.00	MN
Gray goldenrod	2.46	55.00	0.00	MN	Showy goldenrod	0.59	46.00	1.00	MN
Upland goldenrod	2.59	19.00	0.00	MN	Common milkweed	0.49	46.00	1.00	MN
Golden Alexander	2.95	71.00	60.00	MN	Dotted blazingstar	0.44	94.00	94.00	MN
Azure aster	2.00	90.00	90.00	WI	Prairie rose	0.43	72.00	0.00	MN

Net Weight 2 Oz.

Weed seed % 0.12
Other Crop Seed % 0.05
Inert Matter % 11.57
Total % 100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371
Test Date: 9/18/2009

Noxious Weed Seeds/#: 11.40 Hoary alyssum

Figure 8-4 – Seed tags 1 and 2 of 22 from terrace plantings.

Prairie Restorations Inc
31922 128 Street
Princeton, MN
55371

Scientific name:	Avena sativa	Common name:	Oats		
Seed Id:	1873	Orgin:	Minnesota	Lab.	Johnson Seed
Lot Num.	ASA091A500(Esker)	Grown:	Minnesota	Lab #	09-10188
Pure seed:	99.84				
Inert	0.11	Nox per Lb:	0.00		
Other crop:	0.04	MN Nox seed:	0		
Weed seed:	0.01				
Germ.	99.00			PLS %:	98.84
Dormant	0.00	TZ:	0.00	Net Wgt:	6.00
Hard seed:	0.00	Test date:	10/1/2009	PLS Wgt:	5.93
Total Germ.	99.00				

Short/Dry Grass Mix

Lot Number SDG 5A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Little bluestem	40.30	33.00	55.00	Benton Co., MN	MN
Side oats grama	24.33	88.00	0.00	Clay Co., MN	MN
Blue grama	7.17	78.00	6.00	Sherburne Co., MN	MN
June grass	1.50	0.00	93.00	Canada	CANADA
Kalm's brome	0.64	77.00	14.00	Dakota Co., MN	MN
Poverty oat grass	0.64	3.00	52.00	St. Louis Co., MN	MN
Sand dropseed	0.67	20.00	42.00	Sherburne Co., MN	MN
Prairie dropseed	0.33	29.00	2.00	Sherburne Co., MN	MN

Weed seed %	0.18		Net weight Lbs.	0.75
Other Crop seed %	0.06	Prairie Restorations, Inc.	PLS Lbs.	0.50
Inert Matter %	24.18	PO Box 327	Test Date:	1/5/2010
Total %	100	Princeton, MN 55371	Noxious Weed Seeds/#:	0

Figure 8-5 – Seed tags 3 and 4 of 22 from terrace plantings.

Prairie Restorations Inc
31922 128 Street
Princeton, MN
55371

Scientific name:	Avena sativa		Common name Oats		
Seed Id:	1873			Lab.	Johnson Seed
Lot Num.	ASA091A500(Esker)	Orgin:	Minnesota	Lab #	09-10188
Pure seed:	99.84	Grown:	Minnesota		
Inert	0.11	Nox per Lb:	0.00		
Other crop:	0.04	MN Nox seed:	0		
Weed seed:	0.01				
Germ.	99.00			PLS %:	98.84
Dormant	0.00				
Hard seed:	0.00	TZ:	0.00	Net Wgt:	20.00
Total Germ.	99.00	Test date:	10/1/2009	PLS Wgt:	19.77

Mixed Height/Mesic Grass Mix

Lot Number MHG 5A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Big bluestem	23.19	5.00	81.00	Sherburne Co., MN	MN
Little bluestem	21.02	45.00	38.00	Benton Co., MN	MN
Indian grass	15.58	8.00	80.00	Sherburne Co., MN	MN
Side oats grama	16.84	12.00	25.00	Benton Co., MN	MN
Canada wild rye	1.97	95.00	0.00	Sherburne Co., MN	MN
Switch grass	1.71	55.00	18.00	Isanti Co., MN	MN
Kalm's brome	0.60	77.00	14.00	Dakota Co., MN	MN
June grass	0.22	64.00	11.00	Sherburne Co., MN	MN
Sand dropseed	0.62	20.00	42.00	Sherburne Co., MN	MN

Weed Seed %	0.08		
Other Crop Seed %	0.04		
Inert Matter %	18.13		
Total %	100		

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371

Net weight	Lbs.	0.80
PLS	Lbs.	0.50
Test Date:	1/5/2010	
Noxious Weed Seeds/#:	2.07	Giant foxtail
	1.38	Quack grass

Figure 8-6 – Seed tags 5 and 6 of 22 from terrace plantings.

Tall/Wet Grass Mix

Lot Number TWG 2A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Big bluestem	41.57	5.00	81.00	Sherburne Co., MN	MN
Blue joint grass	4.11	56.00	9.00	Aitkin Co., MN	MN
Canada wild rye	8.94	93.00	0.00	Sherburne Co., MN	MN
Cord grass	6.72	16.00	2.00	Sherburne Co., MN	MN
Switch grass	9.11	55.00	18.00	Isanti Co., MN	MN
Green bulrush	3.26	0.00	89.00	Sherburne Co., MN	MN
Indian grass	3.78	8.00	80.00	Sherburne Co., MN	MN
Fringed brome	2.41	84.00	5.00	Canada	MN
Wool grass	2.45	50.00	10.00	Aitkin Co., MN	CANADA
Virginia wild rye	1.59	0.00	93.00	Rice Co., MN	MN
Little bluestem	2.13	71.00	7.00	Benton Co., MN	MN
Giant bur-reed	0.80	0.00	88.00	Sherburne Co., MN	MN
					MN

Weed Seed %	0.03
Other Crop Seed %	0.88
Inert Matter %	12.22
Total %	100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371

Net weight	Lbs.	1.20
PLS	Lbs.	1.00
Test Date:	1/21/2010	
Noxious Weed Seeds/#:	5.38	Giant foxtail
	0.27	Quack grass

Short/Dry Grass Mix

Lot Number SDG 5A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Little bluestem	40.30	33.00	55.00	Benton Co., MN	MN
Side oats grama	24.33	88.00	0.00	Clay Co., MN	MN
Blue grama	7.17	78.00	6.00	Sherburne Co., MN	MN
June grass	1.50	0.00	93.00	Canada	CANADA
Kalm's brome	0.64	77.00	14.00	Dakota Co., MN	MN
Poverty oat grass	0.64	3.00	52.00	St. Louis Co., MN	MN
Sand dropseed	0.67	20.00	42.00	Sherburne Co., MN	MN
Prairie dropseed	0.33	29.00	2.00	Sherburne Co., MN	MN

Weed seed %	0.18
Other Crop seed %	0.06
Inert Matter %	24.18
Total %	100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371

Net weight	Lbs.	1.49
PLS	Lbs.	1.00
Test Date:	1/5/2010	
Noxious Weed Seeds/#:	0	

Figure 8-7 – Seed tags 7 and 8 of 22 from terrace plantings.

Short/Dry Grass Mix

Lot Number SDG 6A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Little bluestem	40.30	33.00	55.00	Benton Co., MN	MN
Side oats grama	24.33	88.00	0.00	Clay Co., MN	MN
Blue grama	7.17	78.00	6.00	Sherburne Co., MN	MN
June grass	1.50	0.00	93.00	Canada	CANADA
Kalm's brome	0.64	77.00	14.00	Dakota Co., MN	MN
Poverty oat grass	0.64	3.00	52.00	St. Louis Co., MN	MN
Sand dropseed	0.67	20.00	42.00	Sherburne Co., MN	MN
Prairie dropseed	0.33	29.00	2.00	Sherburne Co., MN	MN

Weed seed % 0.18

Other Crop seed % 0.06

Inert Matter % 24.18

Total % 100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371

Net weight Lbs. 0.75

PLS Lbs. 0.50

Test Date: 1/5/2010

Noxious Weed Seeds/#: 0

Tall/Wet Native Wildflower Mixture

Lot Number TWFO 1A 2010

Species	Pure Seed %	Total Germination (Includes Dorm.)	Dormant %	Grown In
Blue vervain	14.14	65.00	24.00	MN
Joe-pye weed	9.16	39.00	25.00	MN
Tall blazing star	11.31	79.00	65.00	MN
Blue flag iris	6.69	89.00	89.00	MN
Black-eyed Susan	4.89	96.00	19.00	IA
Mountain mint	4.69	80.00	16.00	MN
Boneset	3.29	41.00	3.00	MN
Sweet flag	3.96	70.00	35.00	MN
Canada tick trefoil	2.81	45.00	2.00	MN
Giant sunflower	2.86	75.00	75.00	MN
Common ox-eye	2.98	92.00	45.00	MN
Ironweed	2.81	69.00	0.00	MN
Golden Alexander	2.86	88.00	86.00	MN
Swamp milkweed	2.95	78.00	8.00	MN

Species	Pure Seed %	Total Germination (Includes Dorm.)	Dormant %	Grown In
Smooth aster	1.00	58.00	22.00	MN
New England aster	1.53	28.00	2.00	MN
Purple prairie clover	2.00	92.00	14.00	MN
Great St. John's wort	1.99	87.00	17.00	MN
Arrowhead	1.67	56.00	58.00	MN
Upland goldenrod	1.92	60.00	22.00	MN
Stiff goldenrod	1.89	69.00	2.00	MN
Culver's root	1.84	49.00	12.00	MN
Grass-leaved goldenrod	0.72	60.00	2.00	MN
Tall meadow rue	0.90	70.00	0.00	MN

Weed seed % 0.04

Other Crop Seed % 0.56

Inert Matter % 8.77

Total % 100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371
Test Date: 9/18/2009

Net Weight 2 oz.

Noxious weed seeds/#: 3.09 Giant foxtail
1.45 Hoary alyssum

Figure 8-8 – Seed tags 9 and 10 of 22 from terrace plantings.

Short/Dry Grass Mix

Lot Number SDG 5A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Little bluestem	40.30	33.00	55.00	Benton Co., MN	MN
Side oats grama	24.33	88.00	0.00	Clay Co., MN	MN
Blue grama	7.17	78.00	6.00	Sherburne Co., MN	MN
June grass	1.50	0.00	93.00	Canada	CANADA
Kalm's brome	0.64	77.00	14.00	Dakota Co., MN	MN
Poverty oat grass	0.64	3.00	52.00	St. Louis Co., MN	MN
Sand dropseed	0.67	20.00	42.00	Sherburne Co., MN	MN
Prairie dropseed	0.33	29.00	2.00	Sherburne Co., MN	MN

Weed seed % 0.18

Other Crop seed % 0.06

Inert Matter % 24.18

Total % 100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371

Net weight Lbs. 0.75

PLS Lbs. 0.50

Test Date: 1/5/2010

Noxious Weed Seeds/#: 0

Short/Dry Grass Mix

Lot Number SDG 5A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Little bluestem	40.30	33.00	55.00	Benton Co., MN	MN
Side oats grama	24.33	88.00	0.00	Clay Co., MN	MN
Blue grama	7.17	78.00	6.00	Sherburne Co., MN	MN
June grass	1.50	0.00	93.00	Canada	CANADA
Kalm's brome	0.64	77.00	14.00	Dakota Co., MN	MN
Poverty oat grass	0.64	3.00	52.00	St. Louis Co., MN	MN
Sand dropseed	0.67	20.00	42.00	Sherburne Co., MN	MN
Prairie dropseed	0.33	29.00	2.00	Sherburne Co., MN	MN

Weed seed % 0.18

Other Crop seed % 0.06

Inert Matter % 24.18

Total % 100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371

Net weight Lbs. 0.75

PLS Lbs. 0.50

Test Date: 1/5/2010

Noxious Weed Seeds/#: 0

Figure 8-9 – Seed tags 11 and 12 of 22 from terrace plantings.

Short/Dry Native Wildflower Mixture

Lot Number SDFO 3A 2010

Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In	Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In
Purple prairie clover	17.99	92.00	14.00	MN	Wild bergamot	1.90	59.00	3.00	MN
Hoary vervain	16.37	83.00	83.00	MN	Showy penstemon	1.71	93.00	93.00	MN
Black-eyed Susan	16.97	96.00	19.00	IA	Yarrow	0.95	93.00	93.00	MN
Leadplant	7.71	50.00	42.00	MN	Fragrant giant hyssop	0.93	67.00	5.00	MN
White prairie clover	3.38	93.00	85.00	MN	Heath aster	0.97	96.00	96.00	IA
Stiff tickseed	2.79	73.00	40.00	MN	Prairie cinquefoil	0.81	88.00	53.00	MN
Bush clover	2.87	38.00	0.00	MN	Stiff goldenrod	0.94	69.00	2.00	MN
Gray goldenrod	2.46	55.00	0.00	MN	Showy goldenrod	0.59	46.00	1.00	MN
Upland goldenrod	2.59	19.00	0.00	MN	Common milkweed	0.49	46.00	1.00	MN
Golden Alexander	2.95	71.00	60.00	MN	Dotted blazingstar	0.44	94.00	94.00	MN
Azure aster	2.00	90.00	90.00	WI	Prairie rose	0.43	72.00	0.00	MN

Weed seed % 0.12 Prairie Restorations, Inc.
Other Crop Seed % 0.05 PO Box 327
Inert Matter % 11.57 Princeton, MN 55371
Total % 100 Test Date: 9/18/2009

Net Weight 2 Oz.

Noxious Weed Seeds/#: 11.40 Hoary alyssum

Short/Dry Native Wildflower Mixture

Lot Number SDFO 3A 2010

Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In	Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In
Purple prairie clover	17.99	92.00	14.00	MN	Wild bergamot	1.90	59.00	3.00	MN
Hoary vervain	16.37	83.00	83.00	MN	Showy penstemon	1.71	93.00	93.00	MN
Black-eyed Susan	16.97	96.00	19.00	IA	Yarrow	0.95	93.00	93.00	MN
Leadplant	7.71	50.00	42.00	MN	Fragrant giant hyssop	0.93	67.00	5.00	MN
White prairie clover	3.38	93.00	85.00	MN	Heath aster	0.97	96.00	96.00	IA
Stiff tickseed	2.79	73.00	40.00	MN	Prairie cinquefoil	0.81	88.00	53.00	MN
Bush clover	2.87	38.00	0.00	MN	Stiff goldenrod	0.94	69.00	2.00	MN
Gray goldenrod	2.46	55.00	0.00	MN	Showy goldenrod	0.59	46.00	1.00	MN
Upland goldenrod	2.59	19.00	0.00	MN	Common milkweed	0.49	46.00	1.00	MN
Golden Alexander	2.95	71.00	60.00	MN	Dotted blazingstar	0.44	94.00	94.00	MN
Azure aster	2.00	90.00	90.00	WI	Prairie rose	0.43	72.00	0.00	MN

Weed seed % 0.12 Prairie Restorations, Inc.
Other Crop Seed % 0.05 PO Box 327
Inert Matter % 11.57 Princeton, MN 55371
Total % 100 Test Date: 9/18/2009

Net Weight 2 Oz.

Noxious Weed Seeds/#: 11.40 Hoary alyssum

Figure 8-10 – Seed tags 13 and 14 of 22 from terrace plantings.

Shoreline Grass Mix

Lot Number SHG 2A 2010

Species	Pure Seed%	Germ %	Dormant Seed %	Genetic Origin	Grown In
Blue joint grass	9.68	56.00	9.00	Aitkin Co., MN	MN
Pointed broom sedge	18.69	26.00	26.00	Aitkin Co., MN	MN
Virginia wild rye	9.39	92.00	0.00	Rice Co., MN	MN
Green bulrush	9.80	0.00	89.00	Sherburne Co., MN	MN
River bulrush	7.99	0.00	82.00	Sherburne Co., MN	MN
Wool grass	4.08	18.00	36.00	Sherburne Co., MN	MN
Giant bur-reed	4.83	0.00	68.00	Sherburne Co., MN	MN
Fringed brome	3.59	90.00	4.00	St. Louis Co., MN	MN
Dudley's rush	3.62	0.00	88.00	Clay Co., MN	MN
Bottlebrush sedge	1.99	65.00	12.00	Sherburne Co., MN	MN
Porcupine sedge	1.91	0.00	95.00	Wisconsin	WI
Fox sedge	1.99	87.00	2.00	Minnesota	MN
Soft-stemmed bulrush	2.00	0.00	98.00	Wisconsin	WI
Cord grass (Red River)	1.87	50.00	45.00	Minnesota	MN
Tall mannagrass	1.77	0.00	77.00	St. Louis Co., MN	MN
Wild rice	1.96	0.00	80.00	Isanti Co., MN	MN

Weed seed %	0.02
Other Crop seed %	1.98
Inert Matter %	12.64
Total %	100

Prairie Restorations, Inc.
PO BOX 327
Princeton, MN 55371

Test Date: 9/30/2009
Noxious Weed Seeds/#: 0

Short/Dry Grass Mix

Lot Number SDG 5A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Little bluestem	40.30	33.00	55.00	Benton Co., MN	MN
Side oats grama	24.33	88.00	0.00	Clay Co., MN	MN
Blue grama	7.17	78.00	6.00	Sherburne Co., MN	MN
June grass	1.50	0.00	93.00	Canada	CANADA
Kalm's brome	0.64	77.00	14.00	Dakota Co., MN	MN
Poverty oat grass	0.64	3.00	52.00	St. Louis Co., MN	MN
Sand dropseed	0.67	20.00	42.00	Sherburne Co., MN	MN
Prairie dropseed	0.33	29.00	2.00	Sherburne Co., MN	MN

Weed seed %	0.18
Other Crop seed %	0.06
Inert Matter %	24.18
Total %	100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371

Net weight Lbs. 0.75
PLS Lbs.
Test Date: 1/5/2010
Noxious Weed Seeds/#: 0

Figure 8-11 – Seed tags 15 and 16 of 22 from terrace plantings.

Short/Dry Native Wildflower Mixture

Lot Number SDFO 3A 2010

Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In	Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In
Purple prairie clover	17.99	92.00	14.00	MN	Wild bergamot	1.90	59.00	3.00	MN
Hoary vervain	16.37	83.00	83.00	MN	Showy penstemon	1.71	93.00	93.00	MN
Black-eyed Susan	16.97	96.00	19.00	IA	Yarrow	0.95	93.00	93.00	MN
Leadplant	7.71	50.00	42.00	MN	Fragrant giant hyssop	0.93	67.00	5.00	MN
White prairie clover	3.38	93.00	86.00	MN	Heath aster	0.97	90.00	96.00	IA
Stiff tickseed	2.79	73.00	40.00	MN	Prairie cinquefoil	0.81	88.00	53.00	MN
Bush clover	2.87	38.00	0.00	MN	Stiff goldenrod	0.94	69.00	2.00	MN
Gray goldenrod	2.46	55.00	0.00	MN	Showy goldenrod	0.59	46.00	1.00	MN
Upland goldenrod	2.59	19.00	0.00	MN	Common milkweed	0.49	45.00	1.00	MN
Golden Alexander	2.95	71.00	60.00	MN	Dotted blazingstar	0.44	94.00	94.00	MN
Azure aster	2.00	90.00	90.00	WI	Prairie rose	0.43	72.00	0.00	MN

Weed seed %	0.12	Prairie Restorations, Inc.
Other Crop Seed %	0.05	PO Box 327
Inert Matter %	11.57	Princeton, MN 55371
Total %	100	Test Date: 9/18/2009

Net Weight 2 Oz.

Noxious Weed Seeds/#: 11.40 Hoary alyssum

Short/Dry Native Wildflower Mixture

Lot Number SDFO 3A 2010

Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In	Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In
Purple prairie clover	17.99	92.00	14.00	MN	Wild bergamot	1.90	59.00	3.00	MN
Hoary vervain	16.37	83.00	83.00	MN	Showy penstemon	1.71	93.00	93.00	MN
Black-eyed Susan	16.97	96.00	19.00	IA	Yarrow	0.95	93.00	93.00	MN
Leadplant	7.71	50.00	42.00	MN	Fragrant giant hyssop	0.93	67.00	5.00	MN
White prairie clover	3.38	93.00	86.00	MN	Heath aster	0.97	96.00	96.00	IA
Stiff tickseed	2.79	73.00	40.00	MN	Prairie cinquefoil	0.81	88.00	53.00	MN
Bush clover	2.87	38.00	0.00	MN	Stiff goldenrod	0.94	69.00	2.00	MN
Gray goldenrod	2.46	55.00	0.00	MN	Showy goldenrod	0.59	46.00	1.00	MN
Upland goldenrod	2.59	19.00	0.00	MN	Common milkweed	0.49	46.00	1.00	MN
Golden Alexander	2.95	71.00	60.00	MN	Dotted blazingstar	0.44	94.00	94.00	MN
Azure aster	2.00	90.00	90.00	WI	Prairie rose	0.43	72.00	0.00	MN

Weed seed %	0.12	Prairie Restorations, Inc.
Other Crop Seed %	0.05	PO Box 327
Inert Matter %	11.57	Princeton, MN 55371
Total %	100	Test Date: 9/18/2009

Net Weight 2 Oz.

Noxious Weed Seeds/#: 11.40 Hoary alyssum

Figure 8-12 – Seed tags 17 and 18 of 22 from terrace plantings.

Short/Dry Native Wildflower Mixture

Lot Number SDFO 3A 2010

Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In	Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In
Purple prairie clover	17.99	92.00	14.00	MN	Wild bergamot	1.90	59.00	3.00	MN
Hoary vervain	16.37	83.00	83.00	MN	Showy penstemon	1.71	93.00	93.00	MN
Black-eyed Susan	16.97	96.00	19.00	IA	Yarrow	0.95	93.00	93.00	MN
Leadplant	7.71	50.00	42.00	MN	Fragrant giant hyssop	0.93	67.00	5.00	MN
White prairie clover	3.38	93.00	86.00	MN	Heath aster	0.97	95.00	96.00	IA
Stiff tickseed	2.79	73.00	40.00	MN	Prairie cinquefoil	0.81	88.00	53.00	MN
Bush clover	2.87	38.00	0.00	MN	Stiff goldenrod	0.94	69.00	2.00	MN
Gray goldenrod	2.46	55.00	0.00	MN	Showy goldenrod	0.59	46.00	1.00	MN
Upland goldenrod	2.59	19.00	0.00	MN	Common milkweed	0.49	46.00	1.00	MN
Golden Alexander	2.95	71.00	60.00	MN	Dotted blazingstar	0.44	94.00	94.00	MN
Azure aster	2.00	90.00	90.00	WI	Prairie rose	0.43	72.00	0.00	MN

Weed seed % 0.12 Prairie Restorations, Inc.
Other Crop Seed % 0.05 PO Box 327
Inert Matter % 11.57 Princeton, MN 55371
Total % 100 Test Date: 9/18/2009

Net Weight 2 Oz

Noxious Weed Seeds/#: 11.40 Hoary alyssum

Short/Dry Native Wildflower Mixture

Lot Number SDFO 3A 2010

Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In	Species	Pure Seed %	Total Germination (includes Dorm.)	Dormant Seed %	Grown In
Purple prairie clover	17.99	92.00	14.00	MN	Wild bergamot	1.90	59.00	3.00	MN
Hoary vervain	16.37	83.00	83.00	MN	Showy penstemon	1.71	93.00	93.00	MN
Black-eyed Susan	16.97	96.00	19.00	IA	Yarrow	0.95	93.00	93.00	MN
Leadplant	7.71	50.00	42.00	MN	Fragrant giant hyssop	0.93	67.00	5.00	MN
White prairie clover	3.38	93.00	86.00	MN	Heath aster	0.97	95.00	96.00	IA
Stiff tickseed	2.79	73.00	40.00	MN	Prairie cinquefoil	0.81	88.00	53.00	MN
Bush clover	2.87	38.00	0.00	MN	Stiff goldenrod	0.94	69.00	2.00	MN
Gray goldenrod	2.46	55.00	0.00	MN	Showy goldenrod	0.59	46.00	1.00	MN
Upland goldenrod	2.59	19.00	0.00	MN	Common milkweed	0.49	46.00	1.00	MN
Golden Alexander	2.95	71.00	60.00	MN	Dotted blazingstar	0.44	94.00	94.00	MN
Azure aster	2.00	90.00	90.00	WI	Prairie rose	0.43	72.00	0.00	MN

Weed seed % 0.12 Prairie Restorations, Inc.
Other Crop Seed % 0.05 PO Box 327
Inert Matter % 11.57 Princeton, MN 55371
Total % 100 Test Date: 9/18/2009

Net Weight 2 Oz

Noxious Weed Seeds/#: 11.40 Hoary alyssum

Figure 8-13 - Seed tags 19 and 20 of 22 from terrace plantings.

Short/Dry Grass Mix

Lot Number SDG 5A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Little bluestem	40.30	33.00	55.00	Benton Co., MN	MN
Side oats grama	24.33	88.00	0.00	Clay Co., MN	MN
Blue grama	7.17	78.00	6.00	Sherburne Co., MN	MN
June grass	1.50	0.00	93.00	Canada	CANADA
Kalm's brome	0.64	77.00	14.00	Dakota Co., MN	MN
Poverty oat grass	0.64	3.00	52.00	St. Louis Co., MN	MN
Sand dropseed	0.67	20.00	42.00	Sherburne Co., MN	MN
Prairie dropseed	0.33	29.00	2.00	Sherburne Co., MN	MN

Weed seed % 0.18

Other Crop seed % 0.06

Inert Matter % 24.18

Total % 100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371

Net weight Lbs. 4.48

Test Date: 1/5/2010

Noxious Weed Seeds/#: 0

Short/Dry Grass Mix

Lot Number SDG 5A 2010

Species	Pure Seed%	Germ %	Dormant Seed%	Genetic Origin	Grown In
Little bluestem	40.30	33.00	55.00	Benton Co., MN	MN
Side oats grama	24.33	88.00	0.00	Clay Co., MN	MN
Blue grama	7.17	78.00	6.00	Sherburne Co., MN	MN
June grass	1.50	0.00	93.00	Canada	CANADA
Kalm's brome	0.64	77.00	14.00	Dakota Co., MN	MN
Poverty oat grass	0.64	3.00	52.00	St. Louis Co., MN	MN
Sand dropseed	0.67	20.00	42.00	Sherburne Co., MN	MN
Prairie dropseed	0.33	29.00	2.00	Sherburne Co., MN	MN

Weed seed % 0.18

Other Crop seed % 0.06

Inert Matter % 24.18

Total % 100

Prairie Restorations, Inc.
PO Box 327
Princeton, MN 55371

Net weight Lbs. 0.75

Test Date: 1/5/2010

Noxious Weed Seeds/#: 0

Figure 8-14 – Seed tags 21 and 22 of 22 from terrace plantings.

Table 8-1 Plants observed from photos taken during site visit on 9/19/19. Photos were taken along a meander survey route for plant ID. Several seed mixes were specified in the planting plan prepared by the Mille Lacs SWCD including 6,234 plugs, 325 shrubs, 500 live willow stakes, 1 lb Tall/Wet grass seed, 2 oz Tall/Wet flower seed, 1 lb Shoreline grass seed, ½ lb Mesic grass seed, 2 oz Mesic flower seed, 3 ½ lbs Short/Dry grass seed, 15 oz Short/Dry flower seed, 3 lbs Canada Wild Rye, and 5 lbs Oats. Approximately 75 Bush honeysuckle, 35 Elderberry, 25 Red osier dogwood and 12 New Jersey Tea were planted on the slopes of the terraces.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Populus deltoides	Cottonwood	<5		Native
Elymus canadensis	Canada wildrye	5-10	x	Native
Verbena sp.	Vervain	<5	x	Native
Quercus cf. rubra	Red oak	<5; Seedling		Native
Schizachyrium scoparium	Little bluestem	10-50	x	Native
Cf. Astragalus canadensis	Canada milkvetch	<5		Native
Unknown grass	Bunchgrass 1	5-25		Native?
Unknown grass	Bunchgrass 2	5-25		Native?
Lichen		5-10		Native
Symphyotrichum sp.	Aster	<5		Native
Monarda fistulosa	Wild bergamot	5-25	x	Native
Dalea candida	White prairie clover	<5	x	Native
Heuchera richardsonii	Alumroot	<5		Native
Equisetum sp.	Horsetail	<5		Native
Solidago canadensis/S. altissima	Canada/tall goldenrod	5-25		Native
Solidago gigantea	Giant goldenrod	1-10		Native
Zizia aurea	Golden alexanders	<5	x	Native
Solidago cf. speciose	Showy goldenrod	1-10	x	Native
Coreopsis palmata	Prairie coreopsis	<5		Native
Geum or Potentilla	Avens/cinquefoil	<5; One basal leaf		Native
Bouteloua curtipendula	Sideoats grama	5-25	x	Native
Carex sp.	Sedge – upland species	<5	x	Native
Quercus macrocarpa	Bur oak	<5		Native
Bromus inermis	Smooth brome	5-25		Invasive
Symphyotrichum ericoides	White heath aster	1-10	x	Native
Salix sp.	Willow	1-10	x	Native
Sorghastrum nutans	Indiangrass	5-25	x	Native
Lycopus americanus	American Water Horehound	<5		Native

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Rumex sp.	Dock	<5		Unknown
Cornus sericea	Red-osier dogwood	1-10	x	Native
Comandra umbellate	Bastard toadflax	<5		Native
Artemisia ludoviciana	White sagewort	<5		Native
Ratibida columnifera	Prairie coneflower	<5		Native
Unknown shrub	Cf. Bush honeysuckle	5-25	x	Invasive
Heliopsis helianthoides	Smooth oxeye	<5	x	Native
Cf. Symphyotrichum leave	Smooth blue aster	<5	x	Native
Potentilla cf. arguta	Tall cinquefoil	<5		Native
Euthamia graminifolia	Grass-leaved Goldenrod	1-10		Native
Bidens sp.	Beggarticks	<5		Native
Urtica dioica	Stinging nettle	<5		Native
Achillea millefolium	Common yarrow	<5	x	Native
Potentilla sp.	Cinquefoil	<5		Native
Rubus idaeus	Raspberry	1-10		Native
Fern	Fern	<5		Native
Vitis riparia	Riverbank Grape	<5		Native
Pinus cf. resinosa	Red pine	<5		Native
Andropogon gerardii	Big bluestem	5-25	x	Native
Rhus glabra	Smooth sumac	1-10		Native
Heterotheca villosa	Hairy False Goldenaster	<5		Native

Appendix B: Site Photographs

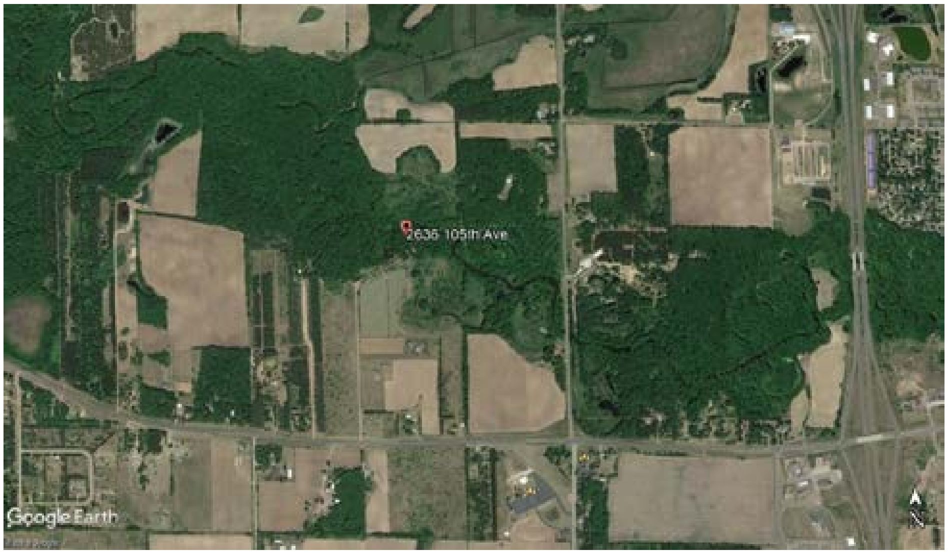


Photo 8-1 Project location overview.

Photo 8-2 Aerial image of the project before construction.

Photo 8-3 Existing steep bank of the West Branch of the Rum River before construction.

Photo 8-4 Bank resloping and terracing during construction. Seed and erosion control blanket installation is occurring as construction progresses and the anchored trees and brush, and brush fascine are installed at the two of the slope on the river.

Photo 8-5 Resloped project area during the first growing season. Landowner provided irrigation during the first growing season, 2010.

Photo 8-6 Resloped project area observed during the site visit. (Rum River West River Branch – Miskowic property, photo taken by Lucius Jonett during site visit 09/19/2019).

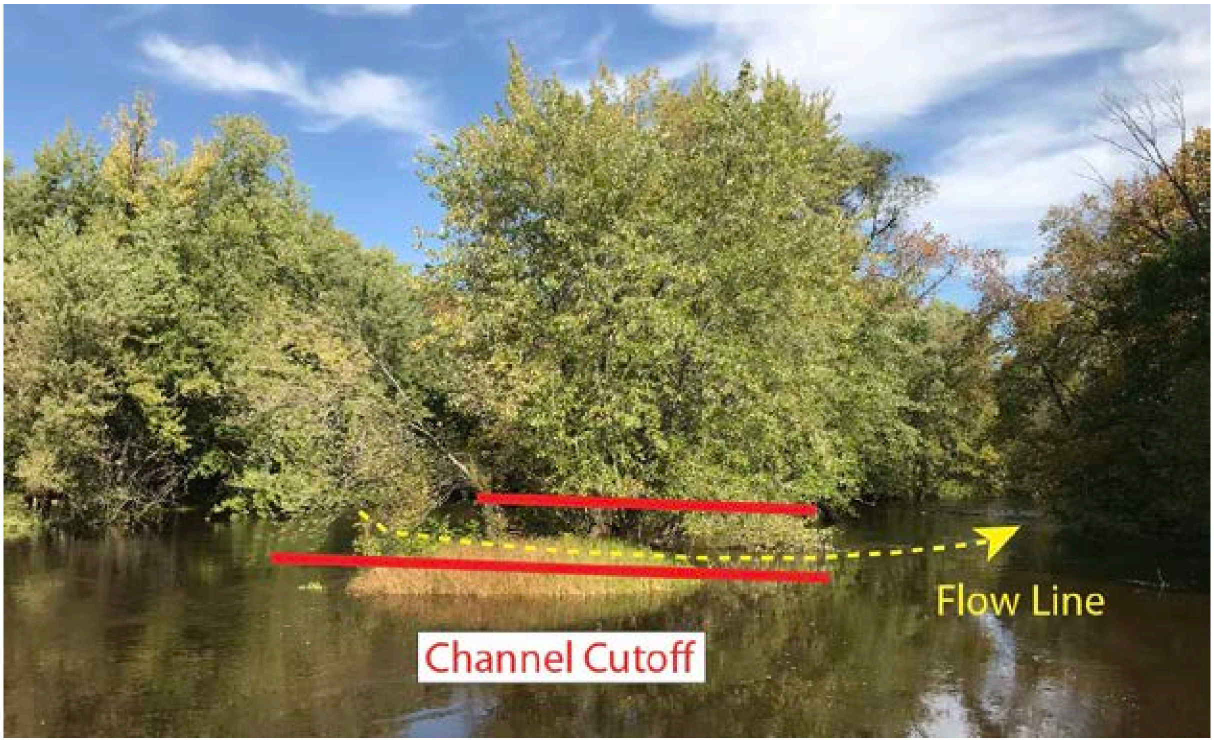


Photo 8-7 Point bar by-pass channel through the inside bend of the meandering channel to allow high flow to short-cut across the inside bend instead of the natural flow path through the outside bend, (Photo taken by Lucius Jonett during site visit 09/19/2019).

Photo 8-8 Conservation Corp and community workshop to review the project and prepare for the planting of native plants and shrubs.

Photo 8-9 Conservation Corp crew planting the plugs, live stake cuttings and shrubs.

Appendix C: Miskowic Planting Plan

Provided by Mille Lacs County SWCD.

All seeding will be done prior to staking down erosion blanket throughout the entire project. All live stakes, shrubs and plugs will be planted into the erosion fabric.

Slopes beyond terraces.

Approximately 25% of plants for all Mesic and Short/Dry areas are assumed to extend beyond terraces to plant slopes at sides of terraces. Approximately 75 Bush honeysuckle, 35 Elderberry, 25 Red osier doogwood and 12 New Jersey Tea will also be planted on slopes.

Trenches for live fascines will be dug at elevations 78, 80 and 83 according to directions in Construction Specifications. Fascine areas will be seeded with Tall/Wet grass seed mix at the same time all other areas are being seeded. Erosion blanket will be staked into fascine trenches after seeding. Live fascines will then be installed per Construction Specifications.

3 pounds of Canada Wild Rye seed will be evenly sown over all planting areas as a companion cover crop with the oats.

Seed an additional 3 lbs of Short/Dry grass seed over top of erosion blanket, evenly distributed over all Mesic and Short/Dry areas.

Elevation 75-80

Construct “tree revetments” as instructed in Construction Specifications.

After construction on tree revetments but prior to placing of Erosion blanket, ½ pound shoreline grass seed mix and ½ pound oats will be sown over areas of bare soil. After seed is sown, erosion control blanket will be staked down. 500 live willow stakes will be inserted through the erosion blanket at elevation 75-80. 312 plugs of appropriate native plant species will be planted through the erosion fabric. Seed, cover crop and plugs should also be placed on edges of tree revetment area and blended into areas beyond project area of concentration.

Elevation 80: Bench 1,200 sq ft

1 pound of Tall/Wet grass seed, 2 oz tall/wet flower seed and ½ pound of oats shall be planted prior to staking down erosion fabric on either side of an 18” maintenance path down the center of the 8 ft bench.

50 False indigo shrubs and 50 Red osier dogwood shall be planted 3 feet apart and mixed and staggered on either side of the 18” maintenance path. 308 plugs of appropriate native plants shall be planted among the shrubs. Spacing of plugs should keep in mind that each shrub will spread to cover approximately 9 square feet.

Elevation 80: Flood plain 400 sq ft

After trees have been tipped into the river from the flood plain, the areas left bare from the removal of the trees shall be planted into appropriate native vegetation. The soil shall be raked smooth and 216 plugs of appropriate native plants will be planted at approximately 1 foot centers. 10 Elderberry shrubs should also be planted into this area.

Elevation 80-85 800 sq ft

All seeding will be done prior to staking down erosion blanket throughout the entire project. All live stakes, shrubs and plugs will be planted into the erosion fabric.

½ pound Mesic grass seed mix, 2 oz mesic flower seed and ½ pound oats shall be planted prior to staking down erosion fabric. 25 Red osier dogwood and 25 ninebark shrubs shall be planted at staggered, 3 foot intervals. 198 plugs of appropriate native plants shall be planted among the shrubs. Spacing of plugs should keep in mind that each shrub will spread to cover approximately 9 square feet.

Elevation 85 900 sq ft

½ pound Short/Dry grass mix, 2 oz short/dry flower seed and ½ pound oats shall be planted prior to staking down erosion fabric on either side of an 18" maintenance path down the center of the 5 foot wide bench. 25 Hazelnut shrubs and 25 nine bark shrubs shall be planted 6 feet apart and staggered on either side of the maintenance path. 402 plugs of appropriate native plants shall be planted among the shrubs. Spacing of plugs should keep in mind that each shrub will cover approximately 9 square feet.

Elevation 85-90 950 sq ft

½ pound Short/Dry grass mix, 2 oz short/dry flower seed and ½ pound oats shall be planted prior to staking down erosion fabric. 25 Hazelnut shrubs shall be planted 6 feet apart. 402 plugs of appropriate native plants shall be planted among the shrubs. Spacing of plugs should keep in mind that each shrub will cover approximately 9 square feet.

Elevation 90 1,000 sq ft

½ pounds Short/Dry grass mix, 2 oz short/dry flower seed and ½ oats shall be planted prior to staking down erosion fabric on either side of an 18" maintenance path down the center of the 5 foot wide bench.

798 plugs of appropriate native plants shall be planted at approximately 1.5 foot centers.

Elevation 90-95 1,060 sq ft

½ pounds Short/Dry grass mix, 2 oz short/dry flower seed and ½ lb oats shall be planted prior to staking down erosion fabric. 750 plugs of appropriate native plants shall be planted at approximately 1.5 foot centers.

Elevation 95 1,110 sq ft

½ pounds Short/Dry grass mix, 2 oz short/dry flower seed and ½ pound oats shall be planted prior to staking down erosion fabric on either side of an 18" maintenance path down the center of the 5 foot wide bench. 750 plugs of appropriate native plants shall be planted at approximately 1.5 foot centers.

Elevation 95-100 1,400 sq ft

1 pound Short/Dry grass mix, 3 oz Short/Dry flower seed and 3/4 pound oats shall be planted prior to staking down erosion fabric. 912 plugs of appropriate native plants shall be planted at approximately 1.5 foot centers.

Elevation 100, Berm 750 sq ft Enlarged to approximately 1300 sq ft

½ pound Short/Dry grass, 2 oz flower seed mix and ½ pound oats shall be planted prior to staking down erosion fabric. 852 plugs of appropriate native plants shall be planted at approximately 1 foot centers.

Extra plants to be added as needed for additional slope and berm

10 6pks harebells, 23 6pks dry grasses, 36 6pks dry grass and forbs

Total Amounts approximately 10,850 sq feet

6,234 plugs

325 shrubs

1 lb Tall/Wet grass seed

2 oz Tall/Wet flower seed

1 lb Shoreline grass seed

½ lb Mesic grass seed

2 oz Mesic flower seed

3 ½ lbs Short/Dry grass seed

15 oz Short/Dry flower seed (one pound may be best value)

3 lbs Canada Wild Rye

5 lbs Oats

9) Stewart River Channel Restoration (Revisit)

County: Lake County

Primary Activity: Stream/River Restoration

Project Size: ~3500 linear feet

Project Completed: 2015

Legacy Fund Restoration Evaluations

See Appendix C for Project Background and Initial Project Evaluation

Project Name: Stewart River – Big Rock Road

Project Manager / Affiliated Organization:

Lake County Soil and Water Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2012

Revisit Site Assessment

Field Review Date: 10/1/2019

Field Visit Attendees: *Karen Tucker–Lake Co SWCD; Ann Thompson –South St. Louis SWCD; Karl Koller–MnDNR; Wade Johnson–MnDNR; Gina Quiram; Cory Goldsworthy–MnDNR; Dean Paron–MnDNR; Jeff Hrubes–BWSR; Erin Loeffler–BWSR; Keith Anderson–Northeast SWCD Technical Services; and Kevin Biehn-EOR*

1. ***What are the stated goals of the project?***
   Excerpt from Original CWF Abstract:
   > This project will restore five severely eroding streambank sites [this project comprises 4 of the 5 sites] along a 1.5 mile reach of the Stewart River.
   > Project will restore and stabilize the natural channel morphology and will contribute to stable stream channel conditions. The benefits from a stable channel in this location will include reduced sediment downstream, less sediment pollution into Lake Superior, and protection of native riparian plant communities. Toe wood combined with rock stream vanes, will decrease bluff erosion and create beneficial fisheries habitat through the introduction of much needed woody debris.

2. ***What are the desired outcomes of achieving the stated goals of the project?***
   - Hydrology: maintain current hydrology (duration, magnitude, and timing of flows); improve baseflow conditions for trout;

- Geomorphology: restore the appropriate channel form (dimension, pattern, and profile) to create a stable channel (neither aggrading nor degrading, while maintaining its form); provide a diversity of habitat and cover;
- Connectivity: restore appropriate connectivity to the floodplain and improve vertical connectivity of stream to groundwater; re-establish the riparian zone where needed;
- Water Quality: reduce sediment input by minimizing stream bank erosion (a reduction of 551 tons per year on 3000 linear feet of stream); improve water temperatures through shading, improved baseflow and narrowing of the channel width;
- Biology: increase the amount and quality of habitat and cover for all life stages of trout and other aquatic organisms; improve temperature and water quality for trout.

3. ***Please note any substantive changes to the site characteristics since last site assessment.***
   Per dialog with project stakeholders portions of the project have been repaired and otherwise modified since the original evaluation in September of 2015. In 2016, some grade control structures were proactively modified to reduce potential risk of failure. Project stakeholders articulated that boulder structures were resized to better match the original design cross sectional area.
   Instabilities caused by 2018 100+ year flood (**Error! Reference source not found.**), were repaired in 2018 (Upper Section), and 2019 (Lower Section). Construction plans for the 2019 repairs (Lower Section) were provided, a sample of which is included herein (**Error! Reference source not found.** & **Error! Reference source not found.**). Design modifications (improvements), in response to the 2018 flood were part of the 2019 modifications. Substrate size throughout the riffle was increased to reduce mobilization, and boulder structures were moved downstream to adjust for new observations on the location of the glide compared to the Point of Tangency on bends – this observation was made on healthy, natural streams and implemented here. Boulder sills were extended from the structures to prevent the stream from cutting around them. On the Upper reach, a constriction in the floodplain that created sediment transport issues was addressed by floodplain grading to restore floodplain continuity and capacity in this area. Ponds were added to increase groundwater infiltration and some fish habitat features (Fish cover) were added. Modifications are expected to make the restoration more resilient and to improve habitat further.
4. ***Is the plan based on current science?*** Yes

   Natural Channel Design (NCD) methodology was implemented to inform analysis and design. NCD is a practice that works to emulate a natural system by using dimension, pattern, and profile measurements from a stable ”reference” reach. The practices employed, such as Toe wood, are common practices used in stream restoration/stabilization in Minnesota and suitable to “North Shore” streams.

5. ***List indicators of project goals at this stage of the project.***
   Given the cursory nature of these evaluations, the complexity of stream restoration and the very recent and substantial repairs to this project it is not prudent to confidently/accurately predict outcomes at this time. Furthermore, the stream was at or near bankfull discharge during the evaluation – a coincidence that both limited the evaluation (physically & visually obstructed) and provided a testing opportunity for the project. Therefore, these limited indicators were available at the time of the evaluation:
   - Hydrology: baseflow conditions for trout appear to have been improved via greater vertical connectivity to groundwater; (Geomorphic restoration, including riffle pool sequences, meandering and toe wood increasing roughness and better lateral connectivity to its floodplain all contribute to improved dissipation of flood flow energy)

- Connectivity: near bankfull event had accessed a portion of the floodplain; Temperature data suggests improved vertical connectivity to groundwater
- Water Quality: relocation of stream away from high, unstable banks should decrease sediment contribution; preliminary temperature & sediment monitoring by project partners are showing positive results; temperature is expected to continue to improve as trees grow and provide shade in the future
- Biology: the addition of wood, large rock and pool forming/holding structures should increase the amount and quality of habitat and cover for trout and other aquatic organisms

6. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project outcomes?***
   The designed and executed project should reasonably address the core hydrology, geomorphology, connectivity, water quality, and biology criteria. The primary risk appears to be the stability of the created grade control structures (boulder riffles) and the mobility of a bed load. Recent flood events have entrained a large bed load and destabilized structures, thus degrading the idealized channel form and habitat potential. This damage was repaired via the 2018/19 work. Project stakeholders have indicated that a vegetation management plan is being followed to ensure desired establishment and to further stabilize the project. As was noted earlier, during the 2018/19 repairs, modifications to the design were implemented to improve resiliency of the channel to another large flood. As time passes and trees get established along the banks, the project should become more and more resilient.
7. ***Are corrections or modifications needed to meet proposed outcomes?***
   There are no warranted corrections/modifications to the evaluators via the cursory review. Given the recent construction disturbance, resulting un-vegetated ground and known difficulty establishing vegetative cover on site soils, additional site restoration inputs may be warranted based on response to 2020 and 2021 establishment.
8. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
   One challenge/limitation is the aggressive grade through the boulder riffles. Via novel adaptive management, project partners made adjustments in 2018-19 to further bolster this potential limitation. Vegetation establishment before another larger flood event is likely an additional challenge. Project partners also indicated that a flow restriction (berm constructed in the late 1800's or early 1900s), between the upper and lower restoration reaches is a potential threat to the project, (in terms of flood flow sediment mobilization), that is being watch closely.
9. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
   No detractors to habitat are apparent to the evaluators via the cursory review.
10. ***Are follow-up assessments needed? Explain.***
    Yes, a follow up assessment(s) is warranted. Given the recent and substantial repairs, and high water during the evaluation, there is value in reevaluating this project in 3-5 years.   In addition, stream projects that require removal of riparian vegetation and regrading of banks are most vulnerable immediately following construction but become more stable over times (decades) as trees grow and get re-established. This project had set a long-term goals and therefore, longer term evaluations will better assess the success..
11. ***Additional comments on the restoration project.***

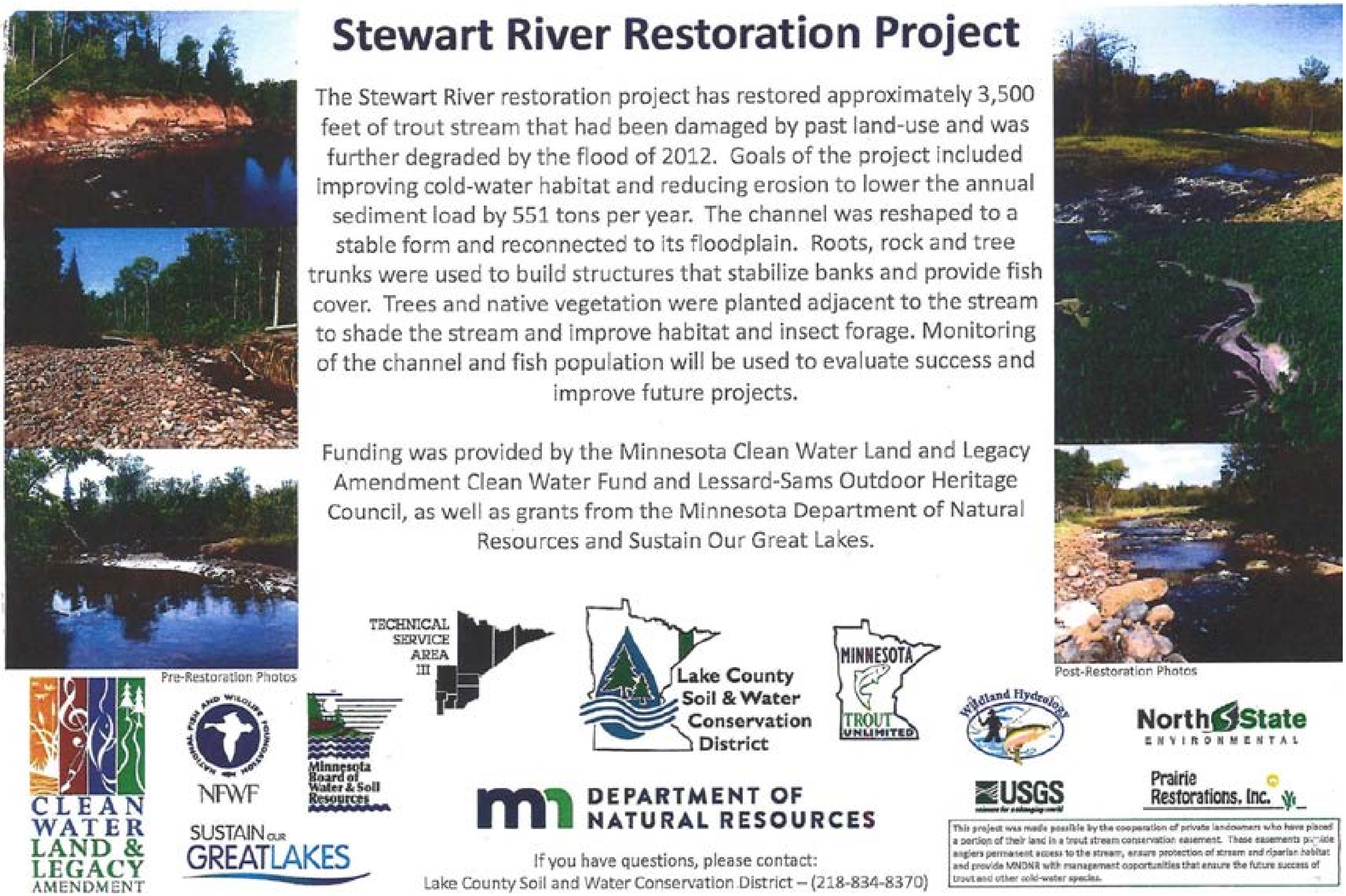
Project managers have established a comprehensive set of goals and design strategies to address overall stream health. This holistic approach has enabled fulfillment of discrete sediment reduction goals and should provide improved long term habitat. The project aimed to address multiple physical and biological processes not only in the channel but also the floodplain. Evaluating comprehensive restorations such as this are challenging with a short-term, somewhat subjective review process. These type of projects would benefit from more comprehensive, qualitative monitoring. Unfortunately, there are limited funding sources for this.

Revisit Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

12. ***The project has:***
    achieved the stated goals.
13. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Low
14. ***Provide explanation of reason(s) for determination.***
    Based on professional judgement the project has achieved the stated goals and will meet proposed outcomes. Given the cursory nature of these evaluations, the complexity of stream restoration and the very recent and substantial repairs, there is 'low' confidence in this determination. This confidence interval is not necessary reflective of or germane to the project, but rather the ability to confidently assume outcome based on limitations previously stated. A subsequent evaluation, (recommended in 3-5 years), should provide further insight.
15. ***Site Assessor(s) Conducting Review:***
    Kevin Biehn-EOR

Appendix A: Revisit Site maps, Project plans or Vegetation tables



Stewart River Restoration Project

The Stewart River restoration project has restored approximately 3,500 feet of trout stream that had been damaged by past land-use and was further degraded by the flood of 2012. Goals of the project included improving cold-water habitat and reducing erosion to lower the annual sediment load by 551 tons per year. The channel was reshaped to a stable form and reconnected to its floodplain. Roots, rock and tree trunks were used to build structures that stabilize banks and provide fish cover. Trees and native vegetation were planted adjacent to the stream to shade the stream and improve habitat and insect forage. Monitoring of the channel and fish population will be used to evaluate success and improve future projects.

Funding was provided by the Minnesota Clean Water Land and Legacy Amendment Clean Water Fund and Lessard-Sams Outdoor Heritage Council, as well as grants from the Minnesota Department of Natural Resources and Sustain Our Great Lakes.

Pre-Restoration Photos

Post-Restoration Photos

TECHNICAL SERVICE AREA III

Lake County Soil & Water Conservation District

MINNESOTA TROUT UNLIMITED

Wildland Hydrology

North State ENVIRONMENTAL

CLEAN WATER LAND & LEGACY AMENDMENT

NFWF

Minnesota Board of Water & Soil Resources

DEPARTMENT OF NATURAL RESOURCES

USGS

Prairie Restorations, Inc.

SUSTAIN OUR GREAT LAKES

If you have questions, please contact:
Lake County Soil and Water Conservation District – (218-834-8370)

This project was made possible by the cooperation of private landowners who have placed a portion of their land in a trout stream conservation easement. These easements provide anglers permanent access to the stream, ensure protection of stream and riparian habitat and provide MNDNR with management opportunities that ensure the future success of trout and other cold-water species.

Figure 9-1 Scan of project summary provided by Lake County SWCD.

NO.	NOTE	ITEM	QUANTITY	UNIT
1		MOBILIZATION	1	LS
2	1	SITE GRADING	1	LS
3	2	CLASS III RIP RAP	626	CU YD
4	3	EXCAVATE J-HOOK STRUCTURES	5	EACH
5	4	RE-BUILD J-HOOK STRUCTURES	5	EACH
6	5	REBUILD GLIDE STRUCTURE	9	EACH
7	6	TOE WOOD	237	LIN FT
8		MULCH MATERIAL TYPE 3	1.7	TON
10		CONIFEROUS TREE, 1.5' HT CONT	280	EACH
11		DECIDUOUS TREE, 1.5' HT CONT	100	EACH
12		DECIDUOUS SHRUB, 1.5" HT CONT	203	EACH
13		TRANSPLANTS	20	EACH
14		SEEDING	0.95	ACRE
15		SEED MIXTURE 34-361	18	LBS
16	7	MN DOT CAT 4 EROSION CONTROL BLANKET	1691	SY
17		SEED MIXTURE 36-311	33	LBS
18	8	9.8 ' WIDE ROLL EROSION CONTROL BLANKET- 700 GRAM COCUNUT FIBER WITH CAT. 3N BACKER BLANKET	1624	FT

BID TAB NOTES:

1. SITE GRADING CONSISTS OF ALL GRADING ON THE SITE NOTED ON PLANS, EXCAVATION OF POOLS, CREATING STABLE SLOPES OF 2:1 IN RIFFLES AND FILLING AREAS OF THE FLOODPLAIN THAT WERE IMPACTED BY THE FLOOD. THIS IS A LUMP SUM QUANTITY PAID OUT AT THE COMPLETION OF THE PROJECT.
2. CLASS III RIP RAP IS INTENDED FOR USE IN REBUILDING THE RIFFLES WITH 50% CLASS III RIP RAP AND 50% IN PLACE MATERIAL ALONG WITH IMPORTED MATERIAL AS NEEDED TO ACHIEVE SLOPE IN PROFILE.
3. ITEM INCLUDES EXCAVATING GRAVEL AND SAND MATERIAL TO RESTORE FUNCTION OF J–HOOK.
4. ITEM INCLUDES REBUILDING J HOOK SUCH THAT THE ROCK SILL AND LOG FUNCTION AS DESIGNED IN THE DETAIL IN PLAN SET.
5. THIS ITEM INCLUDES REBUILDING THE ROCK PORTION OF THE GLIDE STRUCTURE AS NOTED IN THE DETAIL, IN MOST CASES THE ROCK NEEDED WILL BE ON SITE, IT IS ANTICIPATED THAT 30 ADDITIONAL ROCKS NOT LOCATED ON SITE
6. THIS ITEM IS NOTED ON THE PLANS WHERE ADDITIONAL TOE WOOD WILL BE INSTALLED ON THE SITE.
7. THIS ITEM IS TO BE USED IN THE UPPER AREA OF THE PROJECT WHERE CALLED OUT ON THE PLANS.
8. THE EROSION CONTROL, 700 GRAM BLANKET SHALL BE USED ALONG THE STREAM EDGE WHERE GRADING AND RESHAPING WILL BE OCCURRING

GENERAL NOTES;

1. PLAN NOTES THAT ARE NOT INCLUDED IN THE QUANTITIES ARE CONSIDERED INCIDENTAL TO THE PROJECT BID, NO CHANGE ORDERS SHALL BE ISSUED FOR PLAN ITEMS NOT INCLUDED ON THE BID TAB.
2. CONTRACTOR SHALL TAKE PRECAUTIONS TO MINIMIZE DISTURBANCE AND ONLY HAVE ONE ACCESS PATH THAT MINIMIZES DISTURBANCE TO EXISTING VEGETATION.
3. CUT/FILL QUANTITIES SHALL BE BALANCED ON SITE.

TECHNICAL SERVICE AREA III

215 N 1ST AVE E, ROOM 301
DULUTH MN, 55802
(218) 723 - 4865

PROJECT:

LOWER STEWART RIVER REPAIRS

LOCATION:

LATITUDE: 47.072272
LONGITUDE: -91.710005

DISTRICT:

LAKE COUNTY SWCD

NOTES:

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.

PRINTED NAME: KEITH A. ANDERSON

SIGNATURE:

DATE: 6/21/2019 LIC. NO. 42827

DESIGNED: KAA DATE: 6/21/2019
DRAWN: PDV DATE: 6/21/2019
CHECKED: DATE:

REVISION:	BY:	DATE:	APPROVED:
—	—	—	—
—	—	—	—
		—	

2 - QUANTITIES

T:\ACTIVE PROJECTS\Lake\2018_stewart\Plans\2A LOWER STEWART REPAIR OVERVIEW.dwg, 6/21/2019 10:59:24 AM, _AutoCAD PDF (General Documentation).pc3

Figure 9-2 2019 Repair Plans – Construction Sheet 2 of 18

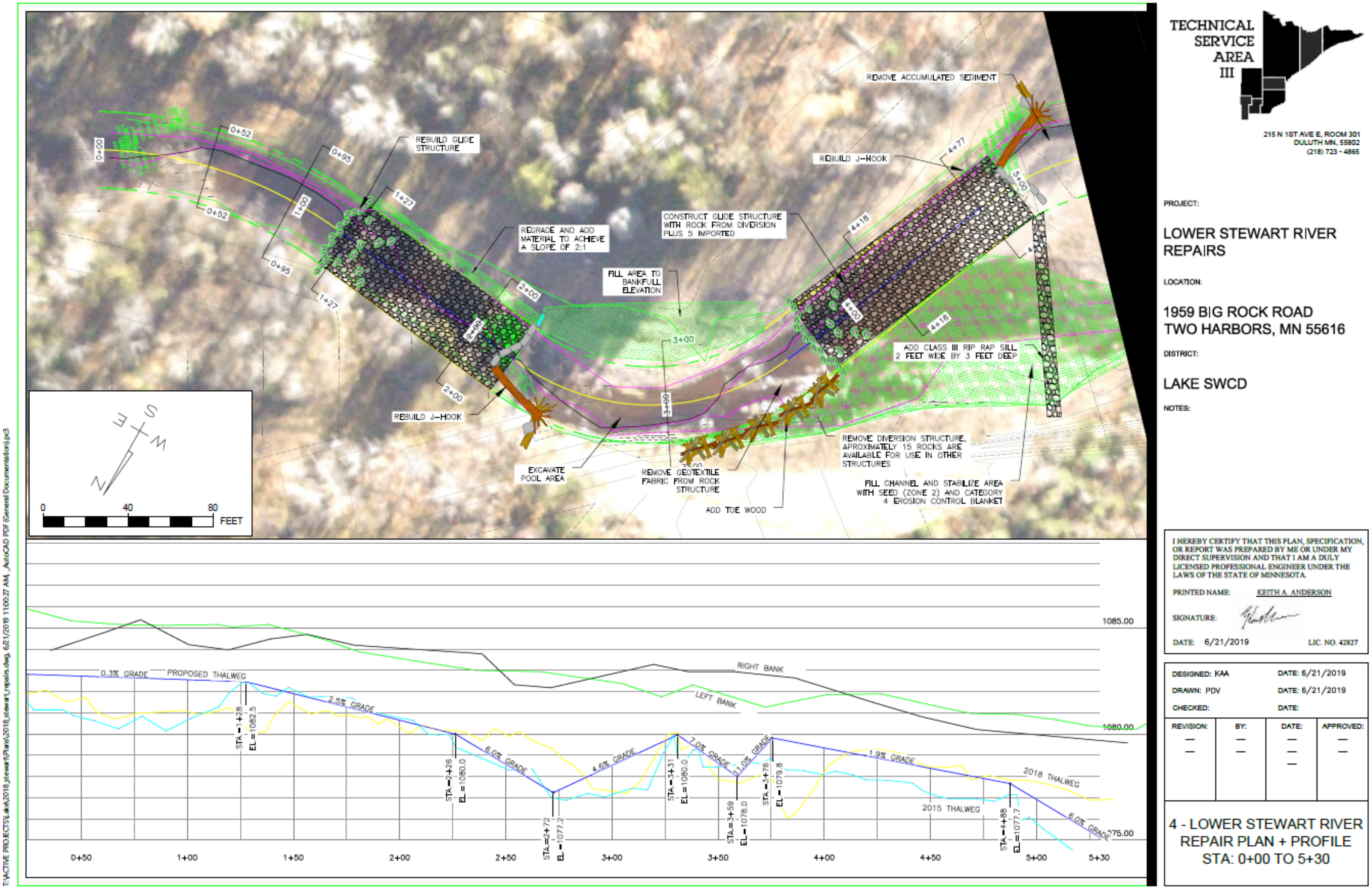


Figure 9-3 2019 Repair Plans – Construction Sheet 4 of 18

Table 9-1 Meander Search Species List compiled by Kevin Biehn on 10/1/2019 site visit.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Agastache foeniculum	Blue giant hyssop	0-1%	Yes	Native
Alnus incana	Speckled alder	5-25%	Yes	Native
Andropogon gerardii	Big bluestem	1-5%	Yes	Native
Arctium minus	Common burdock	1-5%	No	Invasive
Cirsium arvense	Canada thistle	1-5%	No	Invasive
Cornus sericea	Red-osier dogwood	1-5%	Yes	Native
Equisetum spp.	Horsetail spp.	1-5%	No	Native
Eupatorium perfoliatum	Boneset	0-1%	Yes	Native
Glyceria grandis	American manna grass	1-5%	Yes	Native
Leucanthemum vulgare	Ox-eye daisy	0-1%	No	Non-native
Melilotus officinalis	Yellow sweet clover	1-5%	No	Non-native
Monarda fistulosa	Wild bergamot	1-5%	Yes	Native
Phalaris arundinacea	Reed canary grass	5-25%	No	Invasive
Picea glauca	White spruce	1-5%	Yes	Native
Pinus resinosa	Red pine	1-5%	Yes	Native
Pinus strobus	White pine	1-5%	Yes	Native
Quercus alba	White oak	1-5%	Yes	Native
Rubus spp.	Raspberry spp.	5-25%	No	Native
Rudbeckia hirta	Black-eyed Susan	1-5%	Yes	Native
Schizachyrium scoparium	Little bluestem	1-5%	Yes	Native
Scirpus atrovirens	Dark green bulrush	1-5%	Yes	Native
Securigera varia	Crown vetch	5-25%	No	Non-native
Solidago spp.	Goldenrod spp.	1-5%	Unknown	
Spartina pectinate	Prairie cordgrass	1-5%	Yes	Native
Tanacetum vulgare	Common tansy	5-25%	No	Invasive
Thalictrum spp.	Meadow rue spp.	1-5%	Unknown	Native
Thuja occidentalis	White cedar	1-5%	Yes	Native
Trifolium repens	White clover	1-5%	No	Non-native
Viburnum opulus var. americanum	American highbush cranberry	1-5%	Yes	Native

Appendix B: Revisit Site Photographs

Photo 9-1 Eroding bank in the project reach June 2012 prior to 2015 project construction.

Photo 9-2 Spring 2018 100-year flood event on the Stewart River. Image provided by Ann Thompson.

Photo 9-3 Representative 'before' image (prior to 2015 restoration) of Stewart River restoration. Note point of reference for comparison between Photo 9-3 & Photo 9-4 (1). Image provided by Ann Thompson.

Photo 9-4 2018 'after' image from same perspective as Photo 9-3. Note that the thalweg has been moved away from formerly steep, eroding, clay bank. Note point of reference for comparison between Photo 9-2 & Photo 9-3 (1). Image provided by Ann Thompson.

Photo 9-5 Disturbance and associated site restoration that parallels both side of the stream is a product of 2018-19 repairs and modifications. Photograph taken by Kevin Biehn during 10/1/2019 site visit.

Photo 9-6 Representative image of high gradient segment of river and repaired grade control structure (1) looking upstream. Note saplings recently planted along stream edge (2). Photograph taken by Kevin Biehn during 10/1/2019 site visit.

Appendix C: Initial Project Evaluation

*Fields in original evaluation form may vary. Information was translated to newest version as applicable.

Project Background

Project Name: Stewart River – Big Rock Road

Project Location: Lake County

Township/Range Section: Township 53N Range 10W Section 13

Project Manager / Affiliated Organization: Lake County Soil and Water Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2012

Project Start Date: 2015

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest , Choose an item.

Project Status: Establishment Phase

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

16. ***What are the specific project components and treatments?***
    - Alteration of stream dimension, pattern & profile
    - Associated habitat and stabilization inputs
    - Site restoration / vegetation establishment inputs

17. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***

    WSFR Section 7 Evaluation Documents (1/26/2015) Environmental Assessment Worksheet (2/2015); Construction Plan Set (4/10/2015); Quality Assurance Project Plan (4/15/2015); Cultural Resource Reconnaissance Survey (6/2015); and Project Overview (dated 9/2015).

18. ***What are the stated goals of the project?***
    Excerpts from Original CWF Abstract:

    > This project will restore five severely eroding streambank sites [it's understood that the Big Rock Road Project comprises 4 of the 5 sites] along a 1.5 mile reach of the Stewart River. The cumulative streambank length is 976 feet and the streambank heights vary from 6 to 30 feet. The sites generate over 446 tons of sediment and 480 pounds of phosphorus annually.
    >
    > Overall, these five projects will restore and stabilize the natural channel morphology and will contribute to stable stream channel conditions. The benefits from a stable channel in this location

will include reduced sediment downstream, less sediment pollution into Lake Superior, and protection of native riparian plant communities. Toe wood combined with rock stream vanes, will decrease bluff erosion and create beneficial fisheries habitat through the introduction of much needed woody debris.

Hydrology: maintain current hydrology (duration, magnitude, and timing of flows); improve baseflow conditions for trout;

Geomorphology: restore the appropriate channel form (dimension, pattern, and profile) to create a stable channel (neither aggrading nor degrading, while maintaining its form); provide a diversity of habitat and cover;

Connectivity: restore appropriate connectivity to the floodplain and improve vertical connectivity of stream to groundwater; re-establish the riparian zone where needed;

Water Quality: reduce sediment input by minimizing stream bank erosion (a reduction of 551 tons per year on 3000 linear feet of stream); improve water temperatures through shading, improved baseflow and narrowing of the channel width;

Biology: increase the amount and quality of habitat and cover for all life stages of trout and other aquatic organisms; improve temperature and water quality for trout.

19. ***What are the desired outcomes of achieving the stated goals of the project?***
    - Question not a part of 2015 evaluation form -
20. ***Were measures of restoration success identified in plans?*** *Yes*
    If yes, list specific measurements.
    From a stand point of evaluating the project & stream health the Owner intends to execute a monitoring plan. The following is an excerpt of the provided plan:
    The completed stabilization reach will be inspected for structural and vegetative components at the end of the first year and every three years thereafter throughout the duration of the effective life. Lake SWCD and DNR staff will establish permanent cross-sections that will be monumented and re-surveyed in the future to ensure the channel remains stable and to estimate erosion rates. Bank Erosion Hazard Index (BEHI) and Near Bank Shear Stress (NBSS) assessments have been performed and will continue to be assessed after restoration is complete to determine erosion rates and amounts of sediment entering the river. The DNR will assess fish populations and stream temperatures prior to restoration and post-restoration in varied locations throughout the watershed. These numbers will be compared to baseline data collected prior to the June 2012 flood. Sediment loads will be monitored by the DNR in partnership with the USGS. Sediment samples will be taken during high flow events to measure both suspended sediment and bedload. Sediment loads will be monitored pre and post construction at the downstream edge of the restoration reach. Sediment load data will be paired with flow data to allow DNR and SWCD staff to determine how much sediment is being moved during specific flow events. Flow data will be collected by the SWCD and the DNR. Flow data will be collected at low, medium, and high flows with the goal of creating a flow duration curve.

21. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No
    If yes, provide in Appendix A and list Maps provided:
    Figure 9-1 Project Overview from construction plan set (sheet 2 of 15)

Figure 9-2 - Plan & Profile from Construction Plan Set (Sheet 3 of 15)
Figure 9-3 - Representative image of restoration. Stream was near bankfull discharge during site evaluation
Photo 9-4 - Representative image of one of the created ponds (left)
Photo 9-5 – Representative image of project elements: Toe Wood (right) with willow harvested mats above and Log J Hook with Rootwad downstream (left)

22. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***

    Natural Channel Design (NCD) methodology was reportedly implemented to inform analysis & design. NCD is a standard industry methodology for stream restoration, most associated with Wildland Hydrology Consultants and Dave Rosgen.

    The practices employed, such as Toe-wood, are common practices used in stream restoration/stabilization in Minnesota and suitable to "North Shore" streams.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

23. ***Were alterations made to the plan during project implementation?***

    No

    Click here to enter text.

24. ***In what ways did alterations change the proposed project outcome?***

    N/A

Site Assessment

Field Review Date: *9/24/2015*

Field Visit Attendees: *Wade Johnson – MN DNR, Kevin Biehn – EOR, Dan Schutte and Ann Thompson – Lake County SWCD, Jeff Hrubes – MN BWSR*

25. ***Surrounding Landscape Characteristics:***

    Land type of the project area is Laurentian Mixed Forest. Vegetation at the project site consists of hardwood trees and conifers. Riparian vegetation is made up of grasses, sedges, willow and alder. The Stewart River is a designated trout stream. Brook trout and steelhead are present in this reach.

    Current land use is privately owned, undeveloped forest land. Private homes are present on each of the three parcels of land. The homes are outside of the project area. State angling easements are present along the riparian corridor on parcel 25-5311-15910 on the northeast side of the river and on parcel 25-5311-15740 on both the east and west sides of the Stewart River.

26. ***Site Characteristics:***

    k. ***Soils:***

       The two primary soils types within the restored reach are Forbay-Fluvaquents, frequently flooded complex, 0 to 45 percent slope, 24 percent area; 60% Coarse-loamy drift over friable fine-loamy till over dense coarse-loamy lodgment till, well drained, HSG = B 35% stratified loamy and clayey alluvium, very poorly drained, HSG = B/D Miskoaki-Fluvaquents, frequently flooded complex, 0 to 45 percent slope, 31 percent area; 60% Stratified loamy and clayey alluvium with soils that are fine and well drained alfisols HSG = D35% Fluvaquents that are very poorly drained stratified loamy and clayey alluvium HSG = B/D

l. ***Topography:***

High gradient stream

m. ***Hydrology:***

Stream flow is flashy due to prevalence of tight soils, shallow depth to bedrock and steep topography

n. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***

The following vegetation establishment measures were completed prior to the evaluation: Native seeding (hydro-mulch), live staking of cuttings and onsite harvest & transplant of single woody species and a conglomeration of “living root balls”. Additional specified plantings are scheduled for 2016. At the time of the site visit the live cuttings and transplanted material appeared viable and an emerging nurse/cover crop was apparent with 20%± coverage of disturbed ground. Overall, it is too soon after installation and late in the year to estimate survivorship and vegetation establishment. Project managers should monitor plant establishment throughout 2016 & 2017, paying particular attention to project & site challenges, such as: harvest and transplanting of material outside of dormancy and the general difficulty of establishing cover on rocky, low-organic soils.

o. ***Vegetation B: Meander Search Species List (as appropriate for site)***

- Question not a part of prior evaluation -

27. ***Is the plan based on current science?*** Yes

“*See #6, BMPs*”**.** Referenced question is currently under #22

28. List indicators of project goals at this stage of project:

Summary: It is too early to confidently predict outcomes at this time (see #17 below). Furthermore the stream was at or near bankfull discharge during the evaluation – a coincidence that both limited the evaluation (physically & visually obstructed) and provided a testing opportunity for the project. Therefore, these limited indicators were available at the time of the evaluation:

- Connectivity: near bankfull event had accessed a portion of the floodplain;
- Water Quality: relocation of stream away from high, unstable banks should decrease sediment contribution;
- Biology: the addition of wood, large rock and pool forming/holding structures should increase the amount and quality of habitat and cover for trout and other aquatic organisms.

29. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

The design and executed project can reasonably address the core hydrology, geomorphology, connectivity, water quality, and biology criteria. The intended long-term monitoring should be sufficient and documenting success and any shortcomings.

30. Are corrections or modifications needed to achieve proposed goals?

No warranted corrections/modifications apparent this early in the establishment phase.

31. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

No foreseeable issues with the core project, there may be challenges with maintaining the created ponds (see #34).

32. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No long-term detraction apparent.
33. ***Are follow-up assessments needed? Explain.***
    Yes – there would be significant value in reevaluating this project in 3-5 years. This evaluation was completed within 3± weeks of substantial completion, when vegetation inputs were not fully completed and temporary and permanent vegetation had yet to establish. A follow up evaluation after vegetation has established and the project has experienced ≥ 2 channel forming discharges will be more telling of probable outcome, especially if the monitoring plan is executed as planned (see #20 above).
34. ***Additional comments on the restoration project.***
    The created ponds should also be closely monitored as the project evolves. A beneficial product of onsite borrow/harvesting gravel and/or rock for the project, resources were also invested in providing and controlling flow to and through these features. Created, flow-through ponds/wetlands in the floodplain are difficult to control and/or maintain, as flood flows and associated detritus commonly fill, erode and otherwise alter these feature. Constructed ponds/wetland in this context should be resilient, permitted to evolve and/or constructed for a short lifespan. It's worth noting that additional value was gained from this project via the utilization as a hands-on learning opportunity for 30± local and state water resource professionals.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

35. ***The project has:*** Field not present in initial evaluation
    Choose an item.
36. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium
37. ***Provide explanation of reason(s) for determination.***
    Given that the project is in the very early stages of establishment, reviewer evaluation is conservative. The designed and executed project has indicators of success, but it is premature to determine whether goals have been met.

38. ***Site Assessor(s) Conducting Review:***
    Kevin Biehn, Consultant, Emmons & Olivier Resources, Inc.

Site Maps

Figure 9-4 Project Overview from construction plan set (sheet 2 of 15)

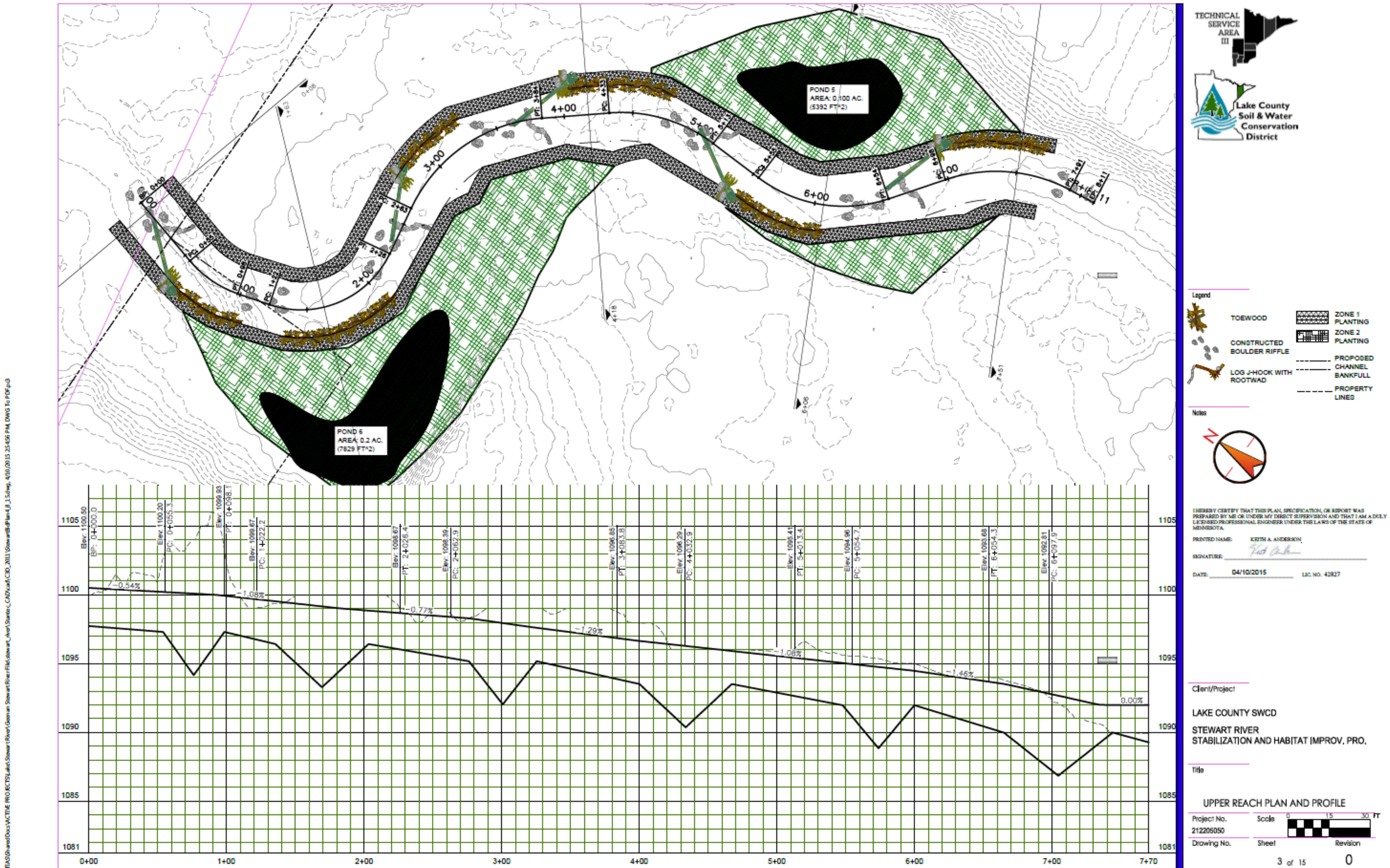


Figure 9-5 Plan & Profile from Construction Plan Set (Sheet 3 of 15)

Site Photographs

Photo 9-7 Representative image of restoration. Stream was near bankfull discharge during site evaluation 09/24/2015.

Photo 9-8 Representative image of one of the created ponds (left) 09/24/2015.

Photo 9-9 Representative image of project elements: Toe Wood (right) with willow harvested mats above and Log J Hook with Rootwad downstream (left) 09/24/2015.

10) Stewart River Watershed Protection (Revisit)

Legacy Fund Restoration Evaluations

See Appendix C for Project Background and Initial Project Evaluation

Project Name: Stewart River Stabilization and Habitat Improvement– Liukkonen Project

Project Manager / Affiliated Organization:

Lake County Soil and Water Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2012

County: Lake County

Primary Activity: Stream/River Restoration

Project Size: ~300 linear feet

Project Completed: 2015

Revisit Site Assessment

Field Review Date: 10/1/2019

Field Visit Attendees: *Karen Tucker–Lake Co SWCD; Ann Thompson –South St. Louis SWCD; Karl Koller–MnDNR; Wade Johnson–MnDNR; Gina Quiram; Cory Goldsworthy–MnDNR; Dean Paron–MnDNR; Jeff Hrubes–BWSR; Erin Loeffler–BWSR; Keith Anderson–Northeast SWCD Technical Services; Barb Liukkonen-Land Owner and Kevin Biehn-EOR*

1. ***What are the stated goals of the project?***
   Excerpt from Original CWF Abstract:
   This project will restore five severely eroding streambank sites [this project comprises 1 of the 5 sites] along a 1.5 mile reach of the Stewart River.
   Project will restore and stabilize the natural channel morphology and will contribute to stable stream channel conditions. The benefits from a stable channel in this location will include reduced sediment downstream, less sediment pollution into Lake Superior, and protection of native riparian plant communities. Toe wood combined with rock stream vanes, will decrease bluff erosion and create beneficial fisheries habitat through the introduction of much needed woody debris.
2. ***What are the desired outcomes of achieving the stated goals of the project?***
   - Hydrology: maintain current hydrology (duration, magnitude, and timing of flows); improve baseflow conditions for trout;

- Geomorphology: restore the appropriate channel form (dimension, pattern, and profile) to create a stable channel (neither aggrading nor degrading, while maintaining its form); provide a diversity of habitat and cover;
- Connectivity: restore appropriate connectivity to the floodplain and improve vertical connectivity of stream to groundwater; re-establish the riparian zone where needed;
- Water Quality: reduce sediment input by minimizing stream bank erosion; Improve water temperatures through shading, improved baseflow and narrowing of the channel width;
- Biology: increase the amount and quality of habitat and cover for all life stages of trout and other aquatic organisms; improve temperature and water quality for trout.

3. ***Please note any substantive changes to the site characteristics since last site assessment.***
   No substantial changes or alterations are known to the evaluator.
4. ***Is the plan based on current science?*** Yes
   Natural Channel Design (NCD) methodology was implemented to inform analysis and design. NCD is a practice that works to emulate a natural system by using dimension, pattern, and profile measurements from a stable ”reference” reach. The practices employed, such as Toe-wood, are common practices used in stream restoration/stabilization in Minnesota and suitable to “North Shore” streams.
5. ***List indicators of project goals at this stage of the project.***
   The stream was at or near bankfull discharge during the evaluation – a coincidence that both limited the evaluation (physically & visually obstructed) and provided a testing opportunity for the project. Therefore, these limited indicators were available at the time of the evaluation:
   - Connectivity: near bankfull event had accessed a portion of the floodplain;
   - Water Quality: relocation of stream away from high unstable banks should decrease sediment contribution;
   - Biology: the addition of wood, large rock, and pool forming/holding structures should increase the amount and quality of habitat and cover for trout and other aquatic organisms
6. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project outcomes?***
   The design and executed project can reasonably address the core hydrology, geomorphology, connectivity, water quality, and biology criteria. The intended long-term monitoring should be sufficient in documenting success and any shortcomings.
7. ***Are corrections or modifications needed to meet proposed outcomes?***
   Bank erosion is occurring in conjunction with a constructed grade control structure (boulder riffle). The landowner stated on the visit that the bank had not been eroding until a large tree was caught on the structure this spring, which was re-directing some of the flow into the bank at this point (see **Photo 10-2**). This structure and log should be closely watched and corrected if erosion worsens and/or the structure is threatened.
8. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
   In addition to the aforementioned potential bank instability, the downstream terminus of the Toe-wood should be observed for stability. Bank instability immediately downstream of a transition in roughness can be common if the treatment is not terminated correctly. As it exists now it is not a threat and actually provides habitat, but should be observed in the future.
9. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***

No additional detractors are apparent to the evaluators via the cursory review.

10. ***Are follow-up assessments needed? Explain.***
    This is the 2nd assessment of this project. It is given a low priority for additional assessment, but recommended that it be paired with a future nearby assessment to evaluate the condition/repair of the bank erosion (see response to #7).
11. ***Additional comments on the restoration project.***
    The presence of common restoration plant species, which are native to Minnesota, but not native to the site, are likely the product of a well-meaning landowner and not formally a part of the project. The landowner's diligence for controlling invasive species likely helped establishment of the healthy riparian vegetation.

Revisit Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

12. ***The project has:***
    achieved the stated goals.
13. ***The project will:***
    Minimally meet proposed outcomes
    Confidence of outcome determination:
    Medium
14. ***Provide explanation of reason(s) for determination.***
    Given the potential threat to the boulder riffle and associated potential bank instability, the outcome is limited to 'minimally achieving'.
15. ***Site Assessor(s) Conducting Review:***
    Kevin Biehn-EOR

Appendix A: Revisit Site maps, Project plans or Vegetation tables

Table 10-1 Meander Search Species List compiled by Kevin Biehn on 10/1/2019 site visit.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Abies balsamea	Balsam fir	0-1%	Yes	Native
Alnus incana	Speckled alder	25-50%	Yes	Native
Asclepias incarnate	Swamp milkweed	0-1%	Yes*	Native
Calamagrostis Canadensis	Canada bluejoint	1-5%	Yes	Native
Chelone glabra	White turtlehead	0-1%	Yes*	Native
Cirsium arvense	Canada thistle	0-1%	No	Non-native
Elymus canadensis	Canada wild rye	5-25%	Yes	Native
Equisetum spp.	Horsetail spp.	0-1%	No	Native
Eutrochium maculatum	Spotted joe-pye weed	0-1%	Yes*	Native
Fragaria spp.	Strawberry spp.	1-5%	No	Native
Geranium maculatum	Wild geranium	0-1%	No	Native
Glyceria canadensis	Rattlesnake manna grass	1-5%	Yes	Native
Heliopsis helianthoides	Smooth oxeye	1-5%	Yes	Native
Liatris pycnostachya	Prairie blazing star	0-1%	Yes*	Native
Lycopus spp.	Bugleweed spp.	0-1%	Unknown	Native
Melilotus spp.	Sweet clover spp.	1-5%	No	Non native
Monarda fistulosa	Wild bergamot	1-5%	No	Native
Phalaris arundinacea	Reed canary grass	5-25%	No	Invasive
Picea glauca	White spruce	1-5%	Yes	Native
Picea mariana	Black spruce	1-5%	Yes	Native
Populus tremuloides	Quaking aspen	1-5%	Yes	Native
Rudbeckia hirta	Black-eyed Susan	0-1%	Yes	Native
Sagittaria latifolia	Broad-leaf arrowhead	0-1%	Yes	Native
Salix interior	Sandbar willow	1-5%	Yes	Native
Schoenoplectus acutus	Hard-stem bulrush	0-1%	Yes	Native
Scirpus atrovirens	Dark green bulrush	0-1%	Yes	Native
Scirpus spp.	Woolgrass spp.	1-5%	Yes	Native
Silphium perfoliatum	Cup plant	0-1%	Yes*	Native
Solidago spp.	Goldenrod spp.	0-1%	Yes	Native
Symphyotrichum puniceum	Purple-stemmed aster	0-1%	Unknown	Native
Tanacetum vulgare	Common tansy	1-5%	No	Invasive
Thuja occidentalis	White cedar	0-1%	Yes	Native
Verbena hastata	Blue vervain	0-1%	Yes	Native

* Based on anecdotal landowner input assumed to have been planted and established by landowner

Appendix B: Revisit Site Photographs

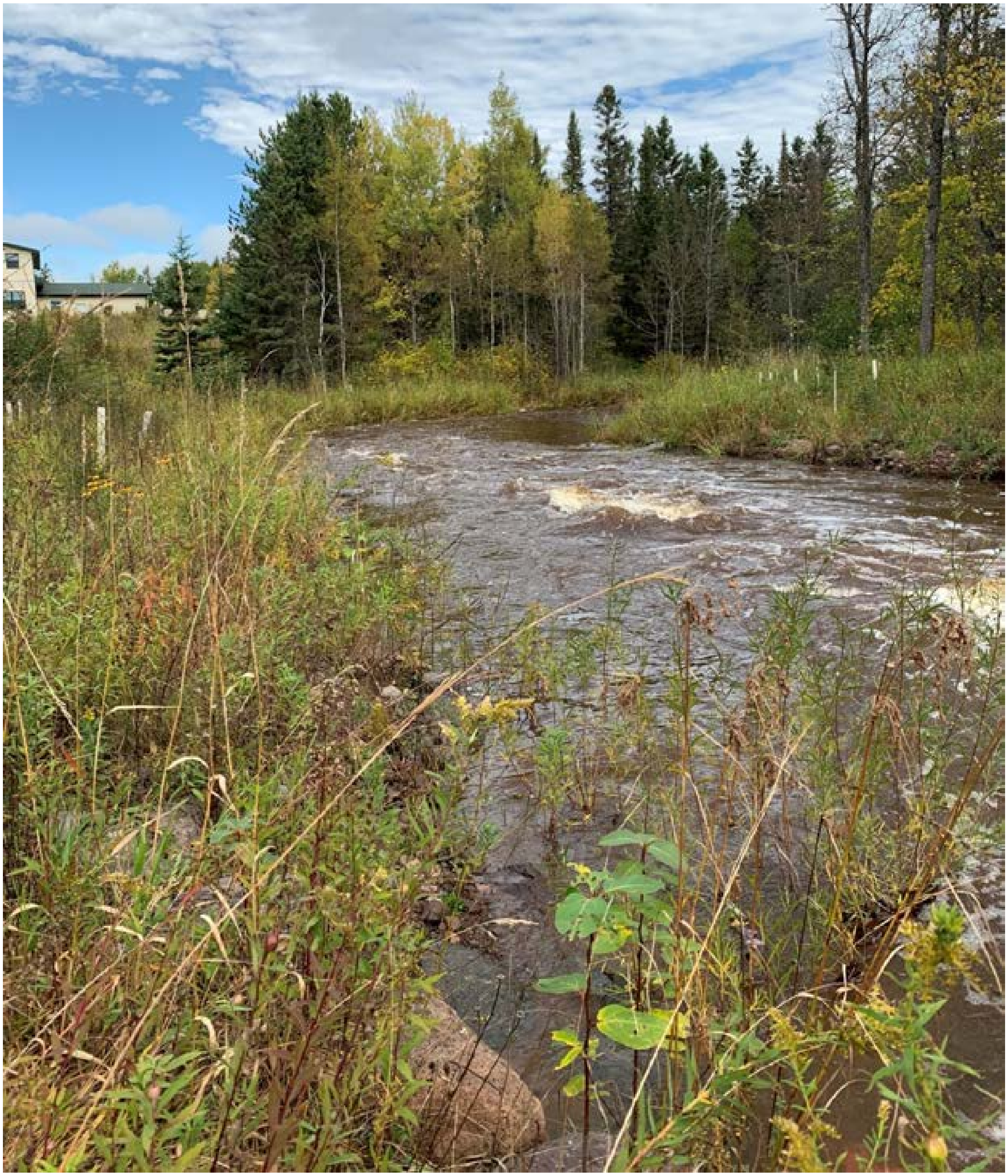


Photo 10-1 – Current representative image of 2015 stabilization efforts on the Steward River – Liukkonen Site. Photograph taken looking downstream at a period of high (near bankfull) river stage. Photograph taken by Kevin Biehn during 10/1/2019 site visit.

Photo 10-2 – Image of grade control structure (rock riffle) at a period of high (near bankfull) river stage. Note the erosion on the opposite bank, which is likely a product of water deflection from a log (1), which was caught on the structure this past spring. Photograph taken by Kevin Biehn during 10/1/2019 site visit.

Minnesota Department of Natural Resources
Minnesota Board of Water and Soil Resources

Appendix C: Initial Project Evaluation

*Fields in original evaluation form may vary. Information was translated to newest version as applicable.

Project Background

Project Name: Stewart River Stabilization and Habitat Improvement– Liukkonen Project

Project Location: Lake County

Township/Range Section: Section 13 T53N, R10W

Project Manager / Affiliated Organization: Lake County Soil and Water Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2012

Project Start Date: 2015

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest , Choose an item.

Project Status: Establishment Phase

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

16. ***What are the specific project components and treatments?***
    Bank stabilization via channel alteration (pattern, profile and dimension) and the introduction of Toe Wood and instream structures.
17. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
    Construction Plan Set (3/2015); SHPO Review and Compliance Memorandum (5/27/2015); Stewart River Clean Water Fund Evaluation (9/2015).

18. ***What are the stated goals of the project?***

Excerpts from Original CWF Abstract:

> This project will restore five severely eroding streambank sites [it is understood that the Liukkonen Project is 1 of 5 sites] along a 1.5 mile reach of the Stewart River. The cumulative streambank length is 976 feet and the streambank heights vary from 6 to 30 feet. The sites generate over 446 tons of sediment and 480 pounds of phosphorus annually.
>
> Overall, these five projects will restore and stabilize the natural channel morphology and will contribute to stable stream channel conditions. The benefits from a stable channel in this location will include reduced sediment downstream, less sediment pollution into Lake Superior, and protection of native riparian plant communities. Toe wood combined with rock stream vanes, will decrease bluff erosion and create beneficial fisheries habitat through the introduction of much needed woody debris.
>
>> Hydrology: maintain current hydrology (duration, magnitude, and timing of flows); improve baseflow conditions for trout
>>
>> Geomorphology: restore the appropriate channel form (dimension, pattern, and profile) to create a stable channel (neither aggrading nor degrading, while maintaining its form); provide a diversity of habitat and cover
>>
>> Connectivity: restore appropriate connectivity to the floodplain and improve vertical connectivity of stream to groundwater; re-establish the riparian zone where needed
>>
>> Water Quality: reduce sediment input by minimizing stream bank erosion (a reduction of 551 tons per year on 3000 linear feet of stream); improve water temperatures through shading, improved baseflow and narrowing of the channel width.
>>
>> Biology: increase the amount and quality of habitat and cover for all life stages of trout and other aquatic organisms; improve temperature and water quality for trout.

19. ***What are the desired outcomes of achieving the stated goals of the project?***
    - Question not addressed by prior evaluation -
20. ***Were measures of restoration success identified in plans?*** *Yes*
    If yes, list specific measurements.
    From a stand point of evaluating the project & stream health the Owner intends to execute a monitoring plan. The following is an excerpt of the provided plan:

> The completed stabilization reach will be inspected for structural and vegetative components at the end of the first year and every three years thereafter throughout the duration of the effective life. Lake SWCD and DNR staff will establish permanent cross-sections that will be marked and re-surveyed in the future to ensure the channel remains stable and to estimate erosion rates. Bank Erosion Hazard Index (BEHI) and Near Bank Shear Stress (NBSS) assessments have been performed and will continue to be assessed after restoration is complete to determine erosion rates and amounts of sediment entering the river. The DNR will assess fish populations and stream temperatures prior to restoration and post-restoration in varied locations throughout the watershed. These numbers will be compared to baseline data collected prior to the June 2012 flood. Sediment loads will be monitored by the DNR in partnership with the USGS. Sediment samples will

be taken during high flow events to measure both suspended sediment and bedload. Sediment loads will be monitored pre and post construction at the downstream edge of the restoration reach. Sediment load data will be paired with flow data to allow DNR and SWCD staff to determine how much sediment is being moved during specific flow events. Flow data will be collected by the SWCD and the DNR. Flow data will be collected at low, medium, and high flows with the goal of creating a flow duration curve.

21. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No
    If yes, provide in Appendix A and list Maps provided:
    Figure 10-1 - Project Overview from construction plan set (Sheet 2 of 6)
    Figure 10-2 - Design Profile, Cross-Sections and Details (Sheet 3 of 6)
    Figure 10-3 - Representative image of stabilization. Note the grade control structure (center images) was a project add-on (understood to have been requested and/or funded separately by Minnesota Trout Unlimited).
    Figure 10-4 - Representative image of toe wood (near bank) and onsite transplants (near bank) along with the tree and shrub plantings with browse protection.
    Figure 10-5 – A constructed offline "wildlife pond" (left side of image), a minor project change, was a product of balancing cut & fill.

22. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
    3. Natural Channel Design (NCD) methodology was reportedly implemented to inform analysis and design. NCD is a standard industry methodology for stream restoration, most associated with Wildland Hydrology Consultants and Dave Rosgen.
    4. The practices employed, such as toe wood, are common practices used in stream restoration/stabilization in Minnesota and on North Shore streams.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

23. ***Were alterations made to the plan during project implementation?***
    Yes

    One or more grade control structures (e.g. Cross Vane or Vortex Weir) were added to the project.

24. ***In what ways did alterations change the proposed project outcome?***
    The reasoning is unknown, but the introduction of one or more such structures will likely control the horizontal and vertical position of the stream and will also likely generate and maintain downstream pool depth.

Site Assessment

Field Review Date: 9/24/2015

Field Visit Attendees: *Wade Johnson – MN DNR, Kevin Biehn – EOR, Dan Schutte and Ann Thompson – Lake County SWCD, Jeff Hrubes – MN BWSR*

25. ***Surrounding Landscape Characteristics:***
    Land type of the project area is Laurentian Mixed Forest. Vegetation at the project site consists of hardwood trees and conifers. Riparian vegetation is made up of grasses, sedges, willow, and alder. The Stewart River is a designated trout stream. Brook trout and steelhead are present in this reach. Current land use is privately owned, undeveloped forest land with rural residential homes.

26. ***Site Characteristics:***

    p. ***Soils:***
       The primary soil type within the area of work is Miskoaki-Fluvaquents, frequently flooded, complex 0 to 45 percent slopes; NRCS Map Unit Symbol – E2-33E

    q. ***Topography:***
       High gradient stream

    r. ***Hydrology:***
       Stream flow is flashy due to prevalence of tight soils, shallow depth to bedrock and steep topography

    s. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
       The following vegetation establishment measures were completed prior to the evaluation: Native seeding, live staking of cuttings, tree planting, (with browse protection), shrub planting and onsite harvest & transplant of single woody species and a conglomeration of "living root balls. At the time of the site visit the live cuttings and planted material appeared viable and an emerging nurse/cover crop was apparent with 10%± coverage of disturbed ground. Overall, it is too soon after installation and late in the year to estimate survivorship and vegetation establishment. Project managers should monitor plant establishment throughout 2016 & 2017.

    t. ***Vegetation B: Meander Search Species List (as appropriate for site)***
       - Question not a part of prior evaluation -

27. ***Is the plan based on current science?*** Yes
    Click here to enter text.

28. ***List indicators of project goals at this stage of project:***
    Summary: It is too early to confidently predict outcomes at this time (see #33 below). Furthermore the stream was at or near bankfull discharge during the evaluation – a coincidence that both limited the evaluation (physically & visually obstructed) and provided a testing opportunity for the project. Therefore, these limited indicators were available at the time of the evaluation:
    - Connectivity: near bankfull event had accessed a portion of the floodplain;
    - Water Quality: relocation of stream away from high unstable banks should decrease sediment contribution;
    - Biology: the addition of wood, large rock and pool forming/holding structures should increase the amount and quality of habitat and cover for trout and other aquatic organisms

29. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    The design and executed project can reasonably address the core hydrology, geomorphology, connectivity, water quality, and biology criteria. The intended long-term monitoring should be sufficient and documenting success and any shortcomings.

30. ***Are corrections or modifications needed to achieve proposed goals?***
    No warranted corrections/modifications apparent this early in the establishment phase.

31. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    No foreseeable issues with the core project.
32. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No long-term detraction apparent.
33. ***Are follow-up assessments needed? Explain.***
    Yes – there would be significant value in reevaluating this project in 3-5 years. This evaluation was completed within 3± weeks of substantial completion, when vegetation inputs were not fully completed and temporary and permanent vegetation had yet to establish. A follow up evaluation after vegetation has established and the project has experienced ≥ 2 channel forming discharges will be more telling of probable outcome, especially if the monitoring plan is executed as planned (see #20 above).
34. ***Additional comments on the restoration project.***
    - Question not previously addressed -

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

35. ***The project has:*** Field does not appear in initial evaluation form
    Choose an item.

36. ***The project will:***
    Minimally meet proposed outcomes
    Confidence of outcome determination:
    Medium
37. ***Provide explanation of reason(s) for determination.***
    Given that the project is in the very early stages of establishment, reviewer evaluation is conservative. The designed and executed project has indicators of success, but it is premature to determine whether goals have been met.
38. ***Site Assessor(s) Conducting Review:***
    Kevin Biehn, Consultant, Emmons & Olivier Resources, Inc.

Site Maps

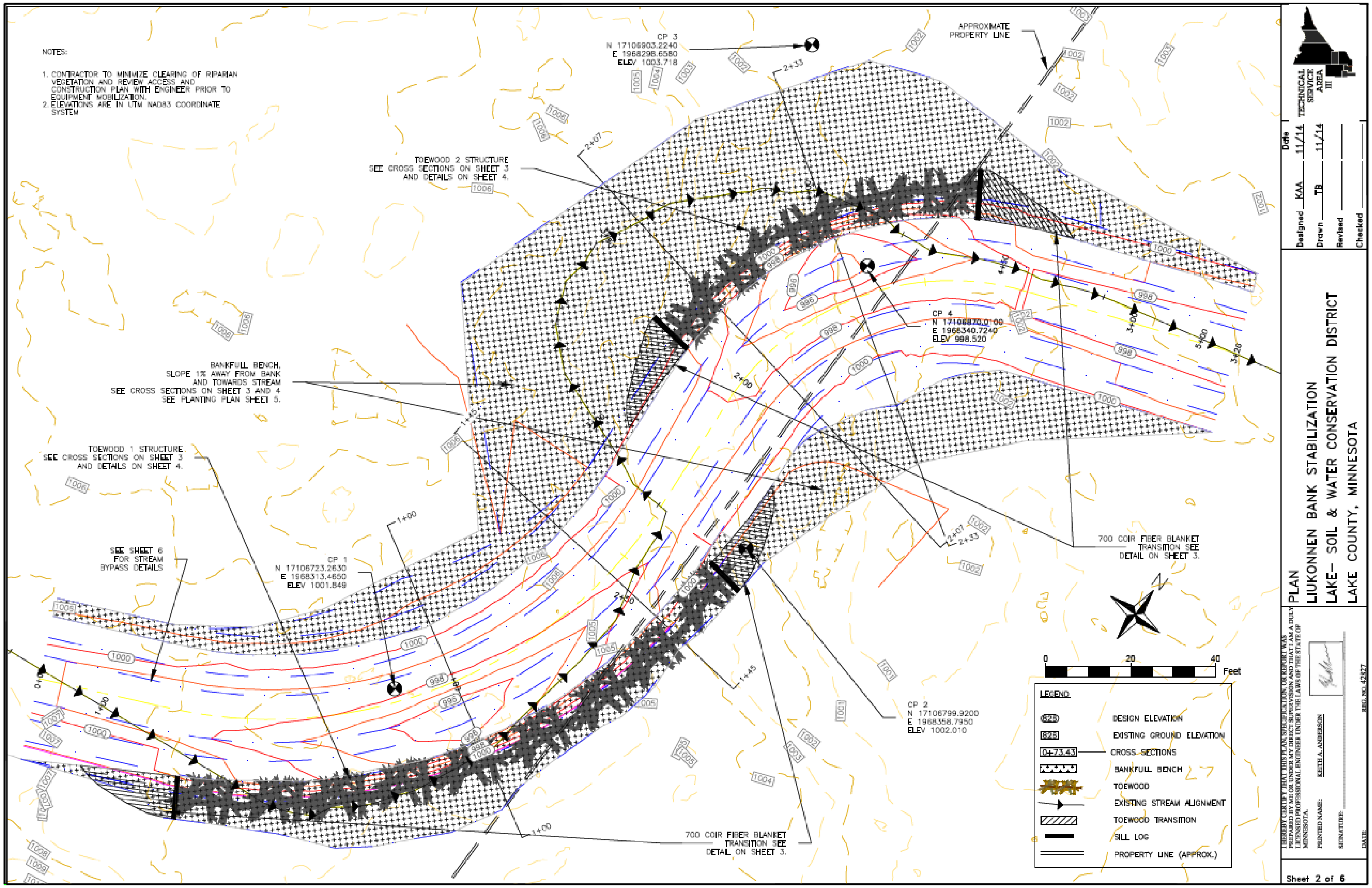


Figure 10-1 Project Overview from construction plan set (Sheet 2 of 6)

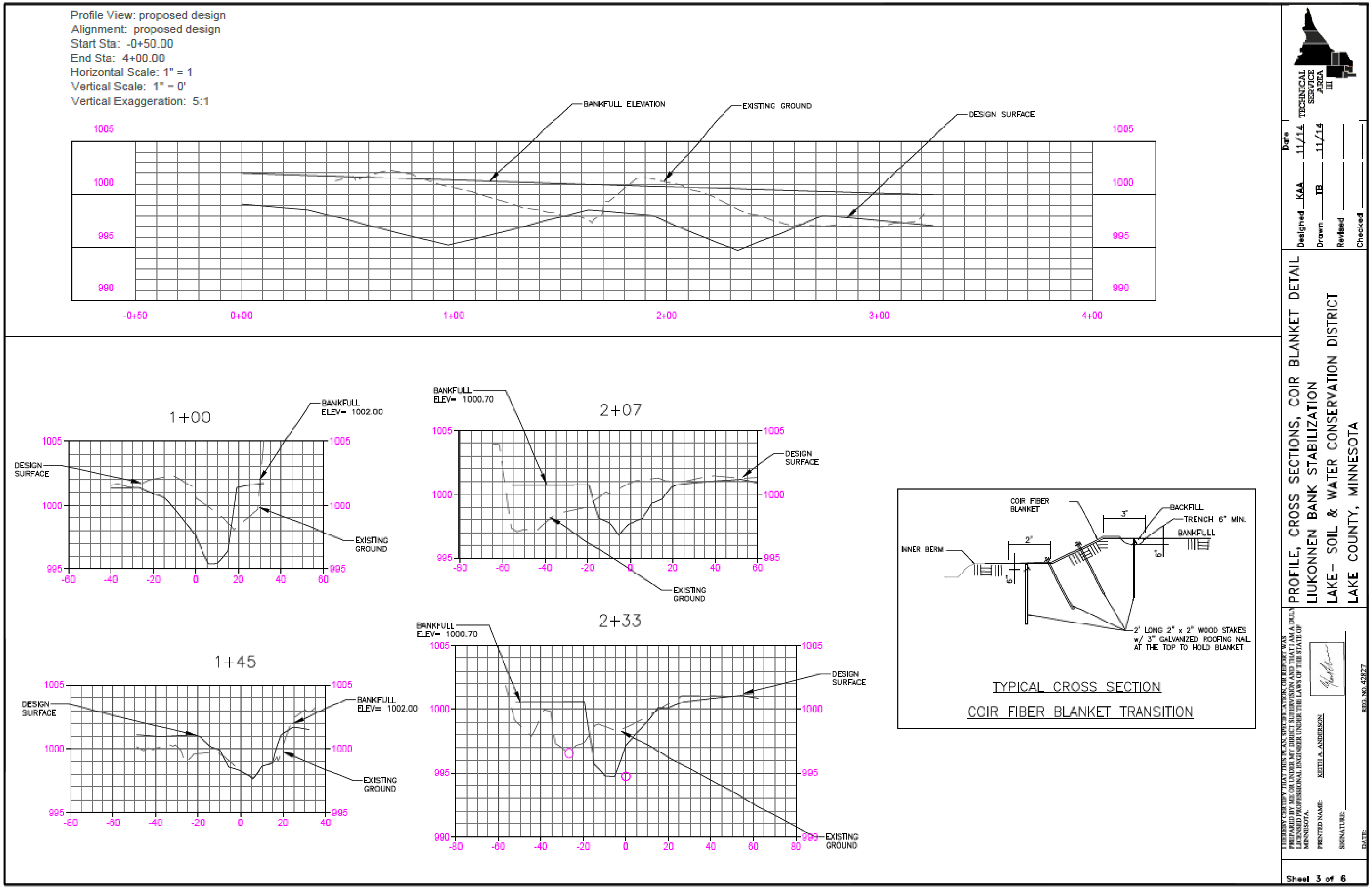


Figure 10-2 Design Profile, Cross-Sections and Details (Sheet 3 of 6)

Site Photographs

Photo 10-3 Representative image of stabilization. Note the grade control structure (center images) was a project add-on (understood to have been requested and/or funded separately by Minnesota Trout Unlimited). Date 10/24/2015.

Photo 10-4 Representative image of toe wood (near bank) and onsite transplants (near bank) along with the tree and shrub plantings with browse protection. Date 10/24/2015.

Photo 10-5 A constructed offline “wildlife pond” (left side of image), a minor project change, was a product of balancing cut & fill. Date 10/24/2015.

11) Thief River Erickson Streambank Enhancement

Project Background

Project Name: Thief River – Erickson Streambank Stabilization

Project Site: Thief River

Township/Range Section: Township MN T154N Range R43W Section 16

Project Manager / Affiliated Organization: Pennington Soil and Water Conservation District (SWCD) / James Hest

Fund: CWF ***Fiscal Year Funds:*** 2010

Project Start Date: August 12, 2010

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest , Choose an item.

Project Status: Post Establishment Phase

County: Pennington

Primary Activity: Stream/River Restoration

Project Size: 1700 Linear Feet

Project Completed: December 2014

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Eight riprap stream barbs installed on the outside bend of the Thief River. Stream barbs extend from the bank sloping downward into the river, varying between 18 and 22 ft in length. Additionally, installation of a side water inlet to eliminate erosion where the ditch outlets into the river.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   - **Erickson Group – Streambank Stabilization,** Pennington County, MN – Red River Valley Conservation Service Area (RRVCSA), March 2011.
   - **Design Report: Erickson Group – Streambank Stabilization**, RRVCSA
   - **Operation and Maintenance Plan: Streambank Stabilization for Erickson Group**, Pennington SWCD
   - **2010 – Shoreland Improvement – Pennington SCWD Elink Reports**, Pennington SWCD, March 2013 & 2014
3. ***What are the stated goals of the project?***
   Stabilize 1,700 linear feet of streambank using riprap stream barbs.
4. ***What are the desired outcomes of achieving the stated goals of the project?***

Protect two homes threatened by bank failure, preserve as many of the existing oak trees in the backyard and on the streambank as possible, as well as improve water quality for the Thief River which is impaired for low dissolved oxygen and turbidity.

5. ***Were measures of restoration success identified in plans?*** *No*
   If yes, list specific measurements.
   No quantifiable restoration measurements were described in the plans. Observation of the protected bank for continued or new erosion features could be used as a measure of success.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   - **Erickson Group – Streambank Stabilization,** Pennington County, MN – Red River Valley Conservation Service Area (RRVCSA), March 2011. Document includes project location, general plans, typical sections, riprap details, and stream barb details.
   - **Design Report: Erickson Group – Streambank Stabilization, Operation and Maintenance Plan: Streambank Stabilization for Erickson Group,** Pennington County, MN – Pennington SWCD. Document includes design criteria, description of the problem, soils information, research, specifications, and O&M agreement between land user and SWCD.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***

Stream barbs. Installation of stream barbs which extend into the river sloping downward (approximately 20:1 V), varying between 18 and 22 ft in length. Barbs are a minimum of 3 ft wide. Stream bards are keyed into the streambanks to a minimum elevation of the 10-yr peak flow, and 8 ft into the bank to prevent erosion behind the structure. The use of stream barbs and vanes to prevent streambank erosion is a standard in Minnesota as put forth in the Minnesota Pollution Control Agency (MPCA) BMP Table.

The construction and design of the stream barbs was guided by current science: Techniques for Estimating Peak Flow on Small Streams in Minnesota, NRCS MN Technical Note No. 8, NRCS Minnesota Construction Specifications, and MNDOT Standard Specifications for Construction.

Revegetation of disturbed banks. Revegetation of disturbed streambanks with native vegetation is industry standard in Minnesota.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Additional Class III rock riprap quantity was added to the project during construction. Topsoil was also added to the project for revegetation of the disturbed banks.
9. ***In what ways did alterations change the proposed project outcome?***
   The alterations were made to meet the proposed project outcomes and provide a finished construction project.

Site Assessment

Field Review Date: **6/5/2019**

Field Visit Attendees: Zach Foley – Red River Valley Conservation Service Area, James Hest – Red River Valley Conservation Service Area, Matthew Fischer – Board of Water and Soil Resources, Corey Hanson – Red Lake Watershed District, Bryan Malone – Pennington Soil and Water Conservation District, Ed Matthiesen – Wenck Associates, Gina Quiram – MN Department of Natural Resources.

10. ***Surrounding Landscape Characteristics:***
    The site is surrounded by cultivated land to the North, and West, and is adjacent to a small residential area to the East and a golf course to the South. The Thief River at the site location is surrounded by vegetated grass and forested slopes. Average buffer width is roughly 40 ft (width varies between 0-50 ft along site area).
11. ***Site Characteristics:***
    a. ***Soil Series:***
    Clearwater clay (I9F), Fluvaquents, and frequently flooded-Hapludolls complex (I16F).
    b. ***Topography:***
    Main-channel slope of 1.9 ft/mi
    c. ***Hydrology:***
    Poorly drained. Based on the MNDOT report Techniques for Estimating Peak Flow on Small Streams in Minnesota, the channel-forming flow of the river is estimated at 1,150 cfs.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
    Streambank woodland consisting of an overstory of cottonwood, green ash, and other mature native trees (dominants not determined). Understory dominants appear to be western snowberry shrubs, the non-native grasses smooth brome and Kentucky bluegrass, and the native forbs northern bedstraw and veiny meadow rue. Invasive cover in the understory is due to introduced grasses and sweetclover between 50-75% combined. Appear to possibly be a few individuals of Canada thistle (noxious), but this is not confirmed; no other noxious species noted and other invasives appear to contribute relatively low cover.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
    See Appendix A, Table 11-1
12. ***Is the plan based on current science?*** Yes
    The plan was developed with guidance from Techniques for Estimating Peak Flow on Small Streams in Minnesota, NRCS MN Technical Note No. 8, NRCS Minnesota Construction Specifications, MNDOT Standard Specifications for Construction, the Erosion Sedimentation and Sediment Yield Report (USDA NRCS, Pennington and Marshall Beltrami SWCDs, 1996), and Thief River TMDL Studies.

13. ***List indicators of project goals at this stage of project:***
    Banks within project area are well-vegetated and show minimal signs of erosion.
14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Yes, with minimal maintenance needs.
15. ***Are corrections or modifications needed to achieving proposed goals?***

Project goals are met.

16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

    The long-term maintenance for the project will be provided by the landowners as agreed upon in the operation and maintenance plan for the Erikson Group–developed with the Pennington SWCD. Along a small portion of the project mowing to the bank and scraping down to bare soil was observed. This activity is not currently causing problems, but should be monitored.
    There are no additional future steps planned or proposed by the project managers.
    A design suggestion by the observer is to install live stakes on the bare slopes present around Stream Barb 3 and Stream Barb 4. This would provide additional streambank stability while further reducing maintenance needs. Another opportunity to provide similar benefits would be the addition of a buffer on top of the bank in the vicinity of Stream Barbs 3 and 4. The observer also suggested removing the trees and limbs leaning over the river in order to reduce debris in the river in the future.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No, but the project does not provide much additional habitat.
18. ***Are follow-up assessments needed? Explain.***
    No. Project has been observed to meet its proposed outcomes in the 8 years since its completion, and it is anticipated to continue to do so.
19. ***Additional comments on the restoration project.***
    This project was a partnership between the Pennington County Soil and Water Conservation District, the Red River Valley Conservation Service Area, and the landowners. The project was constructed using the funds awarded in the grant, supplemented with funding, materials and in-kind work from the landowners to provide and complete seed installation. Ongoing monitoring is being provided by Pennington SWCD.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    Very certain project has met desirable outcomes.
23. ***Site Assessor(s) Conducting Review:***
    Ed Matthiesen

Appendix A: Site maps, Project plans or Vegetation tables

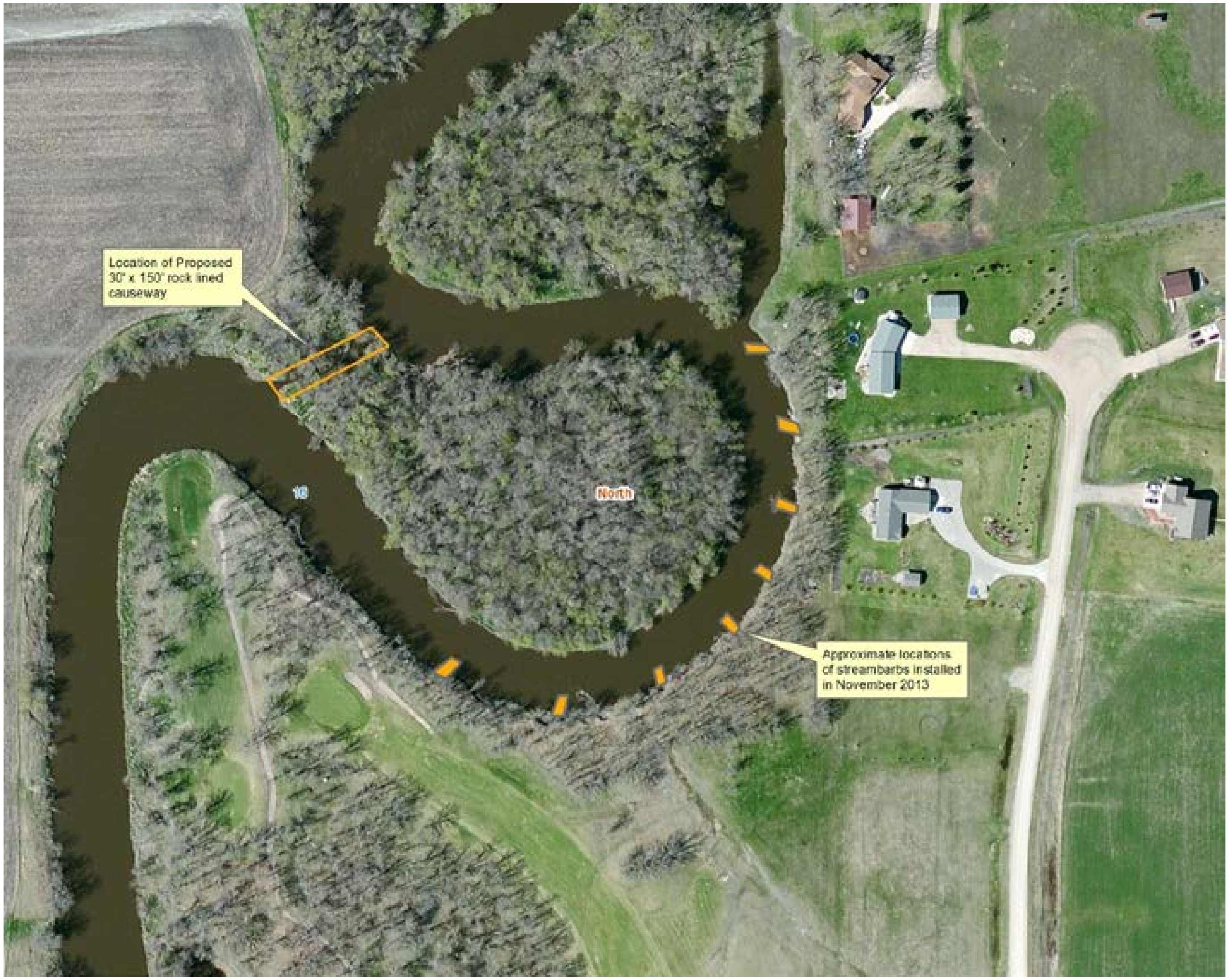


Figure 11-1 Map of project site on Thief River Meander upstream of Thief River Falls. Locations of installed stream barbs are shown.

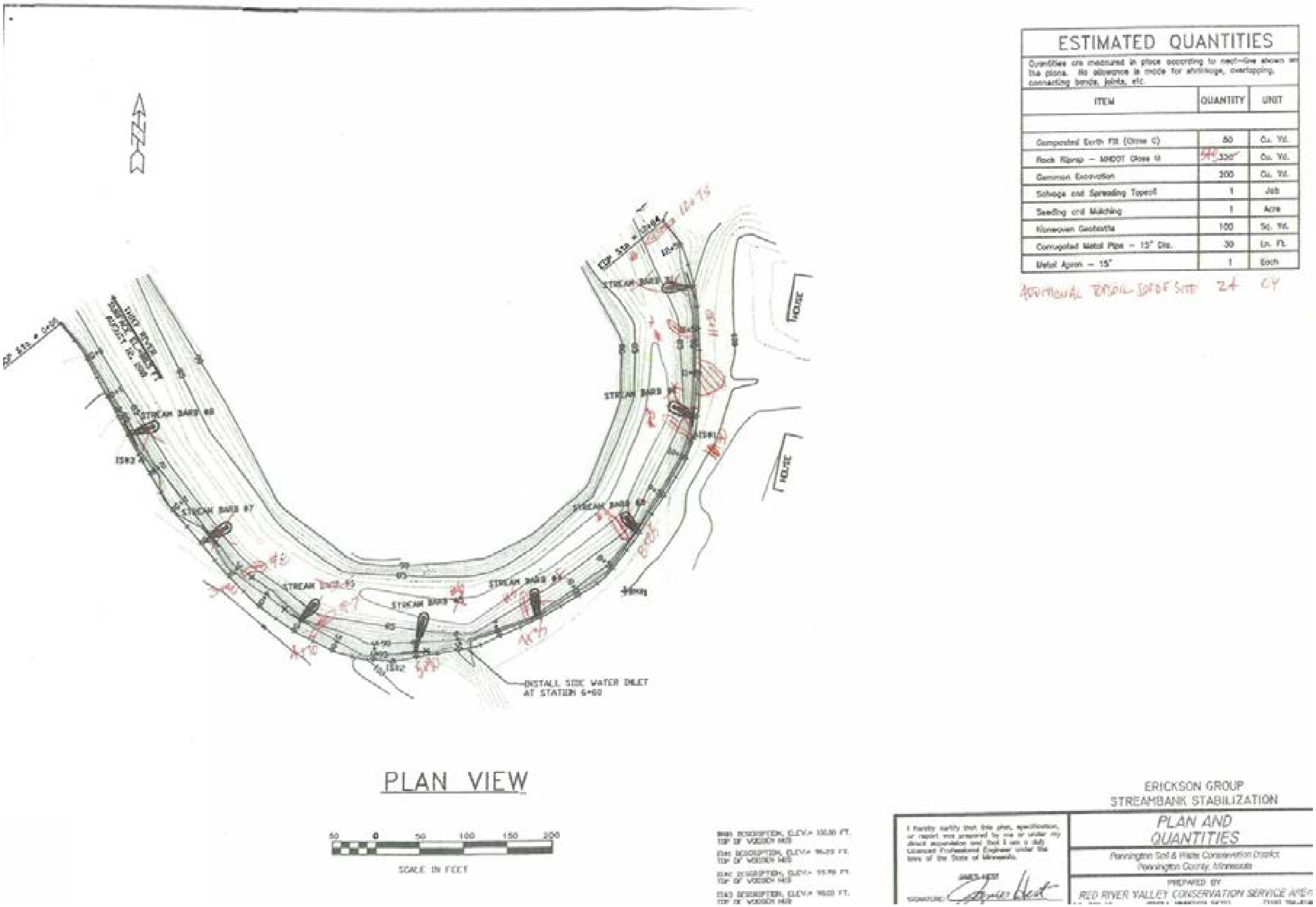
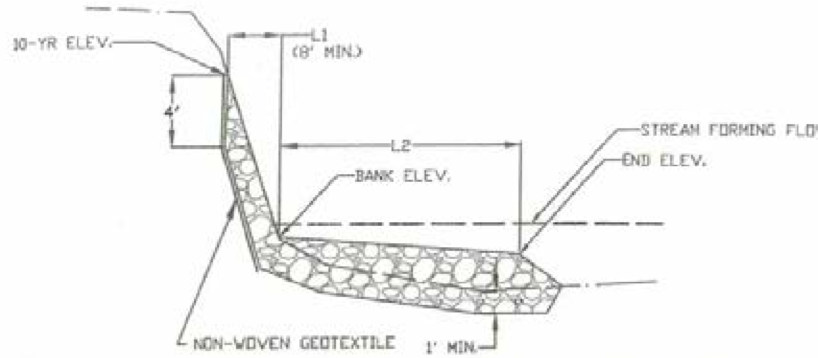


Figure 11-2 Erickson Group – Streambank Restoration sheet 2 of 3, general plan and quantities.

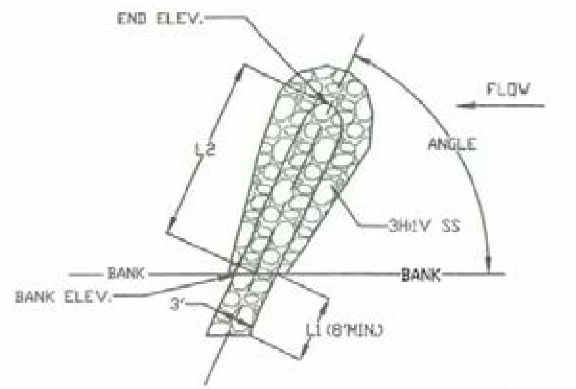
STREAM BARB	ANGLE (DEGREES)	L1 (FT)	L2 (FT)	10-YR ELEV. (FT)	BANK ELEV. (FT)	END ELEV. (FT)	CY
1	70	8	20	94.3	88.0	87.0	60
2	70	8	22	94.3	88.0	87.0	72
3	75	8	18	94.2	87.8	86.8	60
4	70	8	22	94.2	87.8	86.8	48
5	75	20	20	94.2	87.6	86.6	48
6	80	8	19	94.2	87.6	86.6	48
7	80	8	22	94.1	87.4	86.4	48
8	80	8	20	94.1	87.4	86.4	48

STREAM BARB TOTAL 432
JORDE SITE TOTAL 108
540 CY ROCK RIPRAP

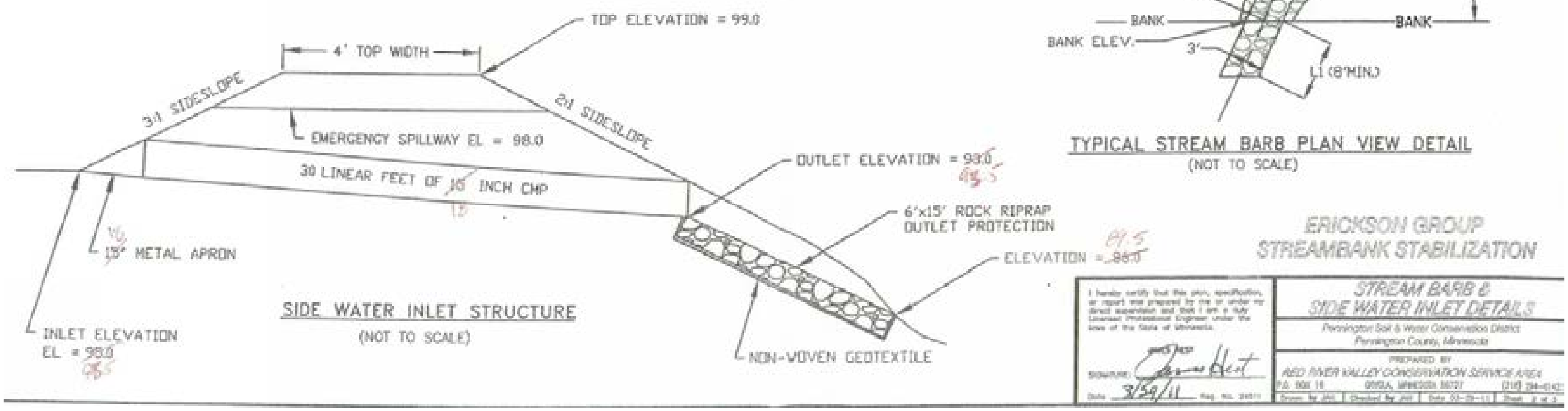
JORDE SITE TOPSOIL 24 CY



TYPICAL STREAM BARB CROSS-SECTION DETAIL
(NOT TO SCALE)



TYPICAL STREAM BARB PLAN VIEW DETAIL
(NOT TO SCALE)



SIDE WATER INLET STRUCTURE
(NOT TO SCALE)

Figure 11-3 Erickson Group – Streambank Stabilization plans sheet 3 of 3, stream barb and side inlet details.

6. Construction details

The seeding mixture shall consist of one of the following:

Seeding Mixture#1	Lbs pls/acre
Kentucky Bluegrass	5
Creeping Red Fescue	5
Perennial Rye	10

Seeding Mixture#2	Lbs pls/acre
Intermediate Wheatgrass	23
Timothy	7
Canada Wildrye	7

Seeding Mixture#3	Lbs pls/acre
Creeping Foxtail	10
Timothy	2
Red Top	2
Perennial Rye	3

Seeding Dates - Cool Season Grasses **(Seeding Mixtures 1 & 3)**
Spring – April 1 to June 15
Summer – July 15 to September 1
Dormant – November 1 to freeze-up
Warm Season Grasses **(Seeding Mixture 2)**
Spring – May 15 to June 30
Dormant – Nov 1 to freeze-up

Dormant seeding will not be made on areas covered with ice or when snow is deeper than 2 inches.

RRVCSA March 29, 2011 MN-06-3
Pennington SWCD
Erickson Group – Streambank Stabilization

Figure 11-4 Seeding instructions provided to homeowners by Pennington SWCD. Homeowners choose to install Seeding Mixture #1.

Table 11-1 Plants observed from photos taken during site visit on 6/5/19. Photos were taken along a meander survey route for plant ID. Seed mix installed by the landowners.

Scientific Name	Common Name	Cover Range -	Species Planted/Seeded	Species Status
Trees in overstory	Multiple species	50-75 combined overstory cover		
Populus deltoides	cottonwood			Native
Galium boreale	northern bedstraw	5-10		Native
Achillea millefolium	common yarrow	<5		Native
Maianthemum stellatum	starry false lily of the valley	<5		Native
Anemone or Geum sp.	Anemone or avens species	1-5		Native
Symphoricarpos cf. sp.		5-10		Native
Lonicera sp.	honeysuckle	<5		Invasive
Viola sororia	common blue violet	<5		Native
Melilotus sp.	sweetclover	1-10		Invasive
Carex cf. sprengellii	Sprengel's sedge	<5		Native
Symphotrichum sp.		<5		Native
Symphotrichum leave	smooth blue aster	1-5		Native
Bromus inermis	smooth brome	10-50		Invasive
Prunus virginiana	chokecherry	<5		Native
Quercus macrocarpa	bur oak			Native
Fraxinus pennsylvanica	green ash	Seedlings and mature		Native
Apocynum androsaemifolium	spreading dogbane	<5		Native
Rosa sp.	rose	1-5		Native
Anemone canadensis	meadow anemone	<5		Native
Antennaria sp.	pussytoes	<5		Native
Vicia sp.	vetch	<5		Native
Carex sp.	sedge	<5		Native
Trifolium sp.	clover	1-5		Invasive
Acer negundo	boxelder	Unknown; seedlings		Native
Cirsium arvense or Cirsium flodmanii	Canada thistle or Flodman's thistle – plants are young	<5		Canada thistle – Noxious; Flodman's – Native
Taraxacum officinale	Dandelion	<5		Weedy
Symphotrichum sp.		<5		Native

Scientific Name	Common Name	Cover Range -	Species Planted/Seeded	Species Status
Thalictrum venulosum	veiny meadow rue	5-10		Native
Comandra umbellata	bastard toadflax	<5		Native
Lathyrus cf. ochroleucus	cream pea	<5		Native
Poa pratensis	Kentucky blue grass	5-25		Invasive
Amelanchier sp.	serviceberry	5-10		Native
Crataegus sp.	hawthorn	<5		Native
Zanthoxylum americanum	prickly ash	5-10		Native
Solidago sp.	goldenrod	<5		Native
Asclepias sp.	milkweed	<5		Native
Fragaria sp.	strawberry	<5		Native
Sonchus sp.	sowthistle	<5		Invasive/Weedy
Zizia aurea	golden alexanders	<5		Native
Rubus sp.	raspberry	<5		Native
Arctium minus	common burdock	<5		Invasive
Pinus cf. banksiana	jack pine	Unknown; only closeup photos		Native
Linum sp.	flax	<5		Native

Appendix B: Site Photographs

Photo 11-1 Upstream view of stream barbs 3 and 4 with some bare slopes downstream and trees leaning over the river. It is recommended to install live stakes on the bare slopes, provide a buffer to the top of the bank, and remove the leaning trees and limbs. Photo taken by Ed Matthiesen during site visit (6/5/2019).

Photo 11-2 Upstream view of stream barbs 1, 2, and 3. Photo taken by Ed Matthiesen during site visit (6/5/2019).

Photo 11-3 Upstream view of stream barbs 6, 7, and 8. Photo taken by Ed Matthiesen during site visit (6/5/2019).

Photo 11-4 Upstream view of stream barbs 4 and 5. Mowing to the top of the bank and bare soil can be seen on the left side of the photo. Photo taken by Ed Matthiesen during site visit (6/5/2019).

12) Thief River Halvorson Streambank Enhancement

Project Background

Project Name: Thief River – Halvorson Streambank Evaluation

Project Site: Thief River Falls, MN

Township/Range Section: Township T154 Range R43 Section S16

Project Manager / Affiliated Organization: Pennington SWCD / Bryan Malone

Fund: CWF ***Fiscal Year Funds:*** 2011

Project Start Date: 2010

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest , Choose an item.

Project Status: Establishment Phase

County: Pennington County

Primary Activity: Stream/River Restoration

Project Size: 300 Linear Feet

Project Completed: December 2012

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Two riprap stream barbs installed on the outside bend of the river. Additionally, bank slope adjacent to the home amended with riprap to provide stabilization and prevent erosion.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   - Design Report: Lloyd Halvorson – Streambank Stabilization, Pennington SWCD, November 2012. Basis of design document including a project description, design criteria, statement of problem, soils information, research and proposed solution.
   - Halvorson Streambank Restoration – eLINK Work Plan, Pennington SWCD, March 2011. Project, description, listing of goals, budget, work items, and personnel involved in project management.
   - Halvorson Streambank Restoration Map
   - Lloyd Halvorson Streambank Protection Design Drawings – Red River Valley Conservation Service Area (RRVCSA), August 2012. Project location and cover sheet, construction plan and construction detail drawings.
   - Lloyd Halvorson Streambank Protection As-Built Drawings – Red River Valley Conservation Service Area (RRVCSA), December 2012. Updated project location and cover sheet, construction plan and construction detail drawings with as-built certification and elevations.

- Operation and Maintenance Plan: Streambank Stabilization for Lloyd Halvorson, Pennington SWCD

3. ***What are the stated goals of the project?***
   Stabilize 300 linear feet of the Thief River streambank using riprap stream barbs and riprap on slopes.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Protect a home threatened by bank failure, reduce debris from the streambank which presents a hazard to aquatic recreation, and improve water quality for the Thief River which is impaired for low dissolved oxygen and turbidity.
5. ***Were measures of restoration success identified in plans?*** *No*
   If yes, list specific measurements.
   No quantifiable restoration efforts were described in the plans. Observation of the protected bank for continued or new erosion features could be used as a measure of success.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   - **Lloyd Halvorson – Streambank Restoration**, Pennington County, MN – RRVCSA, March 2011. Document includes project location, general plans, typical sections, riprap and stream barb details and quantities.
   - **Design Report: Lloyd Halvorson – Streambank Stabilization, Operation and Maintenance Plan: Streambank Stabilization for Lloyd Halvorson,** Pennington County, MN – Pennington SWCD. Document includes design criteria, description of the problem, soils information, research, specifications, and O&M agreement between land user and SWCD.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***

   Stream barbs, rock riprap on slopes.

   The stream barbs will extend from the bank, sloping downward into the river, varying from 25 to 26 in length. The stream barbs will be a minimum of 4 ft wide with 1.5 horizontal to 1.0 vertical side slopes. The rock riprap will be laid on a 2.0 horizontal to 1.0 vertical side slope with a thickness of 1.8 feet. The riprap will begin at the toe of the river and extend to an elevation of 92.0 ft which is higher than that of the 10-yr flood elevation. The use of stream barbs and vanes to prevent streambank erosion is a standard in Minnesota as put forth in the Minnesota Pollution Control Agency (MPCA) BMP Table.

   Stabilization of streambanks with riprap material, when needed, is based on current practice in MN. In this instance, for the long-term success of this project, riprap protection of the banks was justified. The project is long distance from experienced contractors and sources of rock, and future project funding for repairs of streambank failures after construction is limited.

   BMPs are based on current science: Techniques for Estimating Peak Flow on Small Streams in Minnesota, NRCS MN Technical Note No. 8, NRCS Minnesota Construction Specifications, and MNDOT Standard Specifications for Construction.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No
   Click here to enter text.
9. ***In what ways did alterations change the proposed project outcome?***
   N/A

Site Assessment

Field Review Date: **6/5/2019**

Field Visit Attendees: Zach Foley – Red River Valley Conservation Service Area, James Hest – Red River Valley Conservation Service Area, Matthew Fischer – Board of Water and Soil Resources, Corey Hanson – Red Lake Watershed District, Bryan Malone – Pennington Soil and Water Conservation District, Ed Matthiesen – Wenck Associates, Gina Quiram – MN Department of Natural Resources.

10. ***Surrounding Landscape Characteristics:***
    The site is surrounded by cultivated lands to the North and South, with a residential area to the West and a golf course to the East. The thief river at the site is surrounded by vegetated grassy or forested slopes. Average buffer width is roughly 30 ft around the site (with width varying between 0 and 100 ft).
11. ***Site Characteristics:***
    a. ***Soil Series:***
    Clearwater clay (I9F), Fluvaquents, and frequently flooded-Hapludolls complex (I16F).
    b. ***Topography:***
    Site is located at a low spot in the landscape with 1:6 slopes. 1.9 ft/mi river slope
    c. ***Hydrology:***
    Poorly drained. The channel-forming flow is estimated at 1,150 cfs.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
    Streambank woodland consisting of an overstory of cottonwood, green ash, boxelder, and possibly burr oak (dominants not determined). Understory dominants appear to be western snowberry shrubs, the introduced grass smooth brome, and introduce reed canarygrass near the water's edge. Several other native shrubs, vines, and forbs were noted, but overall diversity appeared low. Invasive cover in the understory is due to introduced grasses between 50-75% combined. Individuals of Canada thistle (noxious) were present, and appeared to be few, scattered individual with no large patches and a few buckthorn shrubs (invasive) were noted.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
    Refer to Appendix A, Table 12-1 for species list.
12. ***Is the plan based on current science?*** Yes
    The plan is based on the "Erosion, Sedimentation, and Sediment Yield Report" completed in 1996 by the USDA, NRCS, Pennington and Marshall-Beltrami SWCDs, as well as monitoring conducted by the Red Lake Watershed District. Studies conducted on the Thief River showed that 63% of sediment in the river

originates from the streambank. With this in mind, stabilizing the bank was intended to reduce the turbidity and low oxygen impairments.

13. ***List indicators of project goals at this stage of project:***
    Most banks within the project area show minimal signs of erosion over 8-year period with minimal maintenance. However, a vertical scarp has formed at the top of the streambank covered with riprap. This disturbance at the top of the bank may be signs of a rotational failure. Observation of this area should be continued for additional movement.
14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Yes, with a few maintenance needs. If the vertical scarp at the top of the streambank covered with riprap does not continue to change, it is not expected to reduce the project goals of protecting the homes. The exposed soil is higher than high water flow elevations and should not undermine. If the vertical scarp does get worse, then there may an underlying issue with the stability of the slope.
15. ***Are corrections or modifications needed to achieving proposed goals?***
    No. The evaluator does recommend regrading the slumped top of bank ridge back toward the homes and revegetation of the new slope if the homeowner finds this to be a priority. The tradeoff of completing the regrading will be a decrease in the lawn area by the house.
16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    There are no future steps planned or proposed by project managers. All long term management will be provided by the homeowner as stated in the Operation and Maintenance plan developed with the Pennington SWCD.

    An observed opportunity to further improve the project outcome and to reduce future maintenance needs, suggested by the observer, is to add live stakes on the riprap amended slope adjacent to the home to help minimize any future slope failure, however, this may be a challenge due to limited CWF funding.
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No, but the project does not provide much additional habitat.
18. ***Are follow-up assessments needed? Explain.***
    No. Project has been observed to meet its proposed outcomes in the 8 years since its completion, and it is anticipated to continue to do so.
19. ***Additional comments on the restoration project.***

This project was a partnership between the Pennington County Soil and Water Conservation District, the Red River Valley Conservation Service Area, and the landowner. The project was constructed using the funds awarded in the grant, supplemented with funding from the landowner.

It appears that the vertical at the top of the slope covered with riprap is most likely a rotational failure. Contributing factors to rotational failures are typically one or more of the following categories:

- Recent changes in slope gradient – increases in gradient contribute to movement
- Increased slope load, particularly near the top – it appears riprap has been recently placed

- Reduction in toe support – toe erosion by a stream or excavation at the toe for example
  Increase in groundwater table elevation.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    The project has been observed over the past 8 years since its completion to have met the proposed outcomes, and will continue to do so with minimal maintenance.
23. ***Site Assessor(s) Conducting Review:***
    Ed Matthiesen

Appendix A: Site maps, Project plans or Vegetation tables

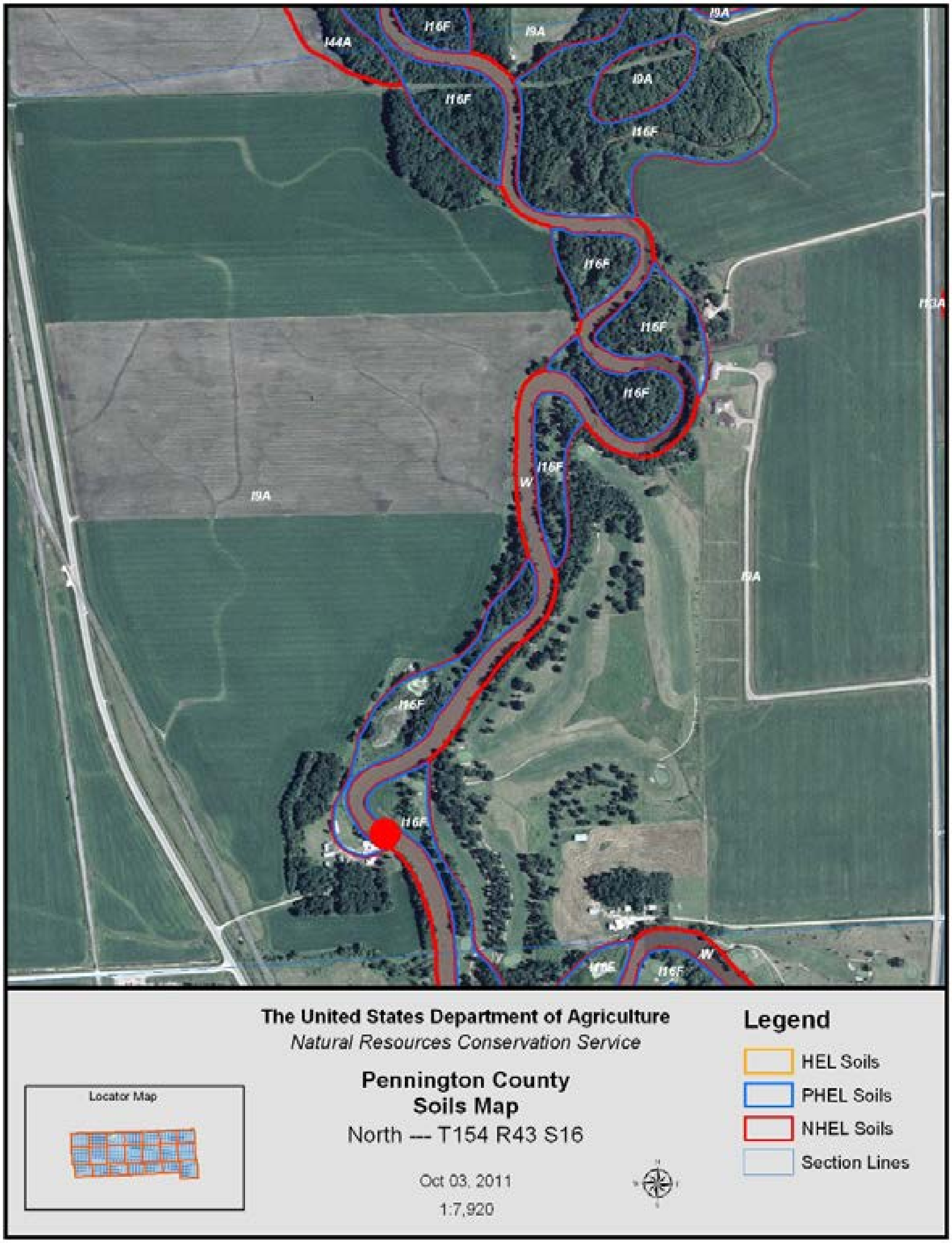


Figure 12-1 Map depicting project site on Thief River, as well as soil types present in area.

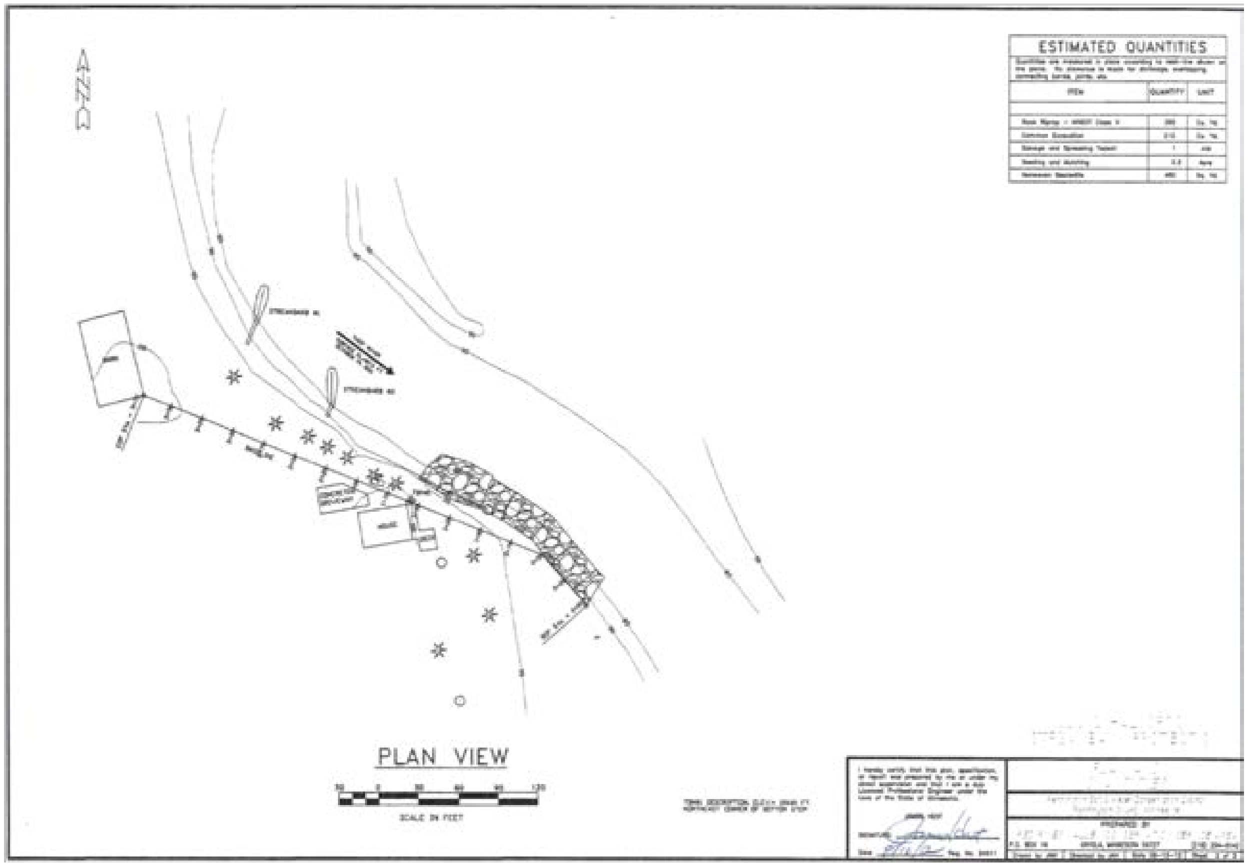


Figure 12-2 Lloyd Halvorson – Streambank Restoration sheet 2 of 3, general plan and quantities.

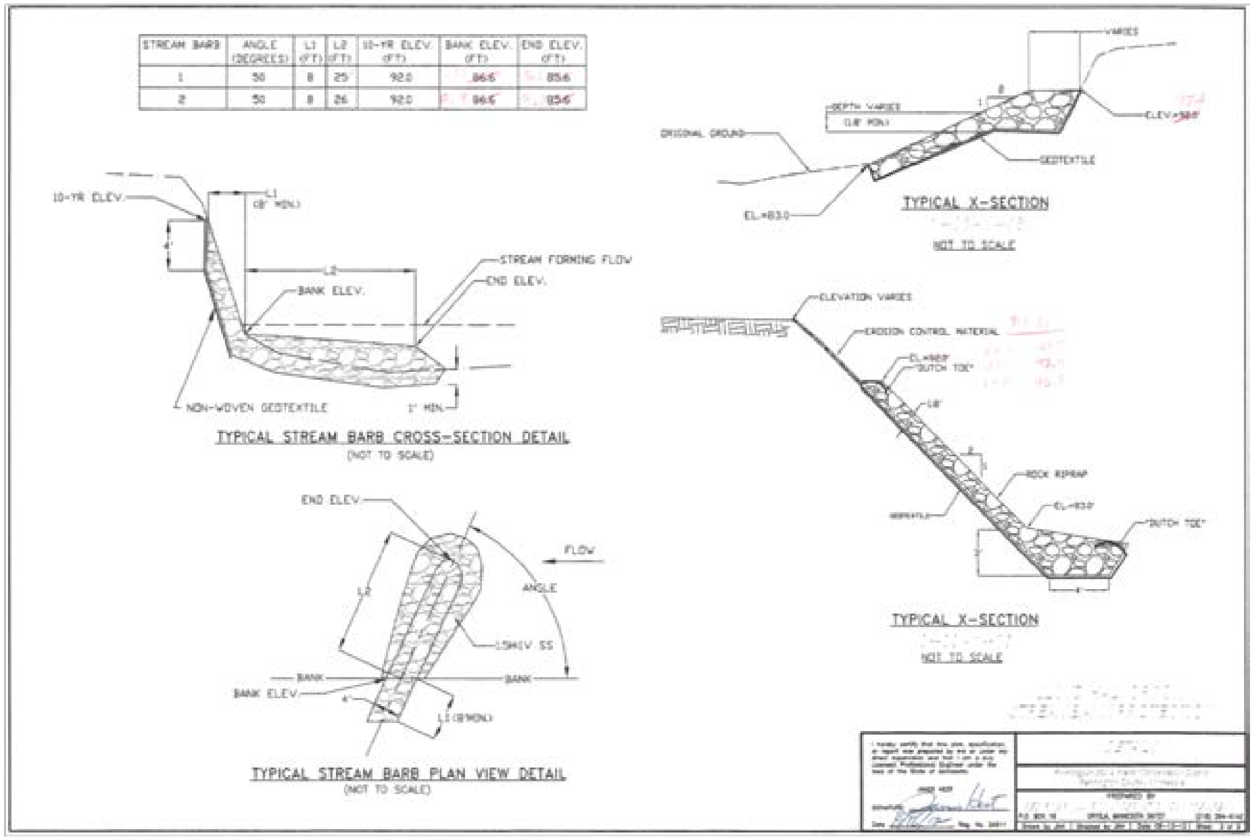


Figure 12-3 Lloyd Halvorson – Streambank Stabilization plans sheet 3 of 3, stream barb and slope riprap details.

6. Construction details

The seeding mixture shall consist of one of the following:

Seeding Mixture#1	**Lbs pls/acre**
Kentucky Bluegrass	5
Creeping Red Fescue	5
Perennial Rye	10

Seeding Mixture#2	**Lbs pls/acre**
Intermediate Wheatgrass	23
Timothy	7
Canada Wildrye	7

Seeding Mixture#3	**Lbs pls/acre**
Creeping Foxtail	10
Timothy	2
Red Top	2
Perennial Rye	3

Seeding Dates - Cool Season Grasses **(Seeding Mixtures 1 & 3)**

Spring – April 1 to June 15

Summer – July 15 to September 1

Dormant – November 1 to freeze-up

Warm Season Grasses **(Seeding Mixture 2)**

Spring – May 15 to June 30

Dormant – Nov 1 to freeze-up

Dormant seeding will not be made on areas covered with ice or when snow is deeper than 2 inches.

RRVCSA March 29, 2011 MN-06-3

Pennington SWCD

Erickson Group – Streambank Stabilization

Figure 12-4 Seeding instructions provided to homeowners by Pennington SWCD. Homeowners choose to install Seeding Mixture #1.

Table 12-1 Plants observed from photos taken during site visit on 6/5/19. Photos were taken along a meander survey route for plant ID. A line item for seeding and mulching was listed on the plan set, but no specific seed mix was labeled or specified on the plans or in the documentation provided.

Scientific Name	Common Name	Cover Range	Species Status
Symphoricarpos occidentalis	Western snowberry	10-50	Native
Phalaris arundinacea	Reed canarygrass	5-25	Invasive
Rubus sp.	Raspberry	1-10	Native
Parthenocissus vitacea	Woodbine	5-10	Native
Vicia sp.	Vetch	<5	Native
Equisetum arvense	Field horsetail	1-10	Native
Rosa sp.	Rose	1-10, Along water's edge	Native
Carex sp. possibly *C. pellita*	Sedge; wooly sedge	1-10, Heads visible along water's edge	Native
Urtica dioica	Stinging nettle	<5	Native
Anemone canadensis	Canada anemone	1-10	Native
Cirsium cf. arvense	Canada thistle	1-10	Noxious
Cornus sericea	Red-osier dogwood	1-10	Native
Ribes sp.	Gooseberry	1-10	Native
Bromus inermis	Smooth brome	25-75	Invasive
Fraxinus pennsylvanica	Green ash	5-25	Native
Populus deltoides	Cottonwood	5-25	Native
Acer negundo	Boxelder	5-25	Native
Asclepias sp.	Milkweed	<5	Native
Poa pratensis	Kentucky bluegrass	5-25	Invasive
Arctium minus	Common burdock	<5	Invasive
cf. Symphotrichum lanceolatum	Panicled aster	<5	Native
Rhamnus cathartica	Buckthorn	1-10	Invasive
Quercus macrocarpa	Bur oak	1-10 Seedling only	Native
Amphicarpaea bracteata	Hog peanut	1-10	Native

Appendix B: Site Photographs

Photo 12-1 Upstream view of 0+25. It is recommended to consider vegetated riprap on slopes. Photo taken by Ed Matthiesen during site visit (6/5/2019).

Photo 12-2 Downstream view from 0+50. There is a slope failure present on the upper slope resulting from a freeze-thaw or a quick drop in water level. It is recommended to add biological improvements. Photo taken during site visit 06/05/2019.

Photo 12-3 Downstream view of Stream Barb #1. Slopes of both banks are stable. There is an NRCS-type vane redirecting flow. Photo taken during site visit 06/05/2019.

Photo 12-4 View of the disturbance at the top of the streambank which may be signs of a rotational failure or slump. Regrading of this ridge back toward the homes is recommended along with revegetation on the new slope. Photo taken during site visit 06/05/2019.

13) Wolverton Creek Restoration

Project Background

Project Name: Wolverton Creek Restoration and Sediment Reduction Project Phase 1

Project Site: Wolverton Creek

Township/Range Section: Township 136N Range 48W Section 4, 9, 10, 14, 15, 23, and 26

Project Manager / Affiliated Organization: Bruce Albright/Buffalo-Red River Watershed District

Fund: CWF ***Fiscal Year Funds:*** 2016

Project Start Date: Fall 2018

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Treatment Phase

County: Wilkin County

Primary Activity: Stream/River Restoration

Project Size: 8.8 Linear Miles

Project Completed: Side inlet BMPs have been installed, easements are in place, and stream restoration construction is ongoing and expected to be completed this year.

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   This project involves adding length and meanders to a previously straightened stream, a 200 -750 foot wide protected buffer, and installation of inlet culverts designed to slow runoff from agricultural fields.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Construction Plans for BRRWD Project No. 79 Wolverton Creek Restoration & Sediment Reduction Project Phase 1, 2018 Wilkin County, MN – Prepared by Houston Engineering. Fourteen weekly summaries were provided dating from August 26th 2018 to November 24th 2018. Wolverton Creek Sediment Reduction presentation slides – Prepared by Buffalo-Red River Watershed District. Grant Workplan, 2016 Targeted Watershed. Design Report Wolverton Creek Restoration, Buffalo-Red River Watershed District, February 15, 2017 – Prepared by Houston Engineering. Restoring Wolverton Creek, Clay County, Wilkin County.
3. ***What are the stated goals of the project?***

Goals and objectives identified in the Design Report for Wolverton Creek Restoration are to improve wildlife habitat, increase wildlife habitat connectivity, improve water quality/reduce sediment loading, and reduce the occurrence and magnitude of flood damages to agricultural fields.

4. ***What are the desired outcomes of achieving the stated goals of the project?***
The 10-year floodplain is expected to be reduced from 1,400 acres to 970 acres and thus result in less flooding of agricultural fields. Significant reduction of sediment loadings is expected to achieve state water quality standards for suspended sediment (see answer to question 14 for more information on water quality). Stream and riparian restoration are expected to improve fish habitat. The permanently protected riparian buffer is expected to provide critical wildlife habitat.

5. ***Were measures of restoration success identified in plans? Choose an item.***
If yes, list specific measurements.
To achieve state water quality standards for suspended solids, annual sediment loading from Wolverton Creek needs to be reduced by 49%, this is expected to be achieved (see answer to 14 for more details). The 10-year floodplain is expected to be reduced from 1,400 acres to 970 acres and thus result in less flooding of agricultural fields. Other measures were not directly identified.

6. ***Are plan Sets available?*** **Yes** ***Have project maps been created?*** Yes
If yes, provide in Appendix A and list Maps provided:
Construction Plans for BRRWD Project No. 79 Wolverton Creek Restoration & Sediment Reduction Project Phase 1, 2018 Wilkin County, MN – Prepared by Houston Engineering. Document includes site location, longitudinal profile, wetland locations, typical cross sections and seeding limits.
Wolverton Creek Restoration Phase 1 Weekly Summary – Houston Engineering. Fourteen weekly summaries were provided dating from August 26th 2018 to November 24th 2018, summaries include weekly construction activities and photos.
Wolverton Creek Sediment Reduction presentation slides – Prepared by Buffalo-Red River Watershed District. Presentation slides include information on proposed project as well as past projects.
Grant Workplan, 2016 Targeted Watershed. Describes various activities to be conducted under the grant.
Design Report Wolverton Creek Restoration, Buffalo-Red River Watershed District, February 15, 2017 – Prepared by Houston Engineering. Document contains project location, goals and objectives, information on existing watershed management plans, channel geometry data for two stage channel design, easement summary, side inlet sediment BMP's summary, current and post project monitoring summary, permitting, cost estimate, summary of funding sources, and maps of project area and watershed.
Restoring Wolverton Creek, Clay County, Wilkin County. Document is a narrative of the project.

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
Restoring a straightened channel to a longer meandered channel to dissipate stream energy is standard practice and based on current science. The new channel is being constructed in the dry while the existing channel is temporarily dammed to reduce sedimentation into the stream. This is not common practice as it impacts fish movement; however, with the severely degraded condition of the existing channel fish movement is not a great concern (see Photo 13-6). Additionally, the weather and upstream conditions are monitored daily and the dam removed often to allow water flow. The inlet culverts are

considered best management practice in agricultural areas in this area of the state to reduce peak flows of the stream while providing temporary storage and metering runoff. These inlet structures also prevent the formation of gullies thus reducing erosion. Typical erosion control BMPs are being used during construction such as having a SWPPP in place that requires rapid stabilization of excavated areas and sediment control elements.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   In an area of the upstream portion of the project a section of the new channel was relocated due to soft, mushy soils in the location were the stream was initially designed to go. The new location of the stream was relocated to an area with more suitable soils.
   Another location downstream of a culvert has had some erosion issues already, they have had to re-build this section. They will adjust the location of sod mats and may have to use riprap in the future at this location if it does not stabilize as expected.
9. ***In what ways did alterations change the proposed project outcome?***
   None

Site Assessment

Field Review Date: **8/15/2019**

Field Visit Attendees: Bruce Albright (Buffalo-Red River Watershed District Administrator), Ted Rud (BRRWD Engineer Houston Engineering), Jamison Wendel (MN DNR Stream Habitat Consultant), Andrew Graham (MN DNR Red River Basin Coordinator), Pete Waller (BWSR Board Conservationist), Don Bajumpaa (Wilkin County SWCD), Kim Melton (Wilkin County SWCD), Marcy Westrick (Clean Water Coordinator), Mark Anderson (BRRWD), Gina Quiram (MN DNR Restoration Evaluation Specialist), and Anna Varian (Stantec Site Assessor)

10. ***Surrounding Landscape Characteristics:***
    Land adjacent to the stream is almost exclusively agricultural fields, and prior to the project crops would often be planted up to the edge of the stream. The watershed is entirely located within the Lake Agassiz Plain ecoregion and has a flat slope.
11. ***Site Characteristics:***
    a. ***Soil Series:***
    The most common soil type within the project area is Sinai silty clay, levees 0 to 6 percent slopes and is not a hydric soil (USDA).
    b. ***Topography:***
    Wolverton Creek flows through a broad valley with gentle slopes and extensive floodplains.
    c. ***Hydrology:***

Wolverton Creek at the downstream point of the project site has a drainage area of 52 square miles with 94% agricultural lands. Flooding is common with sediment deposition in the channel causing flooding outside the historic channel area.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

Reaches of the project are in various phases of construction and much of the seeding had occurred only recently before the site visit. There are multiple zones of seeding (see Figure 13-5). A portion of the slope was seeded in early June by the Wilkin SWCD. This seeding appears to be developing at an appropriate pace in some areas, while lagging in germination in others. Cereal grains oats, wheat, and annual rye comprise approximately half of the cover in this area. This seeding has been mowed, helping to maintain good light levels at ground level to assist with longer-term germination. In areas where natives are most common, they comprise less than one fourth of the total cover and include the seeded natives purple prairie clover, big bluestem, white prairie clover and showy tick trefoil, along with volunteer biennial wormwood, dotted smartweed and Indian hemp. An estimated one fourth of the plant cover is comprised of ruderal agricultural weeds (lambsquarter, pigweed, barnyard grass, and ragweed and a few others) and perennial invasive, nonnative plants. Invasive weeds that could pose challenges for ensuring that native cover prevails in the long-term include sweet clover, curly dock, lady's thumb, and perhaps most importantly reed canary grass. The site should be monitored for establishment of natives, if they do not establish well, supplemental seeding should be considered as part of an integrated approach along with spot weed treatment, mowing, and others.

The flat near channel areas vary somewhat in total vegetative cover from about 50 percent, down to approximately ten percent. While some scattered native plants were observable (e.g. softstem bulrush, sedge spp.) the majority of the vegetation present was comprised of a mix of ruderal agricultural to invasive, nonnative perennial vegetation. Commonly observable annual agricultural weeds include ragweed, pigweed, and lambs quarter. Invasive/nonnative plants prevalent at the site include lady's thumb smartweed, curly dock, barnyard grass, tumble mustard, barnyard grass, reed canary grass, hybrid cattail and others. Results to-date indicate that long-term success would be improved with some supplemental native seeding and several years of maintenance.

In areas immediately adjacent to the stream on outside bends sod mats were used. While some native vegetation was periodically observable, the vast majority of vegetation (estimated 85-90%) was dominated by the invasive, nonnative reed canary grass.

e. Vegetation B: Meander Search Species List (as appropriate for site)

Click here to enter text.

12. *Is the plan based on current science?* Portions

Adding length and meanders to a previously straightened channel is based on current science and will dissipate stream energy and provide bedform diversity. Additionally, the extensive scope of the multiple phases of this project in evaluating and taking a whole watershed approach to restoration is how stream restoration should occur versus the small patches approach. The design is based on natural channel design methods, the two-stage E channel design is appropriate for this area of the state.

The use of side inlet culverts to prevent the formation of gullies and reduce peak flows in Wolverton Creek by providing temporary storage and runoff metering through culvert size is a public drainage BMP. Having a permanently protected riparian buffer to stabilize stream banks and provide wildlife habitat is based on current science. Using sod mats on outside bends is common practice; however, using sod mats of primarily invasive species is not a common best practice. The MN DNR River Ecology unit has found that the roots of reed canary grass grow deeper and denser than reported in current literature and choices for sources of native sod mats on or near the site are very limited. Reed canary grass is prevalent in riparian corridors in this area and preventing its invasion would be difficult as it does very well in the wet silty riparian soils. Reed canary grass often grows in a monoculture and using it in the sod mats could lower overall plant diversity within the project area.

13. ***List indicators of project goals at this stage of project:***

    Portions of this project are still under construction however it is evident that length has been added to the stream channel and a two-stage channel created, both of which will reduce stream energy and thus erosion. Inlet culverts will slow runoff from fields into Wolverton Creek which will also reduce stream energy and erosion in Wolverton Creek as week as prevent gully formation. In-stream habitat has already improved as compared to an area that has not undergone construction yet. The newly constructed stream has water flowing freely through it while pre-constructed locations are choked with sediment and vegetation leaving only stagnant pools (see photos). If the newly constructed stream is stable and riparian vegetation fills in, it will reduce erosion and sedimentation.

    Inlet culverts designed to slow run off from agricultural fields have been installed and will reduce peak flows in Wolverton Creek.

14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***

    In 2010 Wolverton Creek was identified as impaired for turbidity, the annual sediment loading from Wolverton Creek would need to be reduced by 49% to meet state water quality standards for suspended sediment. Soil and Water Assessment Tool (SWAT) modeling estimated the average annual sediment loading in Wolverton Creek to be 14,000 tons/year. Previous efforts have reduced the sediment loading to just over 10,000 tons/year. The current project is expected to reduce sediment loading by an additional 6,500 tons/year (4,400 tons/year through channel restoration, 500 tons/year through buffer expansion, and 1,600 tons/year through side inlet BMPs). This total would more meet the state water quality standards.

    Creating a protected riparian buffer along the stream corridor will improve water quality by slowing agricultural runoff, decrease erosion rates along the stream, and create wildlife habitat. Annual vegetation monitoring is planned, corrective actions will need to take place to ensure natives persist.

15. ***Are corrections or modifications needed to achieving proposed goals?***

    The stream channel design and inlet culverts will ultimately lead to achieving their sediment reduction and water quality improvement goals as long as the newly constructed channel is stable. Vegetation management and monitoring (see answer 11 d) need to occur to accomplish their wildlife habitat goals.

16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

    Continuing on with remaining phases of this project is practical and will ensure a watershed wide restoration. Lessons learned from both channel design and vegetation seeding and management should be applied to future phases. Use and control of invasive vegetation species should be evaluated and alternative sod mat sources considered before future phases of this project are implemented. Annual monitoring of the riparian buffer is planned for by the watershed district. Invasive species in the buffer will be a challenge.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    Yes, the reed canary sod mats that are already a monoculture will likely spread more reed canary and reduce biodiversity of the riparian buffer.
18. ***Are follow-up assessments needed? Explain.***
    Yes. This project is still under construction, both seeding and channel construction are not yet complete. The project hasn't experienced high flows or had time for adjustment to occur. It's important to assess after vegetation is established as vegetation is an important component of stream channel stabilization. The channel is designed as a Rosgen E type channel which are reliant on established vegetated banks for stability.
19. ***Additional comments on the restoration project.***
    An extensive amount of work has gone into this project well before it was funded and designed. The Buffalo-Red River Watershed District has been working on improving Wolverton Creek for decades. Previous projects include multiple efforts to install buffers and side inlets on legal ditches within the watershed, stabilization of the creek at its outlet into the Red River, data collection and modeling. Along with this previous work relationships with landowners began and developed over time. The watershed district maintained these relationships which has allowed a project of this massive extent (26.2 miles total over three phases) over private land to be accomplished.

    This project includes restoration along three reaches of Wolverton Creek, the current work is being conducted along the middle portion of the project and is Phase 1, this is considered to be the most severely impacted reach. Future work of Phase 2 and 3 will restore the reaches upstream to the headwaters and downstream of Phase 1.

    A project of this scale has an equally large cost, the watershed district leveraged funding from several different sources including an Enbridge Ecofootprint Grant and multiple different easement programs (EQIP, RIM, CREP etc.). Along with external funding the watershed district matched a portion of the cost through their own funding and the local SWCDs are assisting with portions of the vegetation work at their own cost. This extra effort put into acquiring funds from multiple sources all during the same timeframe allowed the project to acquire the funding needed to construct such a large project at the watershed scale. It's efforts like this, along with the commitment of the watershed district to provide maintenance, that ensure projects are fully funded and the work necessary for a fully functioning stream is completed.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    minimally achieved the stated goals.
21. ***The project will:***
    Minimally meet proposed outcomes

Confidence of outcome determination:

Low

22. ***Provide explanation of reason(s) for determination.***

This project is still under construction and has yet to experience several high flow events, time for vegetation establishment, and time for channel adjustment. Stream restoration projects need time for riparian vegetation to establish and time for any natural adjustment that may happen to take place in order to determine if the designed stream is stable. At this point in time it is difficult to assess the restoration; however, the construction that has happened thus far is showing signs of improvement to the existing conditions. Meanders and length have been added as well as establishing a two-stage channel both of which will reduce stream energy and thus erosion. The stability of the channel will also ensure erosion reduction, but more time is needed to evaluate this aspect. The channel is designed as a Rosgen E type channel which are reliant on established vegetated banks for stability. At some locations the channel is already adjusting itself to a Rosgen C type channel, which is a stable channel form but these adjustments need to be monitored to make sure it doesn't adjust to an unstable form. The riparian buffer has been seeded but still needs time for establishment in order to evaluate better.

Inlet culverts designed to slow runoff have been installed and will help reduce peak flows in Wolverton Creek and thus stream energy, flooding, and erosion.

The extensive scope of the multiple phases of this project in evaluating and taking a whole watershed approach to restoration will help achieve sediment reduction goals by targeting the root causes of the watershed's sediment issues.

23. ***Site Assessor(s) Conducting Review:***

Anna Varian, Stantec Consulting.

Appendix A: Site maps, Project plans or Vegetation tables

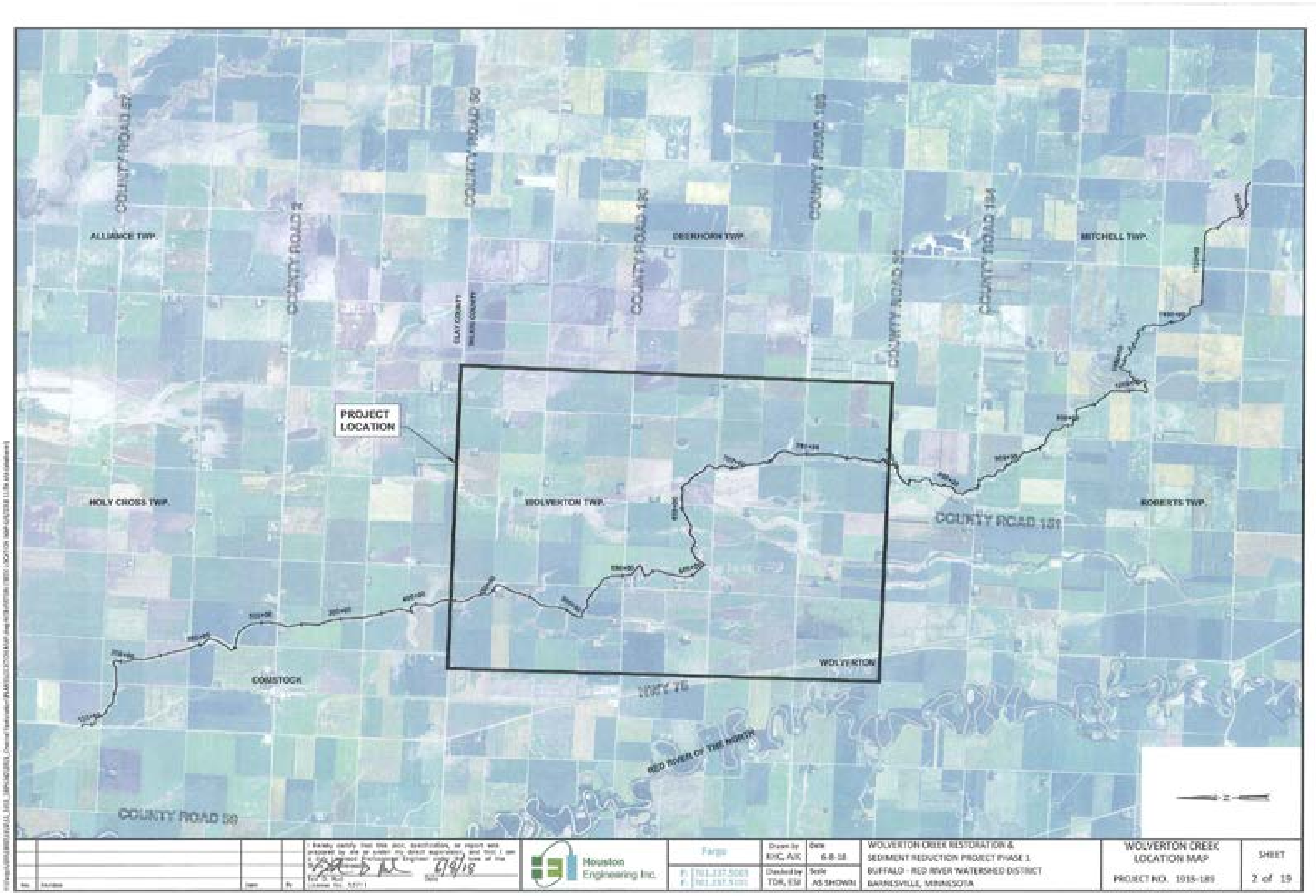


Figure 13-1. Project location map from construction plans.

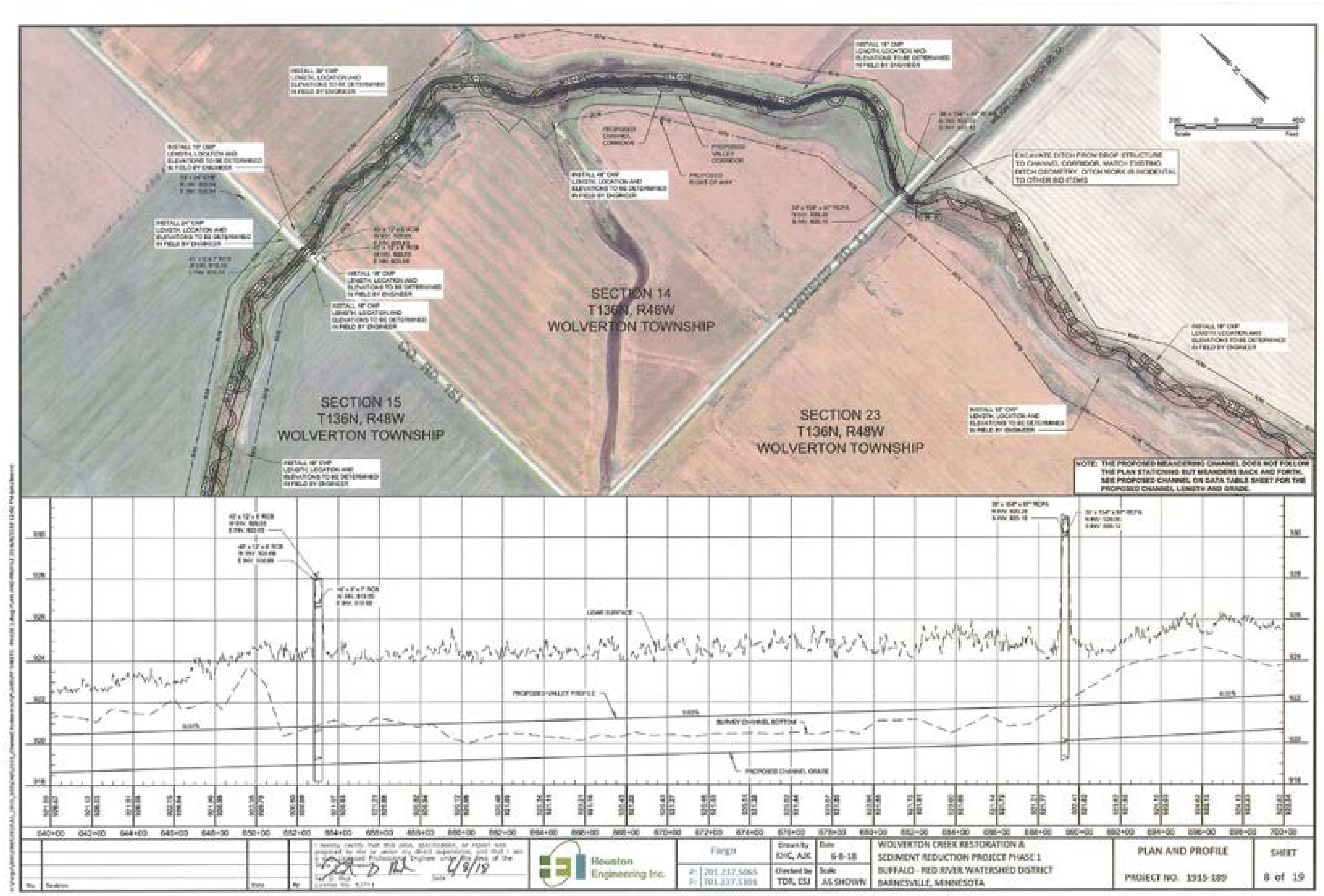


Figure 13-2. A portion of the project plan and profile from the construction plans.

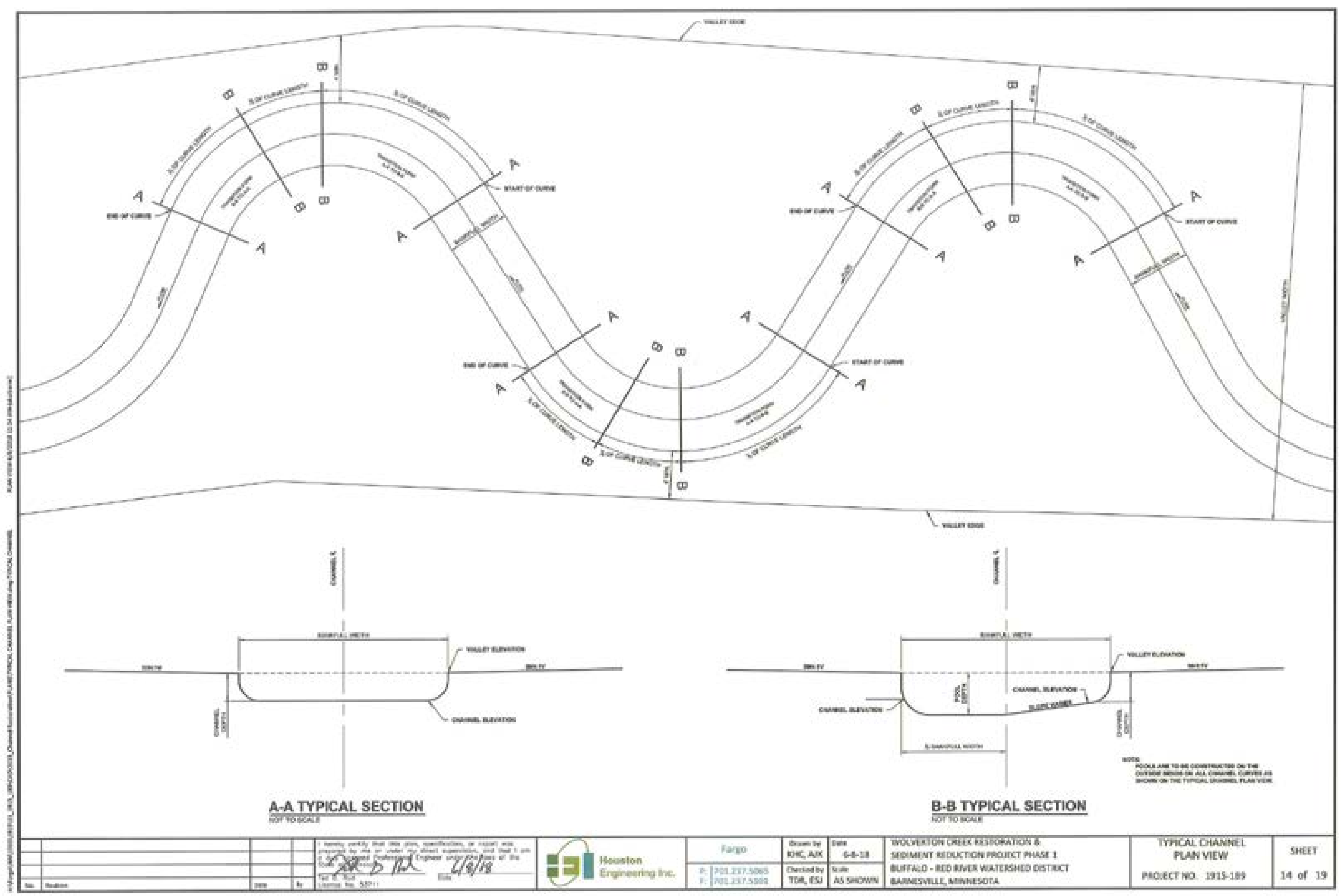


Figure 13-3. Typical sections of pools and riffles from construction plans.

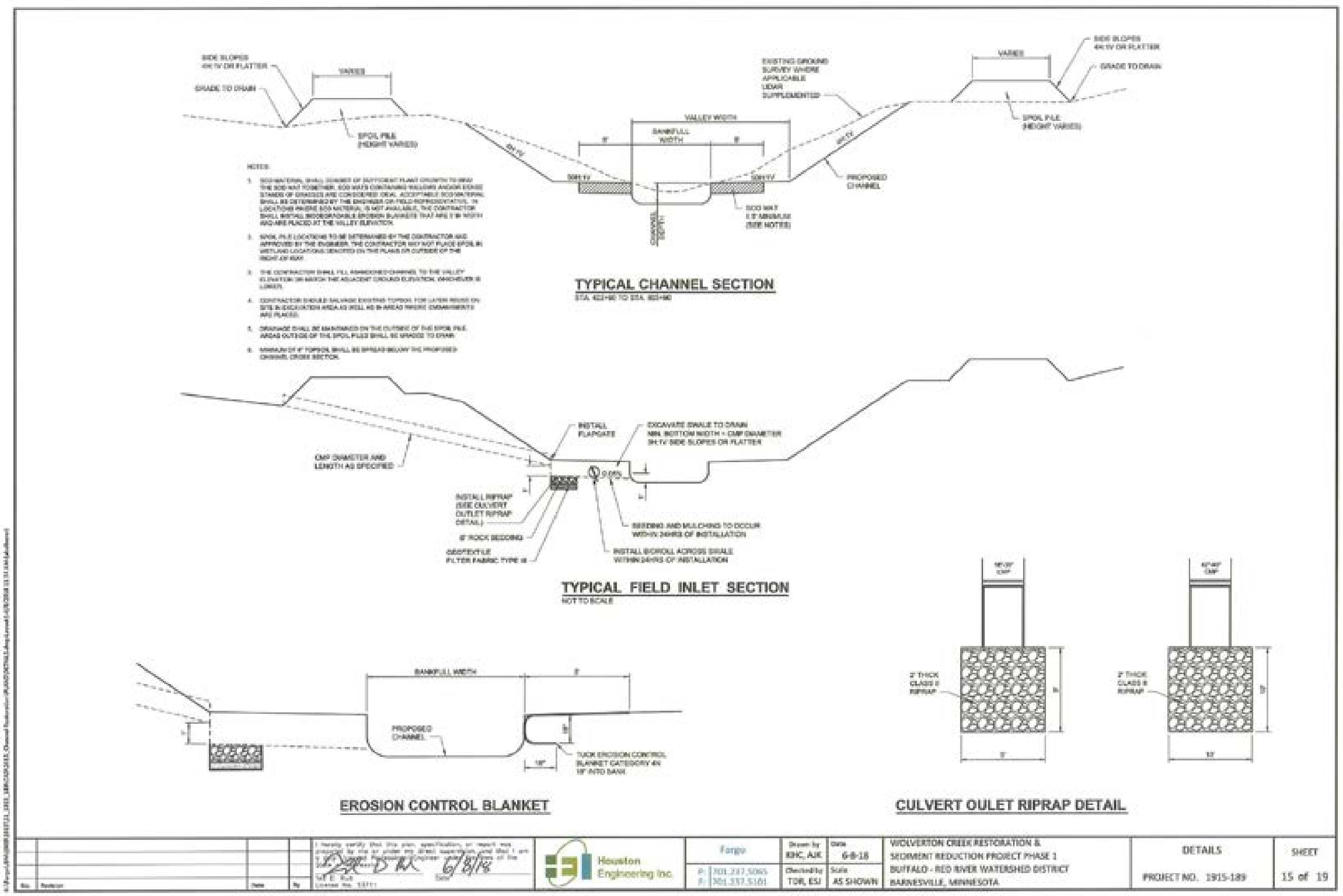


Figure 13-4. Typical sections and details from construction plans.

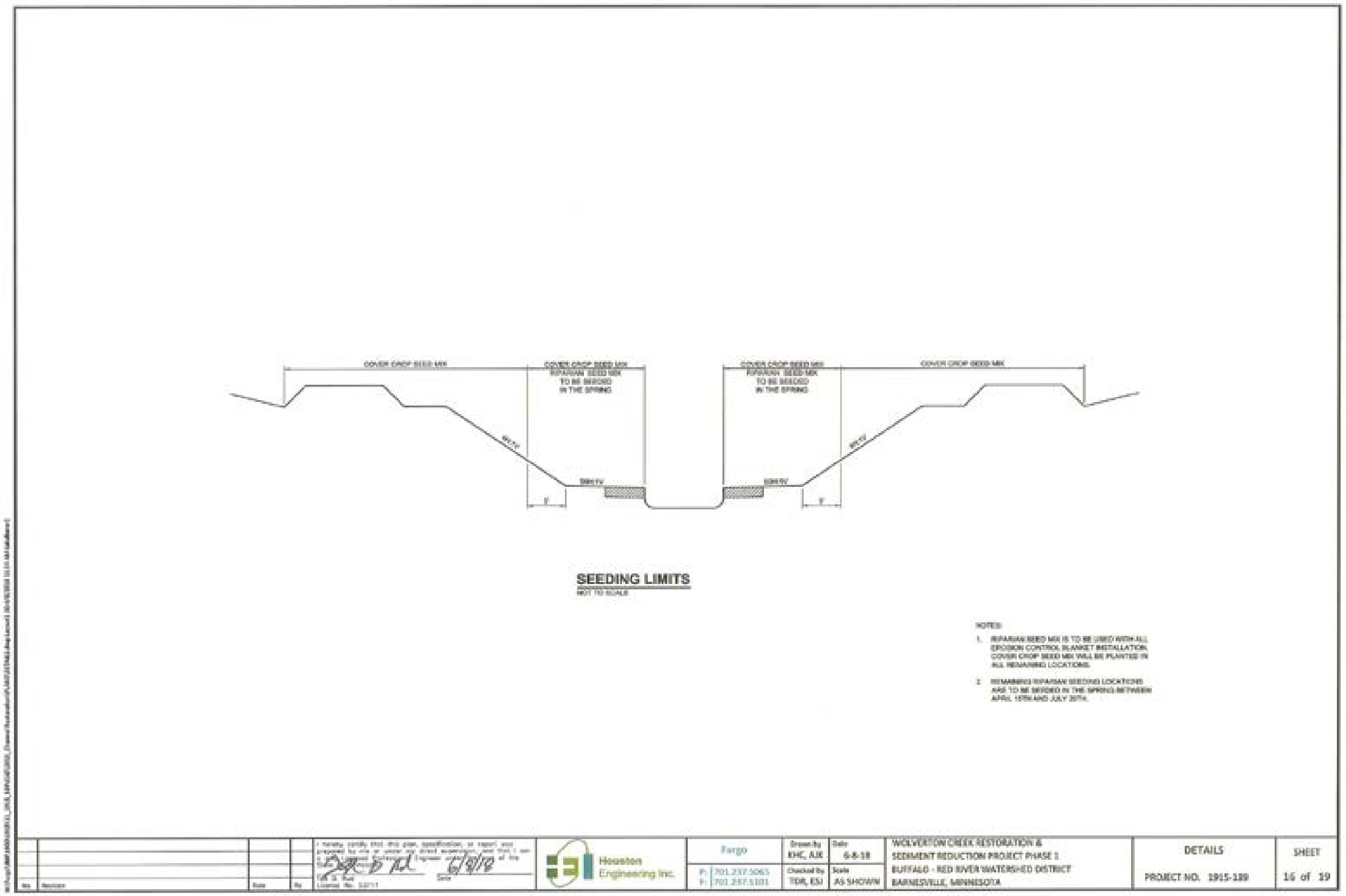


Figure 13-5. Seeding limits from construction plans.

	PROPOSED CHANNEL PROFILE							
	STATION	STRUCTURE(S)	DOWNSTREAM INVERT (FT)	UPSTREAM INVERT (FT)	PROPOSED DOWNSTREAM CHANNEL INVERT (FT)	PROPOSED UPSTREAM CHANNEL INVERT (FT)	PROPOSED DOWNSTREAM VALLEY INVERT (FT)	PROPOSED UPSTREAM VALLEY INVERT (FT)
FUTURE PHASE	143+51	2 - LINES OF 12' x 12' RCB	898.90	898.95	-	898.95	-	-
	181+30	BRIDGE	899.47	899.47	899.47	899.47	-	-
	242+80	2 - LINES OF 169" x 107" RCPA	905.20	905.14	905.20	905.20	-	907.38
	276+50	2 -LINES OF 10' x 10' RCB	906.90	906.91	906.90	906.91	909.08	909.09
	293+00	NO STRUCTURE	907.40	907.40	907.40	907.40	909.58	909.58
	309+85	3 - LINES OF 154" x 97" RCPA	908.81	908.36	908.81	908.81	910.99	910.99
	336+40	NO STRUCTURE	909.01	909.01	909.01	909.01	911.19	910.98
	364+00	BRIDGE	909.22	909.22	909.22	909.22	911.19	911.16
PHASE 1	422+90	2 - LINES OF 169" x 107" RCPA	912.62	912.78	912.62	912.78	914.56	914.66
	532+15	2 - LINES OF 10' x 7' RCB	913.17	913.36	913.17	913.36	915.05	915.24
	550+45	2 - LINES OF 10' x 7' RCB	916.01	916.19	916.01	916.19	917.89	918.02
	653+00	2 - LINES OF 12' x 6' RCB, 8' x 7' RCB	919.00	919.00	919.00	919.00	920.83	920.80
	689+30	2 - LINES OF 154" x 97" RCPA	920.01	920.12	920.01	920.12	921.81	921.78
	747+70	2 - LINES OF 154" x 97" RCPA	923.17	923.19	923.17	923.19	924.83	924.85
	803+90	2 - LINES OF 8' x 6' RCB	926.32	926.40	926.32	926.40	927.98	927.77
FUTURE PHASE	872+05	10' x 6' RCB	926.80	926.86	926.80	926.86	928.17	928.24
	934+15	103" x 71" CMPA	930.32	930.39	930.32	930.39	931.70	931.77
	949+00	87" x 63" CMPA	931.92	931.92	931.92	931.92	933.10	933.12
	1024+10	NO STRUCTURE	937.50	937.50	937.50	937.50	938.70	938.70
	1031+10	30" RCP, 36" CMP, 73" x 45" RCPA	939.91	940.10	939.91	940.10	941.11	941.30
	1056+45	2 - LINES OF 42" CMP, 36" CMP	943.02	943.12	943.02	943.12	944.22	944.32
	1090+35	2 - LINES OF 73" x 55" RCPA	945.91	945.78	945.91	945.91	947.11	947.17
	1145+00	10' x 4' RCB	948.60	949.08	948.60	949.08	949.85	950.34
	1173+15	NO STRUCTURE	950.00	950.00	950.00	950.00	951.26	951.26
	1200+90	NO STRUCTURE	952.80	952.80	952.80	952.80	954.06	954.06
	1214+00	30" CMP	954.98	955.17	954.98	-	956.24	-

	PROPOSED CHANNEL					
	FROM STATION	TO STATION	CHANNEL LENGTH (FT)	CHANNEL GRADE (%)	VALLEY LENGTH (FT)	VALLEY GRADE (%)
FUTURE PHASE	143+51	181+30	4,589	0.011	3,779	-
	181+30	242+80	8,460	0.068	6,150	-
	242+80	276+50	4,470	0.038	3,370	0.050
	276+50	293+00	2,130	0.023	1,650	0.030
	293+00	309+85	2,200	0.064	1,685	0.084
	309+85	336+40	3,450	0.006	2,655	0.008
	336+40	364+00	3,580	0.006	2,760	0.008
	364+00	422+90	7,545	0.045	5,890	0.058
PHASE 1	422+90	449+00	3,415	0.003	2,610	0.004
	449+00	532+15	11,170	0.003	8,315	0.004
	532+15	550+45	2,330	0.114	1,830	0.145
	550+45	653+00	13,555	0.001	10,255	0.027
	653+00	689+30	4,660	0.022	3,630	0.028
	689+30	747+70	7,365	0.041	5,840	0.052
	747+70	803+90	7,295	0.043	5,620	0.056
FUTURE PHASE	803+90	872+05	8,820	0.005	6,815	0.006
	872+05	934+15	7,645	0.045	6,210	0.056
	934+15	949+00	1,815	0.084	1,485	0.103
	949+00	1024+10	9,445	0.059	7,510	0.074
	1024+10	1031+10	750	0.321	700	0.344
	1031+10	1056+45	3,710	0.079	2,535	0.115
	1056+45	1090+35	4,945	0.056	3,390	0.082
	1090+35	1145+00	7,945	0.034	5,465	0.049
	1145+00	1173+15	4,125	0.032	2,815	0.033
	1173+15	1200+90	4,115	0.068	2,775	0.101
	1200+90	1214+00	1,910	0.114	1,310	0.166

	PROPOSED CHANNEL GEOMETRY				
	STATION	DOWNSTREAM BANKFULL WIDTH (FT)	DOWNSTREAM CHANNEL DEPTH (FT)	DOWNSTREAM VALLEY WIDTH (FT)	DOWNSTREAM POOL DEPTH (FT)
FUTURE PHASE	242+80	18	2.2	-	3.9
	336+40	18	2.2	126	3.9
	364+00	16	2.0	114	3.7
	422+85	16	2.0	112	3.7
PHASE 1	550+40	16	1.9	110	3.4
	653+00	15	1.9	106	3.4
	689+30	15	1.8	104	3.3
	803+90	14	1.7	96	3.2
FUTURE PHASE	872+05	9	1.4	60	2.4
	949+00	7	1.4	50	2.4
	1090+35	6	1.3	44	2.3
	1214+15	4	1.3	28	2.3

Houston Engineering Inc. | Fargo | P: 701.237.5065 | F: 701.237.5101

Drawn by: KHC, AJK | Date: 6-8-18 | Checked by: TDR, ESJ | Scale: AS SHOWN

WOLVERTON CREEK RESTORATION & SEDIMENT REDUCTION PROJECT PHASE 1
BUFFALO - RED RIVER WATERSHED DISTRICT
BARNESVILLE, MINNESOTA

DATA TABLES
PROJECT NO. 1915-189
SHEET 17 of 19

Figure 13-6. Data tables from construction plans.

Table 13-1 Plants observed along area seeded by Wilkin County SWCD from photos taken during site visit on 8/15/2019. Photos were taken along a meander survey route for plant ID.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Avena sativa	oats	abundant	yes	cover crop
Triticum aestivum	wheat	abundant	yes	cover crop
Lolium multiflorum	annual ryegrass	common	yes	cover crop
Polygonum punctatum	dotted smartweed	abundant	no	native
Artemisia cf. biennis	biennial wormwood	abundant	no	native
Dalea purpurea	purple prairie clover	common	yes	native
Andropogon gerardii	big bluestem	common	yes	native
Sorghastrum nutans	indiangrass	rare	no	native
Apocynum cannabinum	Indian hemp	rare	no	native
Dalea candida	white prairie clover	rare	yes	native
Desmodium canadense	showy tick tree-foil	rare	no	native
Hordeum jubatum	foxtail barley	rare	no	native
Fraxinus pensylvanicus	green ash	rare	no	native
Acer negundo	box elder	rare	no	native
Polygonum persicaria	lady's thumb smartweed	abundant	no	non-native
Melilotus spp.	sweet clover	abundant	no	non-native
Phalaris arundinacea	reed canary grass	abundant	no	non-native
Setaria pumlia	yellow foxtail	abundant	no	non-native
Ambrosia artemisiifolia	annual ragweed	abundant	no	non-native
Echinoclhoa crus-galli	barnyard grass	abundant	no	non-native
Rumex crispus	curly dock	abundant	no	non-native
Amaranthus spp.	pigweed	abundant	no	non-native
Ambrosia trifida	giant ragweed	common	no	non-native
Medicago lupulina	black medic	common	no	non-native
Chenopodium spp.	lambs quarter	common	no	non-native
Hibiscus trionum	flower-of-an-hour	common	no	non-native
Polygonum aviculare	prostrate knotweed	common	no	non-native
Trifolium pratense	red clover	rare	no	non-native

Appendix B: Site Photographs

Photo 13-1. Representative channel view. Photo taken by Anna Varian during site visit (8/15/2019).

Photo 13-2. Section of stream that has been re-constructed. Photo taken by Anna Varian during site visit (8/15/2019).

Photo 13-3. Recently constructed channel showing reed canary sod mats and two-stage Rosgen E channel design. Photo taken by Anna Varian during site visit (8/15/2019).

Photo 13-4. One of the many side inlet culverts. Photo taken by Anna Varian during site visit (8/15/2019).

Photo 13-5. Stream channel starting to adjust from a Rosgen E type channel to C type channel. Photo taken by Anna Varian during site visit (8/15/2019).

Photo 13-6. View of existing condition at a location just upstream from the Phase 1 construction. Water is stagnant and channel is choked with sediment and vegetation. Photo taken by Anna Varian during site visit (8/15/2019).

Photo 13-7. Aerial view during construction. Photo provided by the BRRWD.

14) Burnham Creek Watershed Projects

Project Background

Project Name: Burnham Creek – Watershed Restoration

Project Site: Burnham Creek

Township/Range Section: Township T148N Range R46W Section 14

Project Manager / Affiliated Organization: Nicole Bernd / West Polk Soil & Water Conservation District

Fund: CWF ***Fiscal Year Funds:*** 2013

Project Start Date: April 2014

Predominant Habitat type: Aquatic Habitat

Additional Habitat types:
Prairie/Savanna/Grassland, Choose an item.

Project Status: Establishment Phase

County: Polk

Primary Activity: Stream/River Enhancement

Project Size: 9 Structures

Project Completed: December 2014

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   A series of nine riprap grade stabilization structures to address down cutting and bank failure along two miles on the upper end of Burnham Creek and improve fish passage throughout the reach
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   - Burnham Creek – Grade Stabilization Structures Phase 2. Red River Valley Conservation Service Area (RRVCSA), April 2014.
   - Red Lake Watershed District Monthly Water Quality Report (October 2018). Red Lake Watershed District, February 2019.
3. ***What are the stated goals of the project?***
   Reduce streambank erosion and provide greater channel stability to Burnham Creek in the project area and improve fish passage.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Reduce sedimentation, improve fish passage, improve aquatic biology, and improve water quality (reduce suspended solids and increase Dissolve Oxygen levels) of Burnham Creek which is a tributary to

the impaired Red Lake River: the source of drinking water for the residents of East Grand Forks and is impaired for turbidity.

5. ***Were measures of restoration success identified in plans?*** *No*
   If yes, list specific measurements.
   Pre and Post project monitoring is in the form of regular samples collected at CSAH 48. Regular samples are also collected at the lower end of the watershed at 320th Ave SW. There have been no exceedances of the 65 mg/L total suspended solids standard at the CSAH 48 sampling site from 2014 through 2018. An intensive fluvial geomorphology assessment of Burnham Creek has been underway in 2018 and 2019. The geomorphologic assessment includes reaches upstream and within the project area. The MPCA sampled fish and macroinvertebrates within Burnham Creek, downstream of the project area, but not upstream. Sampling within or upstream of the project area (WID 09020303-552) will be recommended to the MPCA biological staff prior to the 2022 sampling.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   - **Burnham Creek – Grade Stabilization Structures Phase 2**, Polk County, MN – RRVCSA, April 2014. Document includes project location, general plans, riprap structure details, material quantities, and is overlaid with as-built drawings (dated December 2019).
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Stabilization of streambanks and channel profile elevations with riprap grade control structures is based on current practice in MN. It is preferred to use bioengineered practices where possible. But in some instances, stronger stabilization materials that are more resistant to shear stresses are necessary or based on the location and goals of the project, or where higher guarantees of success are needed. For the long-term success of this project, riprap protection of the banks was justified. Future project funding for repairs of bioengineered streambank failures after construction is limited.

   Revegetation of disturbed streambanks with native vegetation is industry standard in MN.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No
9. ***In what ways did alterations change the proposed project outcome?***
   N/A

Site Assessment

Field Review Date: **6/4/2019**

Field Visit Attendees: Nathan Olson – MN Department of Natural Resources**,** Ed Matthiesen – Wenck Associates, Gina Quiram – MN Department of Natural Resources,

10. ***Surrounding Landscape Characteristics:***

The site is surrounded by cultivated land to the North, East, South, and West. The banks of Burnham Creek at the site location have well-vegetated grassy slopes. Buffer width is relatively uniform across the project area, averaging roughly 60 ft.

11. ***Site Characteristics:***
    a. ***Soil Series:***
    Reis Clearwater Clay (152A), and Clearwater Clay (19A).
    b. ***Topography:***
    The site is low in the landscape with bank slopes at 5:1.
    c. ***Hydrology:***
    Poorly drained.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
    Open grassland streambanks of predominantly introduced cool season grasses: smooth brome, quackgrass, and Kentucky bluegrass, with a combined cover of between 50-100%. Forbs appear to contribute between 25-50% cover, overlapping with grass cover, and include a mix of native and invasive/noxious species such as sweetclover, noxious thistle, and native goldenrods. Minimal shrub cover along the water's edge includes willows, tree seedlings, and snowberry.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
    Refer to Appendix A, Table 14-1 for Species list.
12. ***Is the plan based on current science?*** Yes
    Stabilization of channel profile elevations with riprap grade control structures is based on current science for streambank stabilization to prevent stream channels from incising and to prevent head cut formation and migration along the channel while preserving or improving fish passage.
13. ***List indicators of project goals at this stage of project:***
    Slopes are well-vegetated and show no signs of erosion.
    Some sedimentation is occurring between rock riffles, but was expected.
14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Yes, with minimal maintenance.
15. ***Are corrections or modifications needed to achieving proposed goals?***
    No.
16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    An observed opportunity to improve the project outcome and further minimize future maintenance of riffle structures is to add live stakes. Additionally, it was observed that the benefit to fish habitat could be improved by reducing the rock drop on the NRCS rock flume to a height less than 12 inches. The slope of the structure should be 20:1.
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No. The stabilization of the channel and the improvements to the rock flume provide a benefit to fish habitat.
18. ***Are follow-up assessments needed? Explain.***
    Additional assessments are not required; however the project reach will be routinely inspected by local staff to make sure the structures are working and are intact.

19. ***Additional comments on the restoration project.***
    This project was a partnership between the Burnham Creek Watershed District, the West Polk Soil & Water Conservation District, and the Red River Valley Conservation Service Area. It is being monitored by the Watershed through the Burnham Creek Geomorphology Assessments, with the project site among those targeted for Bank Erosion Hazard Index ratings in October of 2018.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    Project has been observed to meet project goals of reducing erosion on banks since its completion, and will likely continue to do so.
23. ***Site Assessor(s) Conducting Review:***
    Ed Matthiesen

Appendix A: Site maps, Project plans or Vegetation tables

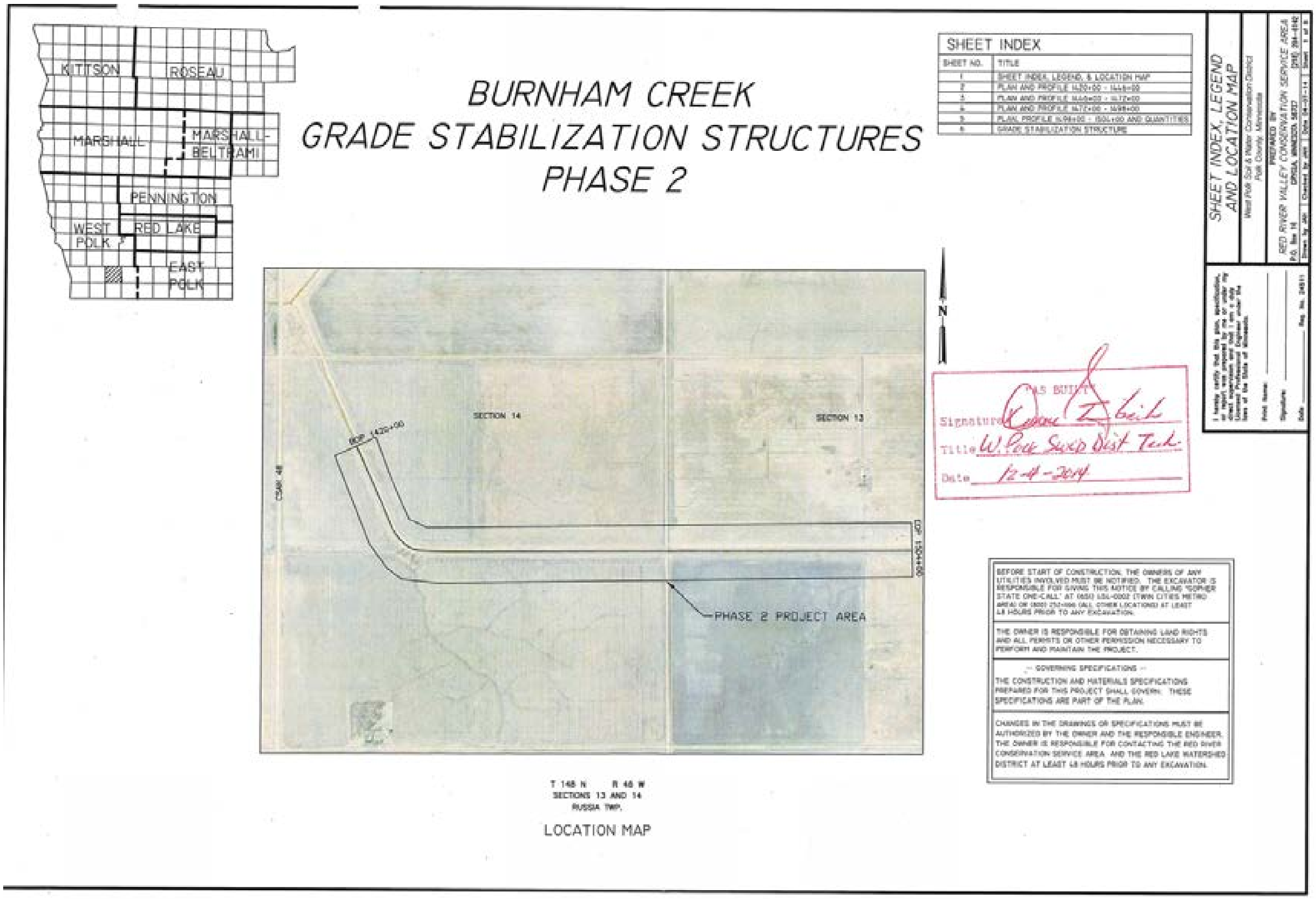


Figure 14-1 Burnham Creek – Grade Stabilization Structures Phase 2 sheet 1 of 16. Project site map showing location of site on Burnham Creek.

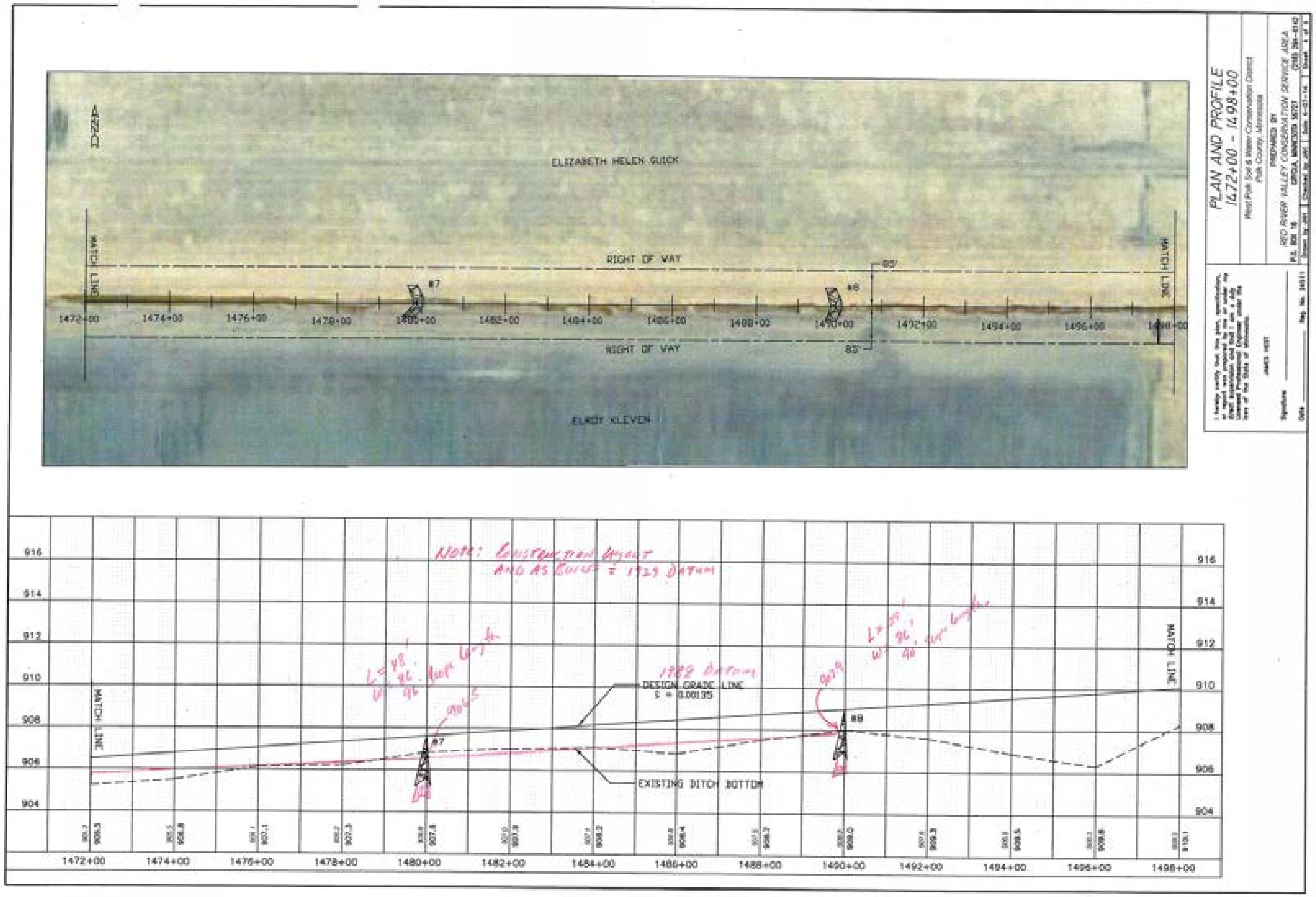
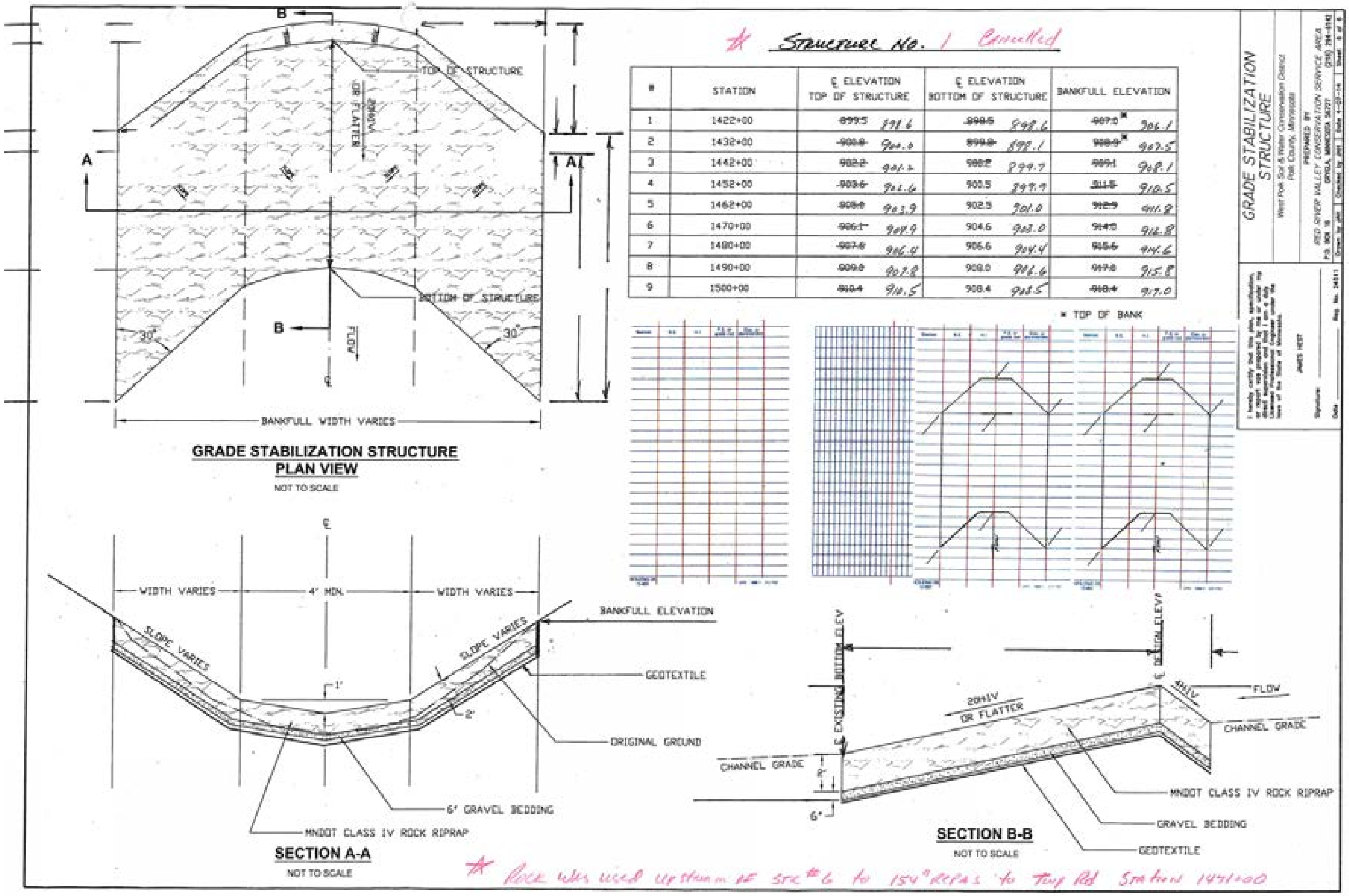


Figure 14-2 Burnham Creek – Grade Stabilization Structures Phase 2 sheet 4 of 16. Project map and site plans showing locations of riffles 7 and 8. Elevations and details are listed below.



#	STATION	℄ ELEVATION TOP OF STRUCTURE	℄ ELEVATION BOTTOM OF STRUCTURE	BANKFULL ELEVATION
1	1422+00	~~899.5~~ 898.6	~~898.5~~ 898.6	~~907.0~~* 906.1
2	1432+00	~~900.8~~ 900.0	~~899.8~~ 898.1	~~908.9~~* 907.5
3	1442+00	~~902.2~~ 901.2	~~900.2~~ 899.7	~~909.1~~ 908.1
4	1452+00	~~903.6~~ 902.6	900.5 899.9	~~911.5~~ 910.5
5	1462+00	~~906.0~~ 903.9	902.5 901.0	~~912.9~~ 911.8
6	1470+00	~~906.1~~ 904.9	904.6 903.0	~~914.0~~ 912.8
7	1480+00	~~907.6~~ 906.4	906.6 904.4	~~915.6~~ 914.6
8	1490+00	~~909.0~~ 907.8	908.0 906.6	~~917.8~~ 915.8
9	1500+00	~~910.4~~ 910.5	908.4 908.5	~~918.4~~ 917.0

Figure 14-3 Burnham Creek – Grade Stabilization Structures Phase 2 sheet 6 of 16. Typical detail and quantities of riffle structure.

Table 14-1 Plants observed from photos taken during site visit on 6/4/19. Photos were taken along a meander survey route for plant ID. Seed mix specified for the turf establishment line item of the Burnham Creek Grade Stabilization Structures project was MN DOT Seed Mix 250 (Mesic General Roadside).

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Salix interior	Sandbar willow	1-10		Native
Bromis inermis	Smooth brome	25-50	Seeded	Invasive
Elymus repens	Quackgrass	25-50		Invasive
Melilotus sp.	Sweetclover	25-50		Invasive
Sonchus arvensis	Sowthistle	5-10		Invasive
cf. Carduus sp.	Musk or plumeless thistle	5-25		Noxious
Taraxacum officinale	Common dandelion	5-10		Invasive
Poa pratensis	Kentucky bluegrass	5-25	Seeded	Invasive
Potentilla sp.	Cinquefoil; Basal leaves, early growth, species inconclusive	<5		Native
Solidago canadensis	Canada goldenrod	5-25		Native
Zizea aurea	Golden alexanders	5-10		Native
Equisetum arvense	Field horsetail	1-10		Native
Lysimachia ciliata	Fringed loosestrife	1-10		Native
Solidago gigantea	Giant goldenrod	5-25		Native
Phalaris arundinacea	Reed canarygrass	5-10; along water's edge		Invasive
Calystegia sepium	Hedge bindweed	1-10		Invasive
Plantago sp.	Plantain	<5		Weedy
Fraxinus pennsylvanica	Green ash	<5; Re-sprouting from stump		Native
Symphoricarpos occidentalis	Western snowberry	<5		Native
Glycyrrhiza lepidota	American licorice	<5		Native
Equisetum sp.	Spikerush	<5; within water (obligate)		Native
Scirpus/Schoenoplectus sp.	Bulrush	<5; within water (obligate)		Native
Populus deltoides	Cottonwood	<5; seedling		Native
Potamogeton nodosus	Long-leaved pondweed	<5; aquatic		Native

Appendix B: Site Photographs

Photo 14-1 Burnham Creek pre construction and channel cleanout. Photo taken by project partners (5/2/2012).

Photo 14-2 View of Burnham Creek riffle #3. Creek is 1-2 channel widths upstream (right) and 2-5 channel widths downstream (left). It is recommended to add live stakes. Photo taken by Ed Matthiesen during site visit (6/4/19).

Photo 14-3 View of Burnham Creek riffle #4. Creek is 1-2 channel widths upstream (right) and 2-5 channel widths downstream (left). It is recommended to add live stakes to 2 channel widths downstream. Photo taken by Ed Matthiesen during site visit (6/4/19).

Photo 14-4 Upstream view of riffle #5. Creek is 1-2 channel widths upstream (right) and 2-5 channel widths downstream (left). It is recommended to add live stakes. Photo taken by Ed Matthiesen during site visit (6/4/19).

Photo 14-5 Upstream view of riffle #8. Creek is 1-2 channel widths upstream (front) and 2-5 channel widths downstream (back). This riffle is meeting project goals of reducing bank erosion. Photo taken by Ed Matthiesen during site visit (6/4/19).

Photo 14-6 Upstream view of NRCS Rock Flume at project location 1502+00 on Burnham Creek. It is recommended to reduce the rise of the structure to less than 12 inches. Photo taken by Ed Matthiesen during site visit (6/4/19).

15) Sand Hill River Watershed Projects

Project Background

Project Name: Sand Hill River – Watershed Projects

Project Site: Sand Hill River

Township/Range Section: Township MN T147N Range R46W Section 24

Project Manager / Affiliated Organization: Nicole Bernd, West Polk SWCD

Fund: CWF ***Fiscal Year Funds:*** 2015

Project Start Date: May 2016

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Prairie / Savana / Grassland , Choose an item.

Project Status: Establishment Phase

County: Polk

Primary Activity: Stream/River Restoration

Project Size: 27,000 Linear Feet

Project Completed: 2016/2017

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   A series of 16 rock riffles to address down cutting and bank failures along 27,000 linear feet of the Sand Hill River East of Beltrami.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   - **Sand Hill River Grade Stabilization Project,** Fertile, MN – Houston Engineering, May 2016.
   - **Specifications for Sand Hill River Grade Stabilization**, Houston Engineering, May 2016.
3. ***What are the stated goals of the project?***
   Stabilize streambed and streambank of Sand Hill River and improve fish passage within the project area using riprap riffle crests and retrofitting of existing drop structures to reduce vertical elevation changes.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Improve water quality in the Sand Hill River and provide a benefit to fish habitat.
   Stabilize the streambanks without large scale intervention of regrading and revegetating of the pre-existing bank slump failures.
5. ***Were measures of restoration success identified in plans?*** *No*
   If yes, list specific measurements.

No quantifiable restoration measurements were described in the plans. Observation of the protected bank for continued or new erosion features could be used as a measure of success.

6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   - **Sand Hill River Grade Stabilization Project,** Fertile, MN – Houston Engineering, May 2016. Document includes project location, general plans, typical sections, and structure details.
   - **Specifications for Sand Hill River Grade Stabilization**, Houston Engineering, May 2016. Document includes agreement with contractor, estimates of cost, and material quantities.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Installation of rock riffles to control channel grade and stabilize stream reaches is industry standard in MN. The Minnesota Department of Natural Resources has developed guidance on including rock arch rapids in constructed riffles for improved fish passage with the document, "Reconnecting Rivers: Natural Channel Design in Dam Removal and Fish Passage," which has a history of success It is standard design practice to include riprap material from the rock riffle up the streambanks to the top of the channel to minimize the potential of the stream channel from migrating and cutting off the riffle. Eventually the exposed riprap on the bank will fill with deposited sediment and revegetate naturally.

   Revegetation of disturbed streambanks with native vegetation is industry standard in MN.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No
9. ***In what ways did alterations change the proposed project outcome?***
   N/A

Site Assessment

Field Review Date: **6/29/2019**

Field Visit Attendees: Ed Matthiesen – Wenck Associates, Zach Herrmann – Houston Engineering, April Swenby – Sand Hill River Watershed District, Nicole Bernd – West Polk Soil and Water Conservation District, Gina Quiram – MN Department of Natural Resources, Jamison Wendel – MN Department of Natural Resources, Nathan Olson – MN Department of Natural Resources

10. ***Surrounding Landscape Characteristics:***
    The sites are surrounded by cultivated land to the North, East, South, and West. The Sand Hill River at the site locations is surrounded by vegetated grass slopes. Average buffer width is roughly 60 ft (width varies between 30-70 ft along site area) to the North of the river, and 150 ft to the South of the river.

11. ***Site Characteristics:***

a. Soil Series:

Glyndon very fine sandy loam (I23A), Bowstring Fluvaquents complex (I7A), Wheatville very fine sandy loam (I68A).

b. Topography:

The site areas are low in the landscape with side slopes average 6:1.

c. Hydrology:

Well-drained.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

Grass-dominated riverbanks. Dominant species were the introduced smooth brome estimated at over 75% cover and sandbar willow ranging from 10-25% cover along the river's edge. The site was relatively low in species diversity and cover of native species, though several native shrubs, graminoids, and forbs were noted. No noxious weeds were noted.

e. Vegetation B: Meander Search Species List (as appropriate for site)

Refer to Appendix A, Table 15-1 for species list.

12. ***Is the plan based on current science?*** Yes

Installation of rock riffles with integrated rock arch rapids is industry standard in MN to control channel grade, stabilize stream reaches, and make the riffles passable for fish. Guidance by the Minnesota Department of Natural Resources in the document, "Reconnecting Rivers: Natural Channel Design in Dam Removal and Fish Passage." This practice has a history of success.

13. List indicators of project goals at this stage of project:

Pre-existing bank slump failures do not grow in size.

Exposed soil faces of the pre-existing slump failures revegetate.

Sand depositions on the streambanks revegetate with pioneering vegetation and seed from the established vegetation not smothered by the deposition.

Flow directed towards center of channel.

Grade drops every 1 foot in elevation change on the channel profile.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes, with minimal maintenance.

15. Are corrections or modifications needed to achieve proposed goals?

No.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

Additional long-term maintenance or repair work on the project area will be a challenge due to the limited availability of funding outside of the scope of the CWF funding for this project.

A design suggestion by the observer for future channel stabilization projects is to consider adding sandbar willow or dogwood shrub species for a distance of one channel width upstream and two channel widths downstream at project locations to provide more streambank stability in the transition from natural channel to installed channel stabilization BMPs and back to natural channel.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No. The rock riffles and rock arch rapid features have been installed to promote fish passage through this reach of the Sand Hill River.
18. ***Are follow-up assessments needed? Explain.***
    Annual visual inspection of the pre-existing bank slump failures should be done to ensure they do not increase in size. Especially after high-flow events.
19. ***Additional comments on the restoration project.***
    This project was a partnership between Sand Hill River Watershed District, Polk County, Reis & Liberty Townships, West Polk SWCD, Enbridge, The Minnesota Pollution Control Agency, US Army corps of Engineers and the MN Department of Natural Resources. An Outdoor Heritage Fund project was completed on this reach of the Sand Hill River to remove drop structures for improved fish passage. This Clean Water Fund project was completed on the same reach and continues the fish passage work by stabilizing the reach and channel grade with rock riffles and includes rock arch rapids in the riffle design to make the riffles passable for fish.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    Project has been in place for three years with little deterioration.
23. ***Site Assessor(s) Conducting Review:***
    Ed Matthiesen

Appendix A: Site maps, Project plans or Vegetation tables

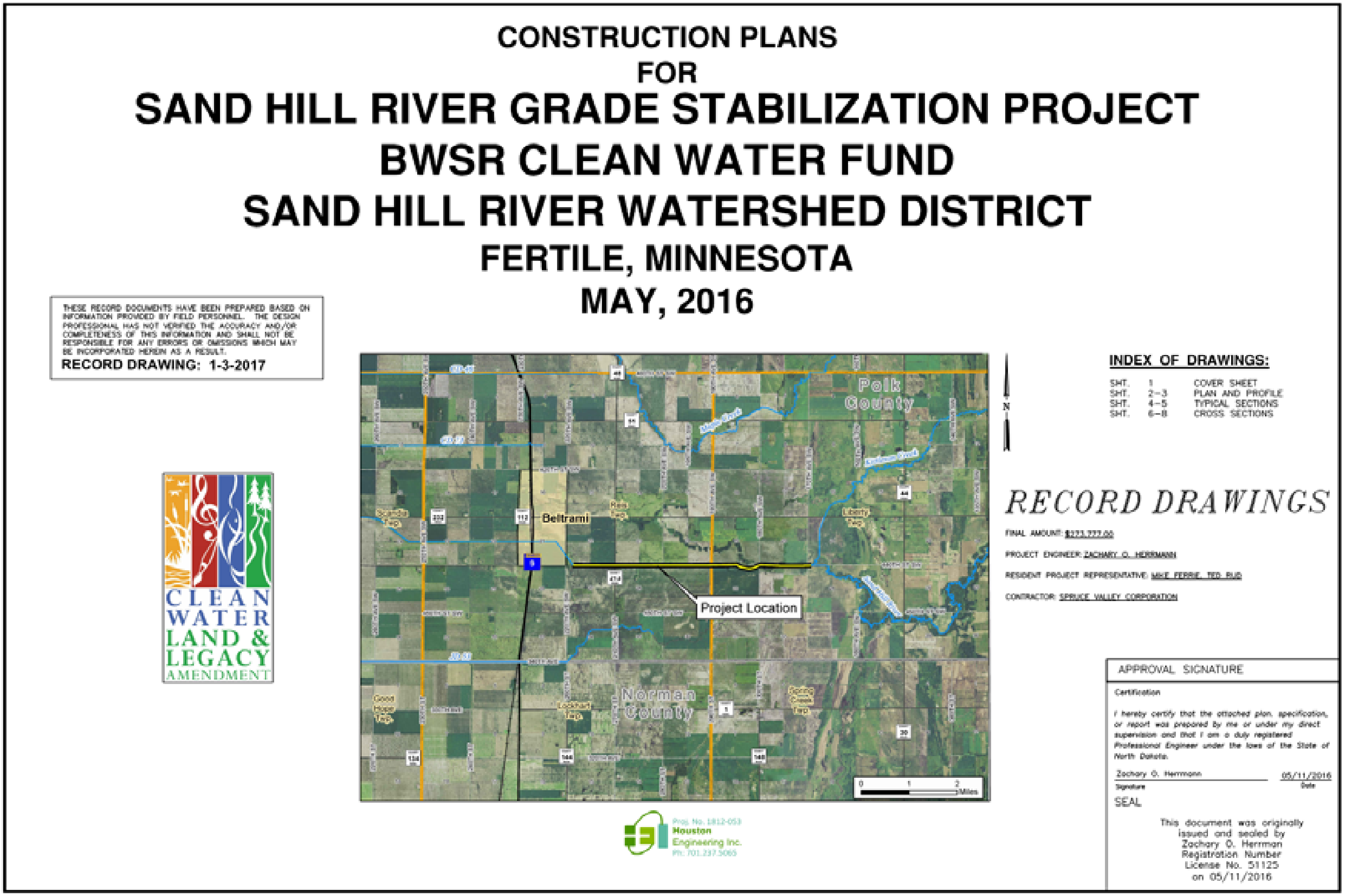


Figure 15-1 Sand Hill River Grade Stabilization Project sheet 1 of 8. Project site map showing location of site on Sand Hill River.

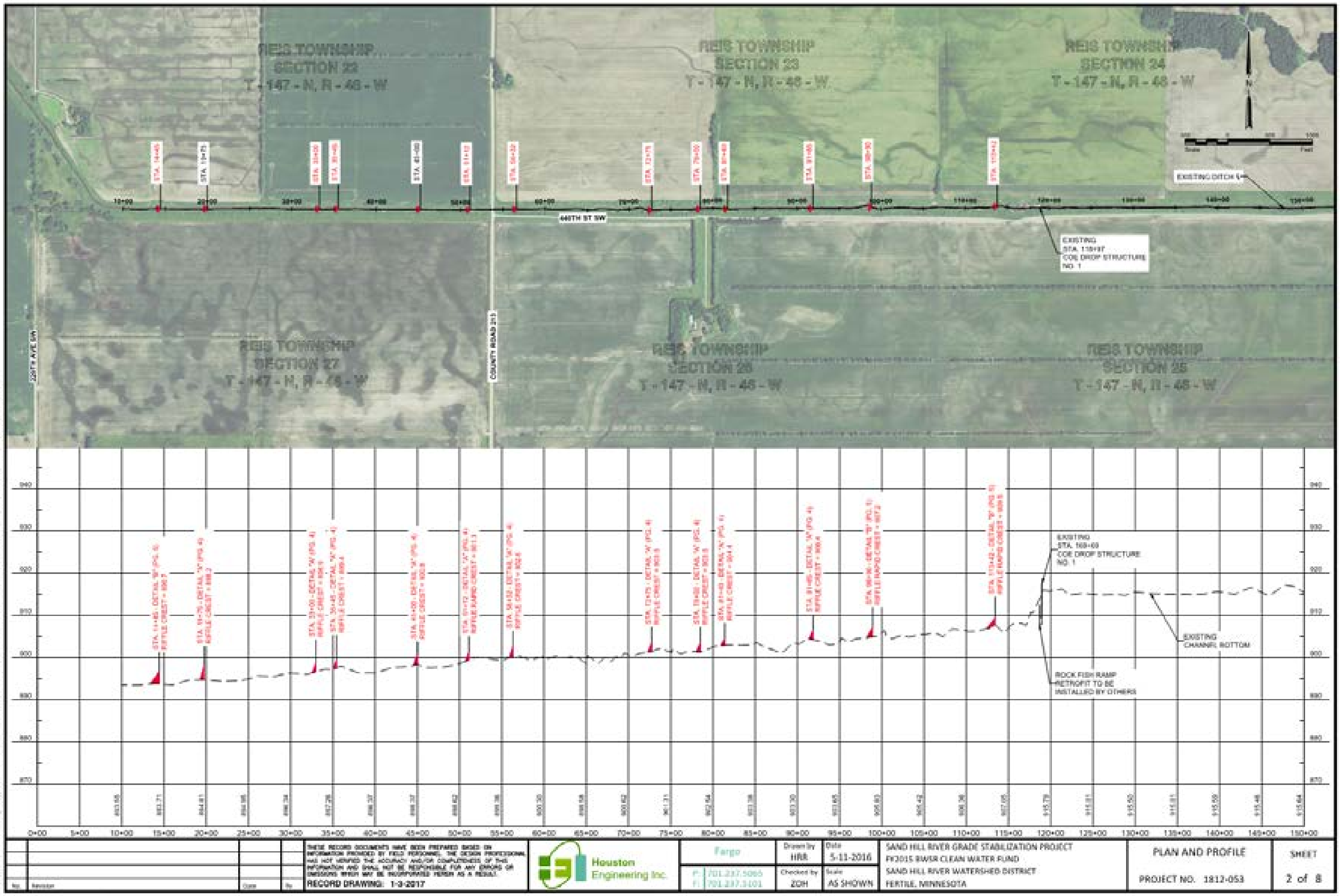
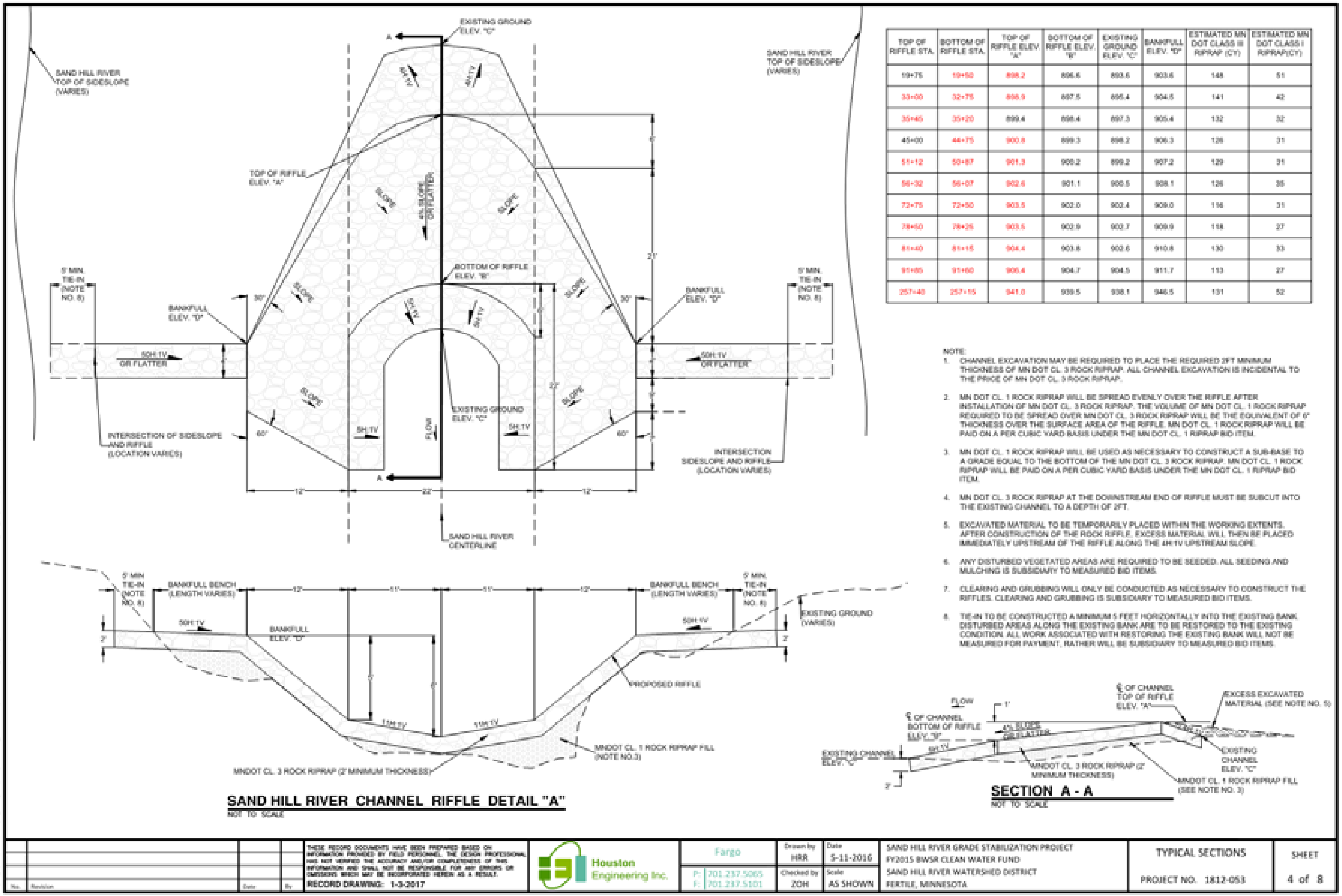
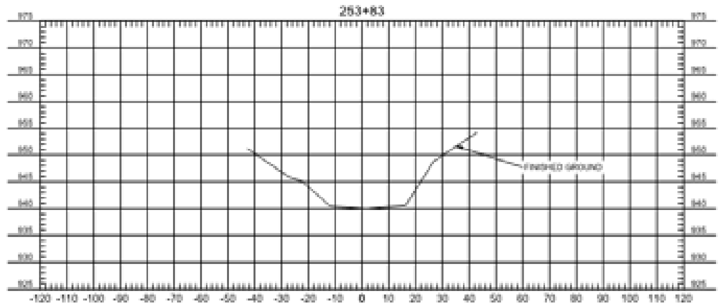


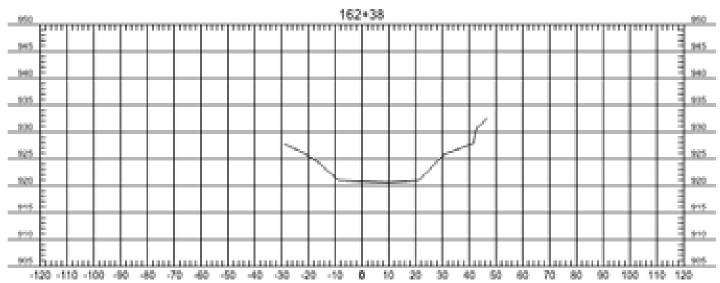
Figure 15-2 Sand Hill River Grade Stabilization Project sheet 2 of 8. Project site map with locations and elevations of structures.



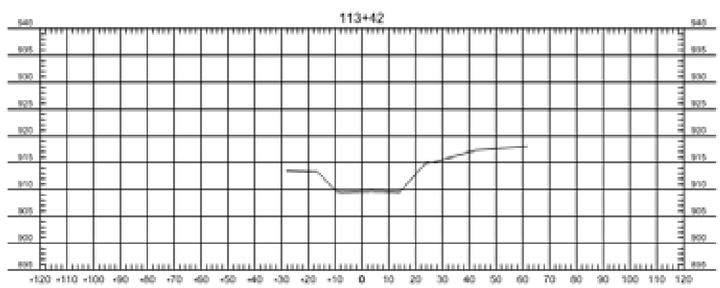
TOP OF RIFFLE STA.	BOTTOM OF RIFFLE STA.	TOP OF RIFFLE ELEV. "A"	BOTTOM OF RIFFLE ELEV. "B"	EXISTING GROUND ELEV. "C"	BANKFULL ELEV. "D"	ESTIMATED MN DOT CLASS III RIPRAP (CY)	ESTIMATED MN DOT CLASS I RIPRAP(CY)
19+75	19+50	898.2	896.6	893.6	903.6	148	51
33+00	32+75	898.9	897.5	895.4	904.5	141	42
35+45	35+20	899.4	898.4	897.3	905.4	132	32
45+00	44+75	900.8	899.3	898.2	906.3	126	31
51+12	50+87	901.3	900.2	899.2	907.2	129	31
56+32	56+07	902.6	901.1	900.5	908.1	126	35
72+75	72+50	903.5	902.0	902.4	909.0	116	31
78+50	78+25	903.5	902.9	902.7	909.9	118	27
81+40	81+15	904.4	903.6	902.6	910.8	130	33
91+85	91+60	906.4	904.7	904.5	911.7	113	27
257+40	257+15	941.0	939.5	938.1	946.5	131	52

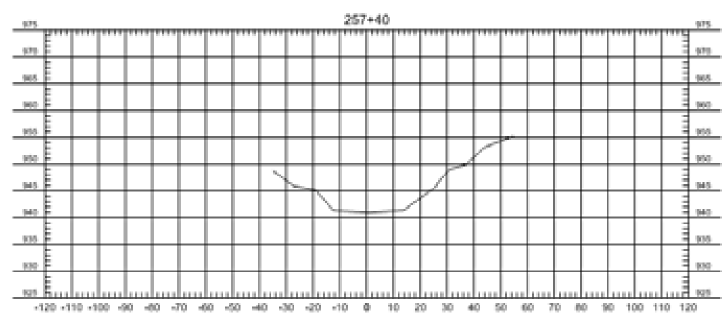
Figure 15-3 Sand Hill River Grade Stabilization Project sheet 4 of 8. Typical section and details of proposed riffles.





STA.	RIFFLE CREST ELEV. AT CENTERLINE OF CHANNEL	DROP TO DOWNSTREAM RIFFLE	BANKFULL ELEVATION	EXISTING GROUND ELEV.
14+45	896.7	-	902.7	893.7
19+75	898.2	1.5	903.6	893.6
33+00	898.9	0.7	904.5	895.4
35+45	899.4	0.5	905.4	897.3
45+00	900.8	1.4	906.3	898.2
51+12	901.3	0.5	907.2	899.2
56+32	902.6	1.3	908.1	900.5
72+75	903.5	0.9	909.0	902.4
78+50	903.5	0.0	909.9	902.7
81+40	904.4	0.9	910.8	902.6
91+85	906.4	2.0	911.7	904.5
98+90	907.2	0.8	913.2	904.9
113+42	909.5	2.3	915.5	907.0
162+38	920.6	-	926.6	918.0
253+83	940.0	-	945.6	937.9
257+40	941.0	1.0	946.5	938.1





RECORD DRAWING: 1-3-2017

Houston Engineering Inc. — Fargo — P: 701.237.5065 F: 701.237.5101

Drawn by: HRR | Date: 5-11-2016 | Checked by: ZOH | Scale: AS SHOWN

SAND HILL RIVER GRADE STABILIZATION PROJECT
FY2015 BWSR CLEAN WATER FUND
SAND HILL RIVER WATERSHED DISTRICT
FERTILE, MINNESOTA

CROSS SECTIONS
PROJECT NO. 1812-053

SHEET 8 of 8

Figure 15-4 Sand Hill River Grade Stabilization Project sheet 8 of 8. Stream cross-section profile at locations of proposed structures.

Table 15-1 Plants observed from photos taken during site visit on 6/4/19. Photos were taken along a meander survey route for plant ID. Seed mix specified for the Sand Hill River Grade Stabilization project was Minnesota State Seed Mix 35-241 – Mesic Prairie General. Not of the species identified are included in the Mesic Prairie General seed mix.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Bromus inermis	Smooth brome	75-100%		Invasive
Salix interior	Sandbar willow	10-25%		Native
Equisetum arvense	Field horsetail	1-10%		Native
Carex sp.	sedge	<5%		Native
Symphyotrichum lanceolatum	Panicled aster	<5%		Native
Rosa arkansana	Wild prairie rose	<5%		Native
Taraxacum officinale	Dandelion	<5%		Invasive
Vicia americana	American vetch	<5%		Native
Thalictrum dasycarpum	Purple meadow-rue	<5%		Native
Echinocystis lobata	Wild cucumber	<5%		Native
Carex cf. emoryi	Possibly Emory's sedge	<5%		Native
Acer negundo	Boxelder – seedlings	1-5%		Native
Salix cf. eriocephala	Missouri River willow – possible seedlings	<5%		Native
Artemisia ludoviciana	White sagewort	<5%		Native
Phalaris arundinacea	Reed canarygrass	1-10%, along water's edge		Invasive
Cornus sericea	Red-osier Dogwood	<5%		Native
Anemone canadensis	Canada anemone	<5%		Native
Glycyrrhiza lepidota	Wild licorice	<5%		Native

Appendix B: Site Photographs

Photo 15-1 View of existing bank slump failure at project Station 91+85. Photo taken by others during pre-construction visit (8/2/2016).

Photo 15-2 View of constructed riffle at project station 91+85. Pre-existing bank slump failures are still visible in the background. Photo taken by others during a post-construction, final inspection (6-29-2017).

Photo 15-3 Upstream view of riffle #12. Note the sand accumulation. An observed opportunity for improvement is to add sandbar willow. Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 15-4 Upstream view of riffle #13. Note erosion on the bare bank (left). An observed opportunity for improvement is to add sandbar willow. Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 15-5 Upstream view of riffle #13. Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 15-6 Downstream view of riffle #13. Note the erosion on the bare slopes of the far bank. Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 15-7 Downstream view of riffle #11. The banks are well-vegetated and held in place by willow and dogwood. Photo taken by Ed Matthiesen during site visit (6/4/2019).

16) Sand Hill River Fish Passage Restoration

Project Background

Project Name: Sandhill River Fish Passage

Project Site: Sandhill River

Township/Range Section: Township 147N Range 46W Section 23

Project Manager / Affiliated Organization: Timothy Smith / US Army Corps of Engineers

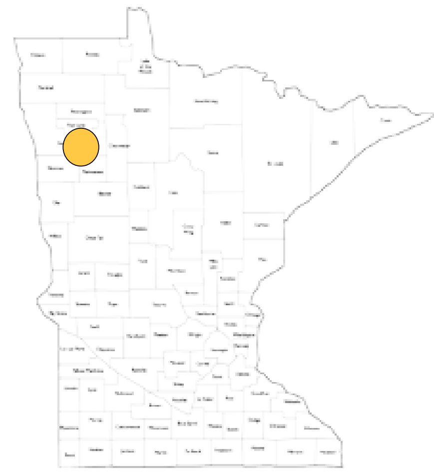
Fund: OHF ***Fiscal Year Funds:*** FY 2016

Project Start Date: 6-30-2015

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Aquatic, Prairie / Savana / Grassland

Project Status: Establishment Phase



County: Polk County

Primary Activity: Stream/River Restoration

Project Size: 4 structures

Project Completed: 2019

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Drop structure removal and fish passage construction at four sites.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   - Sand Hill River Drop Structures, United States Army Corps of Engineers (USCOE) August 2015
   - Sand Hill River Passage Structure, USCOE May 2014
3. ***What are the stated goals of the project?***
   Concrete drop structure removal and fish passage installation at four locations to remove fish passage barriers.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Allow fish passage over a previous fish barrier drop structure
5. ***Were measures of restoration success identified in plans?*** *No*
   If yes, list specific measurements.
   No basis of design memorandum submitted.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:

Sand Hill River Fish Passage, Sand Hill River, Sand Hill River Drop Structures, Polk County, MN – US Army Corps of Engineers, August 2015. Document includes project location, general plans, boring details, plan views and profiles, typical sections, riffle plans, riprap details and existing drop structures.

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Removal of concrete drop structures that are barriers to fish passage is industry standard in MN.
   Stabilization of stream bed and accumulated soils upstream of removed drop structures using ramps of hemi circular rock boulder riffles installed at 20:1 slopes or greater to be passable by fish is industry standard in MN. Minnesota Department of Natural Resources has developed guidance on rock arch rapids in the document, "Reconnecting Rivers: Natural Channel Design in Dam Removal and Fish Passage," which has a history of success.
   Stabilization of streambanks with riprap material, when needed, is based on current practice in MN. It is preferred to use bioengineered practices where possible. But in some instances, stronger stabilization materials that are more resistant to shear stresses are necessary or based on the location and goals of the project, higher guarantees of success are needed. For the long-term success of this project, riprap protection of the banks was justified. The project is long distance from experienced contractors and sources of rock, and future project funding for repairs of bioengineered streambank failures after construction is limited.
   Revegetation of disturbed streambanks with native vegetation is industry standard in MN.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No

9. ***In what ways did alterations change the proposed project outcome?***
   N/A

Site Assessment

Field Review Date: **6/4/2019**

Field Visit Attendees: Ed Matthiesen – Wenck Associates, Zach Herrmann – Houston Engineering, April Swenby – Sand Hill River Watershed District, Nicole Bernd – West Polk Soil and Water Conservation District, Gina Quiram – MN Department of Natural Resources, Jamison Wendel – MN Department of Natural Resources, Nathan Olson – MN Department of Natural Resources

10. ***Surrounding Landscape Characteristics:***
    The sites are surrounded by cultivated land to the North, East, South, and West. The Sand Hill River at the site locations is surrounded by vegetated grass slopes. Average buffer width is roughly 50 ft (width varies between 30-70 ft along site area).

11. ***Site Characteristics:***
    a. ***Soil Series:***
    The sites areas are predominantly Glyndon very fine sandy loam which has 0 to 2 percent slopes.
    b. ***Topography:***
    The sites are low in the landscape with side slopes ranging from 3:1 to 5:1.
    c. ***Hydrology:***
    Well-drained.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
    Herbaceous streambank vegetation among rocks. Willows were primary woody cover in patches with 10-25% overall cover. Few small trees appear to be outside of project area (large mature cottonwoods in distance). Dominant species were smooth brome, white sweetclover, Kentucky bluegrass (all non-native), plus scattered willows along the water's edge. Total non-native and noxious weed cover over 75%. Presence of multiple noxious weeds - typical of disturbed areas, include Canada thistle and musk or nodding thistle. Native species were present; various forbs and sedges. Because some photos had areas of dense grass cover it was difficult to discern species – could be higher native grass cover than estimated there.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
    Refer to table below.
12. ***Is the plan based on current science?*** Yes
    Removal of barriers to fish passage and stabilization of those areas with rock arch rapids is industry standard in MN with guidance by the Minnesota Department of Natural Resources in the document, "Reconnecting Rivers: Natural Channel Design in Dam Removal and Fish Passage." This practice has a history of success.
13. ***List indicators of project goals at this stage of project:***
    Flow directed towards center of channel.
    Grade drops every 1 foot in elevation change on the channel profile.
    No visible evidence of erosion at riffle area.
14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Yes. Fish passage achieved per design criteria noted in 13 above.
15. ***Are corrections or modifications needed to achieve proposed goals?***
    Project goals are met.
16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

    Additional long-term maintenance or repair work on the project area will be a challenge due to the limited availability of funding outside of the scope of the OHF funding for this project. A future opportunity for the project area is that the township is planning to repair/replace the culvert under 440th Street SW, connecting the drainage ditch to the Sand Hill River by fish passage structure #4. The flow through this culvert has caused erosion on the far bank, upstream of where the bank stabilization work started for fish passage structure #4. Funding for the culvert work may provide an opportunity to stabilize this erosion, however the township does not have abundant resources to divert to addressing this erosion at fish passage structure #4.

An observed opportunity to improve the project outcome and minimize future maintenance at fish passage structure #4 would have been to extend riprap on both sides of the channel to the top of the box culverts under 170th Ave. SW and between the box culvert end sections. For fish passage during low flow conditions, consider placing a rock vane in front of one of the box culverts to select a low flow channel.

A design suggestion by the observer for future channel stabilization projects is to consider adding sandbar willow or dogwood shrub species for a distance of one channel width upstream and two channel widths downstream at project locations to provide more streambank stability in the transition from natural channel to installed channel stabilization BMPs and back to natural channel.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    None.
18. ***Are follow-up assessments needed? Explain.***
    Structure #4 should be reexamined after the bank repair at the location of the incoming flow from the channel upstream of 440th is completed.
19. ***Additional comments on the restoration project.***
    This project was part of an ongoing partnership between Sand Hill River Watershed District, Polk County, Reis & Liberty Townships, West Polk SWCD, Enbridge, The Minnesota Pollution Control Agency, US Army corps of Engineers and the MN Department of Natural Resources. The project was constructed under budget of what was awarded with the grant and complements the additional riffles installed in the Sand Hill River for grade stabilization and ties into the additional habitat/culvert work the partners plans to implement with the remaining grant funds.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    exceeded the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    Project has been in place for three years with no deterioration.
23. ***Site Assessor(s) Conducting Review:***
    Ed Matthiesen

Appendix A: Site maps, Project plans or Vegetation tables

Figure 16-1 Sandhill River Fish Passage Structure 4 plans sheet 4 of 16, site map.

Figure 16-2 Sandhill River Fish Passage Structure 4 plans sheet 6 of 16, site plan.

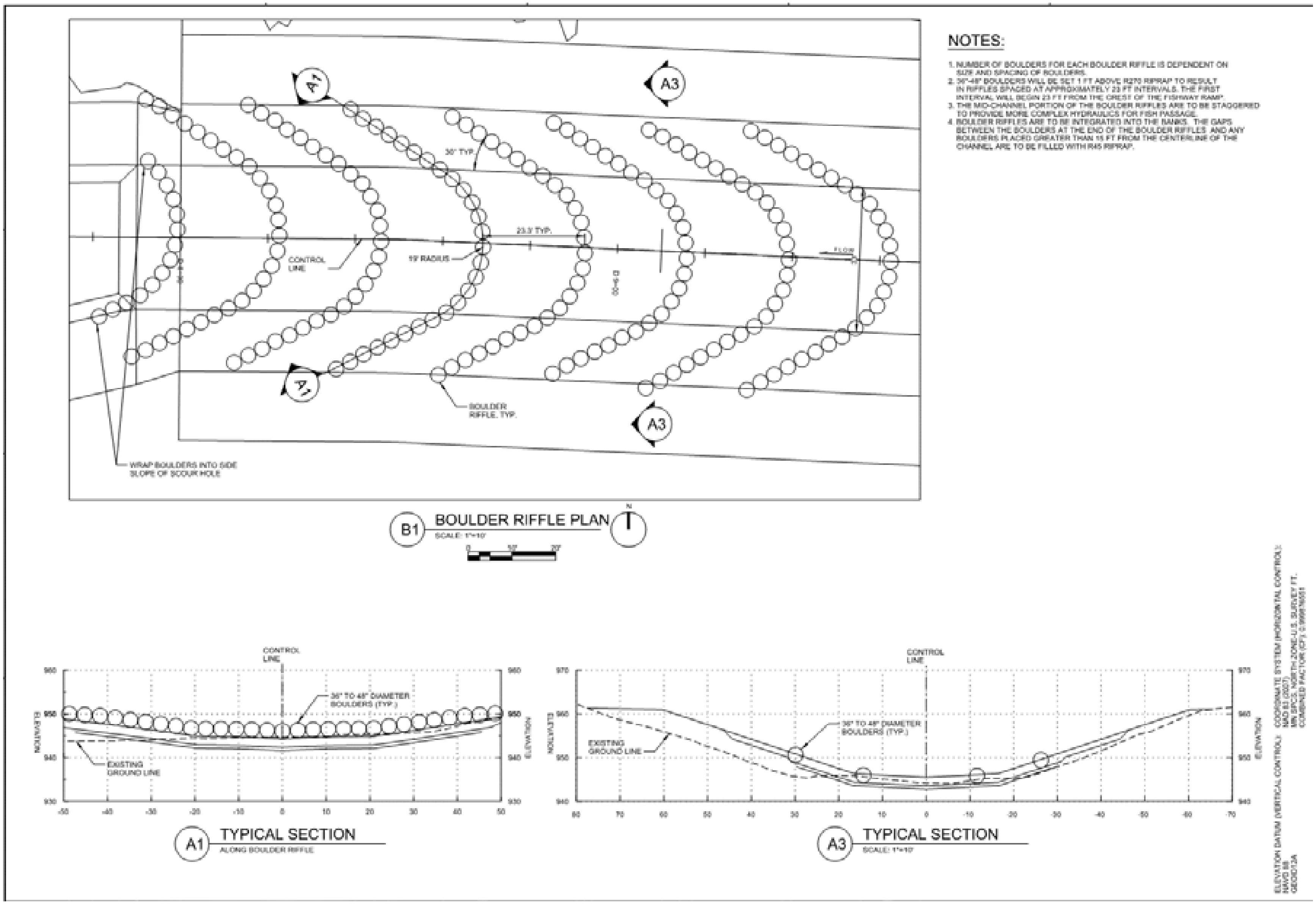


Figure 16-3 Sandhill River Fish Passage Structure 4 plans sheet 11 of 16, boulder riffle plan.

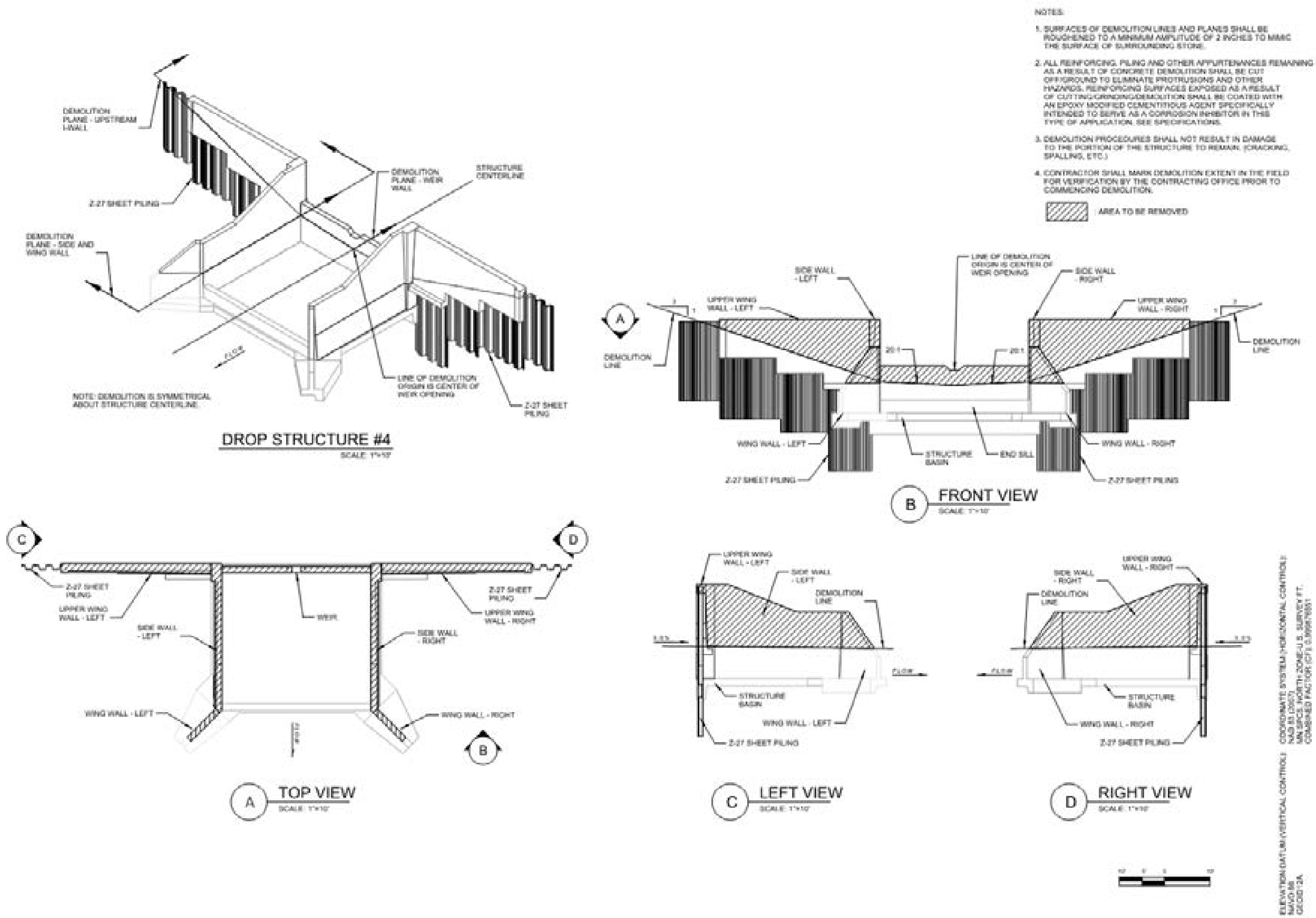


Figure 16-4 Sandhill River Fish Passage Structure 4 plans sheet 16 of 16, drop structure demolition details.

Table 16-1 Plants observed from photos taken during site visit on 6/4/19. Photos were taken along a meander survey route for plant ID. Seed mix specified for the partnering watershed CWF project in the river (grade stabilization project) was State Seed Mix 35-241 – Mesic Prairie General and is assumed to be the same mix used on this fish passage project.

Scientific Name	Common Name	Cover Range %	Species Planted/Seeded	Species Status
Melilotus alba	White sweetclover	25-50		Invasive
Artemisia absinthium	Absinthe wormwood	1-5		Noxious
Possibly Carex sp.	Sedge – can't discern			
Populus deltoides	Cottonwood	Few seedlings, other than mature ones in what appears to be outside project area		
Salix sp.	Willow	10-25 (all willows)		
Cirsium arvense	Canada thistle	1-5		Noxious
Apocynum cannabinum	dogbane			Native
Bromus inermis	Smooth Brome	25-50		Invasive
Possibly Aster lanceolatus				Native
Parthenocissus quinquefolia	woodbine			Native
Solidago rigida	Stiff goldenrod		Seeded	Native
Salix discolor	Pussy willow			Native
Scirpus sp.	bulrush			Native
Equisetum arvense	Field horsetail			Native
Carex sp.	Unknown sedge			
Phalaris arundinacea	Reed canarygrass	1-5		Invasive
Possibly Astragalus canadensis	Canada milkvetch		Seeded	Native
Solidago gigantea	Giant goldenrod	1-5		Native
Helianthus sp.	Sunflower sp.		Seeded	Native
Lycopus sp.	bugleweed			Native
Possibly Carex lacustris	Lake sedge			Native
Carex aquatilis	Water sedge			Native
Salix interior	Sandbar willow			
Eleocharis sp.	spikerush			

Scientific Name	Common Name	Cover Range %	Species Planted/Seeded	Species Status
Carduus sp.	Musk or plumeless thistle	1-5 – could see several basal first year seedlings		Noxious
Clumpy grass – can't discern, possibly Poa sp., a native one.				
Possibly Rudbeckia hirta?	Black-eyed susan		Seeded	
Poa pratensis	Kentucky bluegrass	5-25		Invasive
Vetch/Pea family of some sort				

Appendix B: Site Photographs

Photo 16-1 Drop structure 4 prior to modification. Photo provided by project partners (taken 8/16/2016).

Photo 16-2 Drop structure 4 during removal. Photo provide by project partners (taken 9/1/2016).

Photo 16-3 Drop structure 4 during construction of fishway. Photo provided by project partners (taken 10/14/2019).

Photo 16-4 Photo of drop structure 4 after construction of fishway. Photo provided by project partners (taken 5/26/2017)

Photo 16-5 Sand Hill River fishway ramp #1 after the original drop structure was modified for fish passage. Note the cut-off weir/sheet pile in the foreground (1). Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 16-6 View downstream of Sand Hill River fishway ramp #1. Note the area of un-vegetated sluffing bank outside of the project area where additions of sandbar willow at the bend could increase stability (1). Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 16-7 Sand Hill River fishway ramp #2 after the original drop structure was modified for fish passage. Note the bank outside of the project where the addition of shrubs beyond the slip may increase stability (1). Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 16-8 Sand Hill River fishway ramp #2 after the original drop structure was modified for fish passage. Volunteer sandbar willow is establishing on the right bank. Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 16-9 Sand Hill River fishway ramp #3 after the original drop structure was modified for fish passage. Shrubs at downstream end are holding the soil in place. Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 16-10 Upstream view of fishway ramp #3 with well-established vegetation and no noted erosion on the banks. Photo taken by Ed Matthiesen during site visit (6/4/2019).

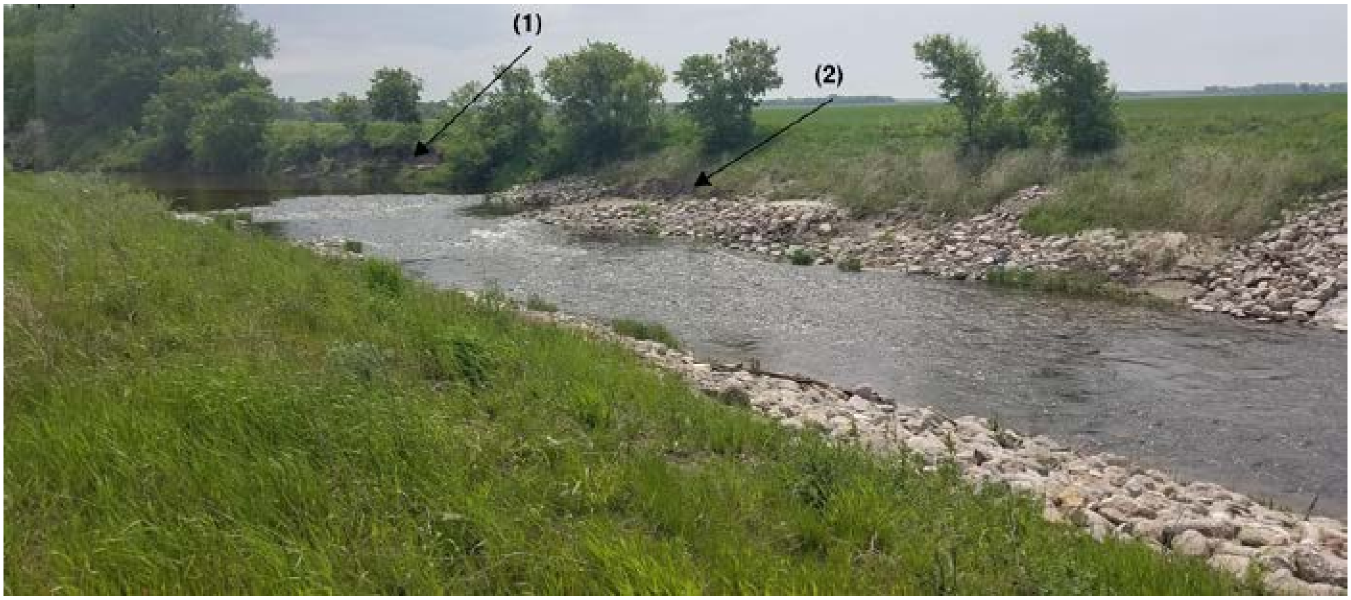


Photo 16-11 Sand Hill River fishway ramp #4 after the original drop structure was modified for fish passage. Upstream of the project area a washout is visible (1). Washout area will be repaired after the culvert connecting the reach to a side channel is addressed. There are also limited bare spots that could be reseeded in the project area (2). Photo taken by Ed Matthiesen during site visit (6/4/2019).

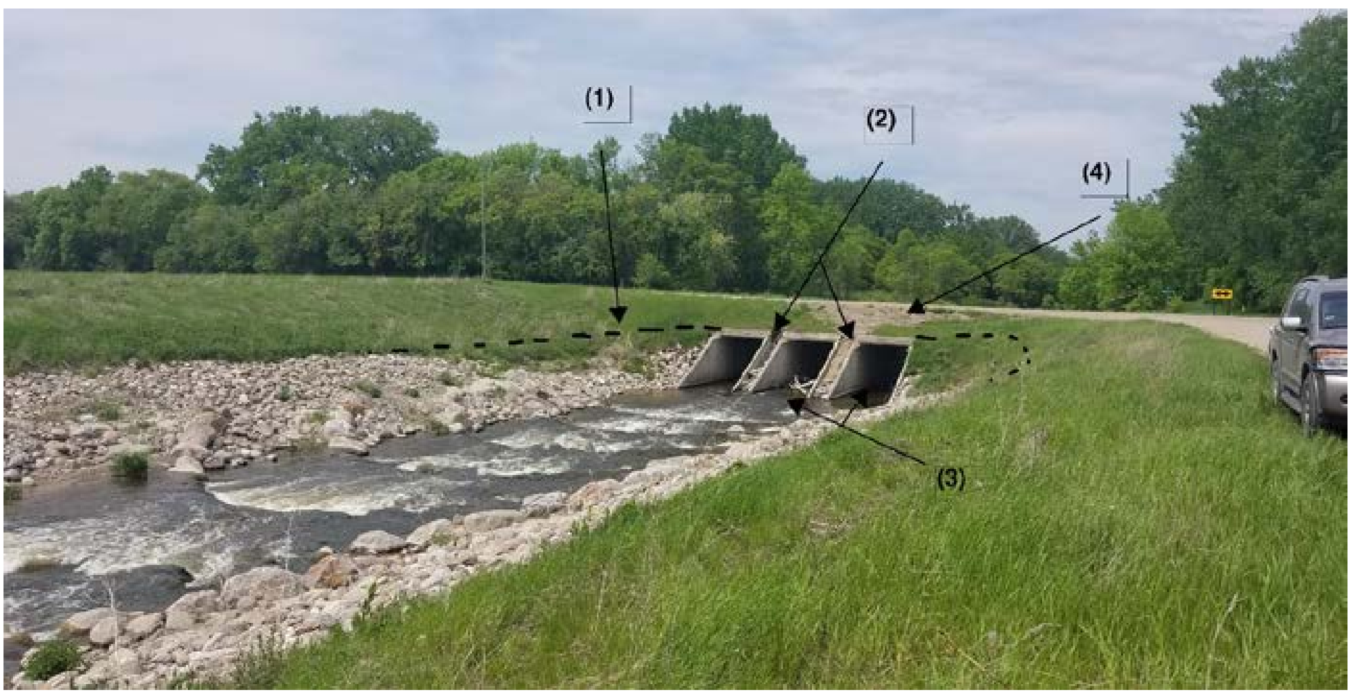


Photo 16-12 Sand Hill River fishway ramp #4. This area of the project has experienced some changes after high flows in spring 2019 came up over the road. Further damage could be mitigated by adding riprap of the same size to the top of the culvert on both sides (1) hand-placing riprap between culverts (2) and repairing the slop with topsoil/seed/25 blanket (4). Project partners also discussed considering rock or a barrier to force low flow into one box. Photo taken by Ed Matthiesen during site visit (6/4/2019).

Photo 16-13 Perched culvert with erosion upstream of structure #4. Funds remaining because fishway work was completed under budget will be used to address fish passage and habitat work in this reach. Photo taken during site visit (6/4/2019).

Photo 16-14 Eroding back across from the perched culvert upstream of structure #4 where stabilization and habitat work will be completed with remaining funds. Photo taken during site visit (6/4/2019).

17) Buffalo River Hawley Restoration

Project Background

Project Name: Buffalo River Hawley Stream Restoration

Project Site: Buffalo River

Township/Range Section: Township 139N Range 45W Section 1, 12

Project Manager / Affiliated Organization: Bruce Albright/Buffalo Red River Watershed District

Fund: OHF ***Fiscal Year Funds:*** 2013

Project Start Date: 2016

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase

County: Clay

Primary Activity: Stream/River Restoration

Project Size: 1500 Linear Feet

Project Completed: Fall 2016

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   This project includes the construction of additional channel length incorporating meanders, toe-wood, and constructed riffles.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Record Drawings for Phase 2 Buffalo River Restoration Project 2015 Clay County Minnesota – Prepared by Houston Engineering, May 13th, 2019. 2014-2015 Buffalo River Restoration, Hawley MN – MN DNR, Buffalo River Restoration at Hawley MN – Buffalo-Red River Watershed District.
3. ***What are the stated goals of the project?***
   From statements in the EAW the goals were to restore habitat in the Buffalo River and to reduce erosion and sedimentation by re-meandering the channel.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Improvements to spawning habitat for fish and mussels, wildlife habitat through the riparian buffer, and water quality along with increased flood storage capacity are expected.
5. ***Were measures of restoration success identified in plans? No***
   If yes, list specific measurements.

Expected project benefits were identified as increased flood storage by adding length to the river and improving connection of the river with its floodplain, reduction of erosion and sediment, and increased spawning habitat for fish and mussels.

6. ***Are plan Sets available?*** **Yes** ***Have project maps been created?*** **No**
   If yes, provide in Appendix A and list Maps provided:
   Record Drawings for Phase 2 Buffalo River Restoration Project 2015 Clay County Minnesota – Prepared by Houston Engineering, May 13th, 2019. Document includes project location, longitudinal profile, treatment locations, riffle typical sections, toe-wood locations, riffle details, SWPPP notes, wetland impacts and erosion control plans.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Toe wood is an industry standard for stabilizing banks while also providing fish habitat, constructed riffles are also an industry standard for improving in-stream habitat. Restoring a straightened channel to a longer meandered channel to dissipate stream energy is also based on current science. The new channel was constructed in full, off-channel from the existing channel to reduce sedimentation into the stream. Typical erosion control BMPs were used during construction such as having a SWPPP in place that requires rapid stabilization of excavated areas and sediment control elements.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No
   Click here to enter text.
9. ***In what ways did alterations change the proposed project outcome?***
   Click here to enter text.

Site Assessment

Field Review Date: **8/12/2019**

Field Visit Attendees: Bruce Albright (Buffalo-Red River Watershed District Administrator), Erik Jones (BRWD District Engineer Houston Engineering), Amanda Hillman (MN DNR Restoration Coordinator), Nicholas Kludt (MN DNR Fisheries), Nathan Olson (MN DNR Fisheries), Gina Quiram (MN DNR Restoration Evaluation Specialist), and Anna Varian (Stantec Site Assessor)

10. ***Surrounding Landscape Characteristics:***
    This project site is surrounded by a golf course. The river flows through a broad valley with gentle slopes and well-developed floodplains associated with lacustrine deposits. The primary land use in the watershed is agricultural.
11. ***Site Characteristics:***
    a. ***Soil Series:***
    The dominant soil type in the project area is Kittson loam which is not a hydric soil type (USDA).

b. Topography:

The Buffalo River flows through a broad valley with gentle slopes.

c. Hydrology:

The Buffalo River (H-026-056) at the project site has a drainage area of 322 square miles and is impaired for turbidity. Land use is 55 percent agricultural and 20 percent forest.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

Stream buffer as well as the stream edge vegetation at the Hawley Site is dominated by native grasses and flowers from the restoration seed mix. A total of 21 native species were readily observable, with 17 of these being part of native seed mixes. Common native plants observed in the stream buffer include big bluestem, bergamot, wild goldenglow, sawtooth sunflower, Canada wildrye and others. Several native plants recolonized the site, including the aggressive/weedy natives Canada goldenrod and giant goldenrod which were observed occasionally across the site. Invasive, nonnatives Canada thistle and sweet clover are common in select areas of the stream buffer restoration seeding.

Wetland and emergent aquatic vegetation are primarily dominated by native species and includes spikerush, arrowhead, sedges and rushes, as well as spike rush.

Overall, the quality of restoration seeding at this site is in moderate to good condition being dominated by desirable native species, with limited amounts of invasive, nonnative vegetation.

The riparian area that was previously golf course turf was planted with a ratio of 2:1, two parts 34-261 MNDOT Riparian South and West Mix to one part Conservation Tallgrass mix at a rate of 31.5 lb/acre. The Conservation Tallgrass Mix is 40% big bluestem, 30% Indian grass, 15% little bluestem, 5% side oats grama, 5% Canada wild rye, and 5% switch grass by PLS weight.

e. Vegetation B: Meander Search Species List (as appropriate for site)

Click here to enter text.

12. *Is the plan based on current science?* Yes

Adding length and meanders to a previously straightened channel is based on science and will dissipate stream energy and provide bedform diversity. Toe wood is an industry standard for stabilizing banks while also providing fish habitat, constructed riffles are also an industry standard for improving in-stream habitat.

13. List indicators of project goals at this stage of project:

Length and meanders have been added to the stream channel, banks are stable and have withstood high flow events with only minor points of erosion. An un-mowed riparian area, toe wood, and riffles are present. Some sediment is collecting on point bars indicating a functioning stream channel.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes, laterally connecting a stream to its floodplain and adding length and meanders will allow for better flood management, reduced sedimentation, and reduced bank erosion which all lead to improved water quality and better aquatic habitat as well as increased flood storage. A riparian buffer in this project area along with that of phase 1 of the project will improve wildlife habitat over the previous conditions.

15. Are corrections or modifications needed to achieving proposed goals?

No, but continued monitoring of the project site should occur, and corrective actions should take place if needed.

16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    The watershed district conducts annual monitoring of their projects and the board determines if corrective action is needed. Additionally, the MN DNR river ecology group is conducting geomorphology surveys along the project and DNR fisheries plans to conduct surveys in the area as well. All these post-project monitoring efforts are important and unfortunately rarely occur on stream restoration sites. Given the constraints of the surrounding area (city of Hawley and golf course) the goals are reasonable and there would not be much opportunity to improve on these. Invasive species in the riparian area will always be a challenge for stream restoration projects as there is a constant source of seed coming from upstream locations, monitoring by the watershed district should help deal with any vegetation issues.
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No
18. ***Are follow-up assessments needed? Explain.***
    No
19. ***Additional comments on the restoration project.***
    The project engineer was only on site about once every other week; however, the location of this project in relation to the DNR's River Ecology group's office allowed trained professionals from the River Ecology group to make frequent visits during construction. Having trained professionals on site during construction is an important aspect of stream restoration and likely contributed to a stabile product. Additionally, the DNR will continue to monitor the geomorphological features of the project to determine its success and stability over time, this type of monitoring is unfortunately rare in stream restoration projects and should lead to a better understanding of treatments used and alert the project partners if problems arise.
    This was Phase 2 of a larger stream restoration project, the first phase involved restoring length and meanders to a larger section of river upstream from this project location as well as decommissioning a road. Combined the two phases added 1,710 feet of length to the river. Both phases involved the cooperation of multiple partners including the DNR, Buffalo-Red River Watershed District, and the city of Hawley.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***

The project has adding length and meanders to the stream channel, restored floodplain connectivity, and protected banks with toe wood which all are known to reduce erosion. The project has experienced high flows and remains intact. Outside banks are fully vegetated which is an important component of bank stability. On its own this site may not have made a large impact on erosion and sediment contribution to the river, but both phases of this project should be taken into consideration. Combined the two phases added 1,710 feet of length to a previously straightened river.

Riparian habitat has improved from the previous condition of being golf course turf. The DNR is conducting geomorphological monitoring on this project, an important post-project activity that is rarely conducted. This monitoring will alert the project partners to any potential issues. The watershed district's commitment to monitor the riparian habitat and the DNR's geomorphology monitoring will ensure long term success.

23. ***Site Assessor(s) Conducting Review:***

Anna Varian, Stantec Consulting.

Appendix A: Site maps, Project plans or Vegetation tables

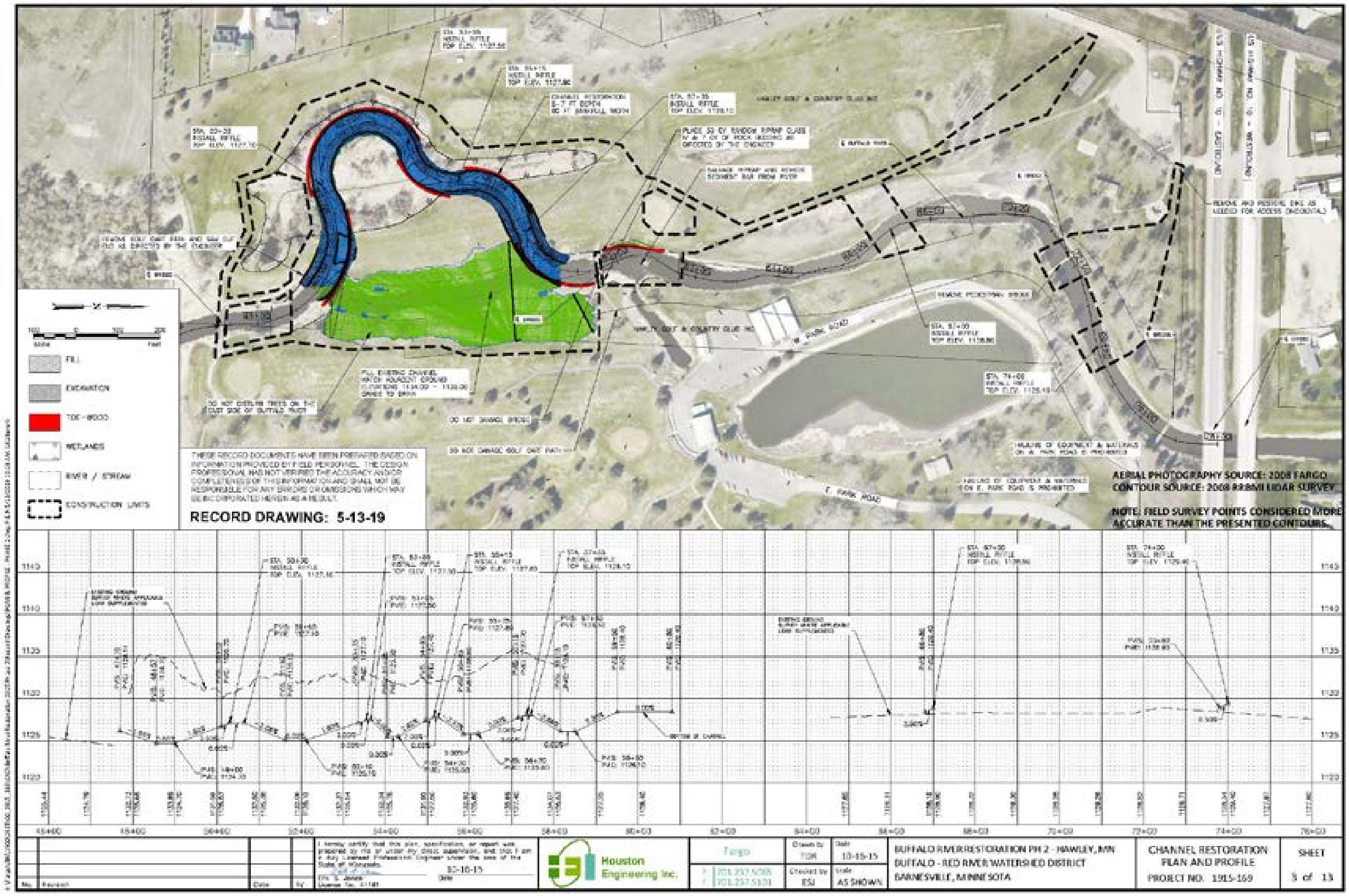


Figure 17-1. Construction plans sheet 3 of 13, project location and profile.

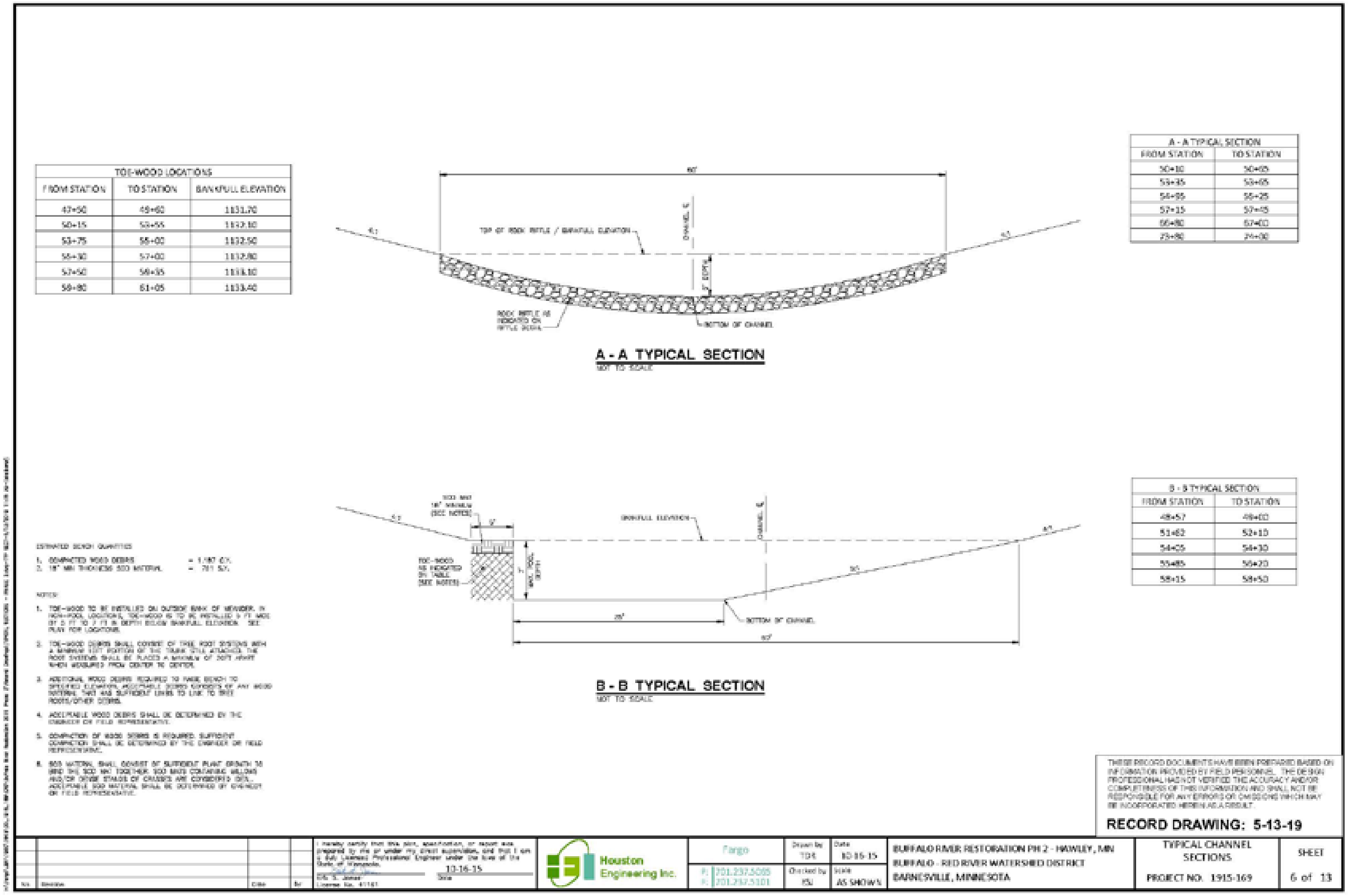


Figure 17-2. Construction plans sheet 6 of 13, typical cross sections.

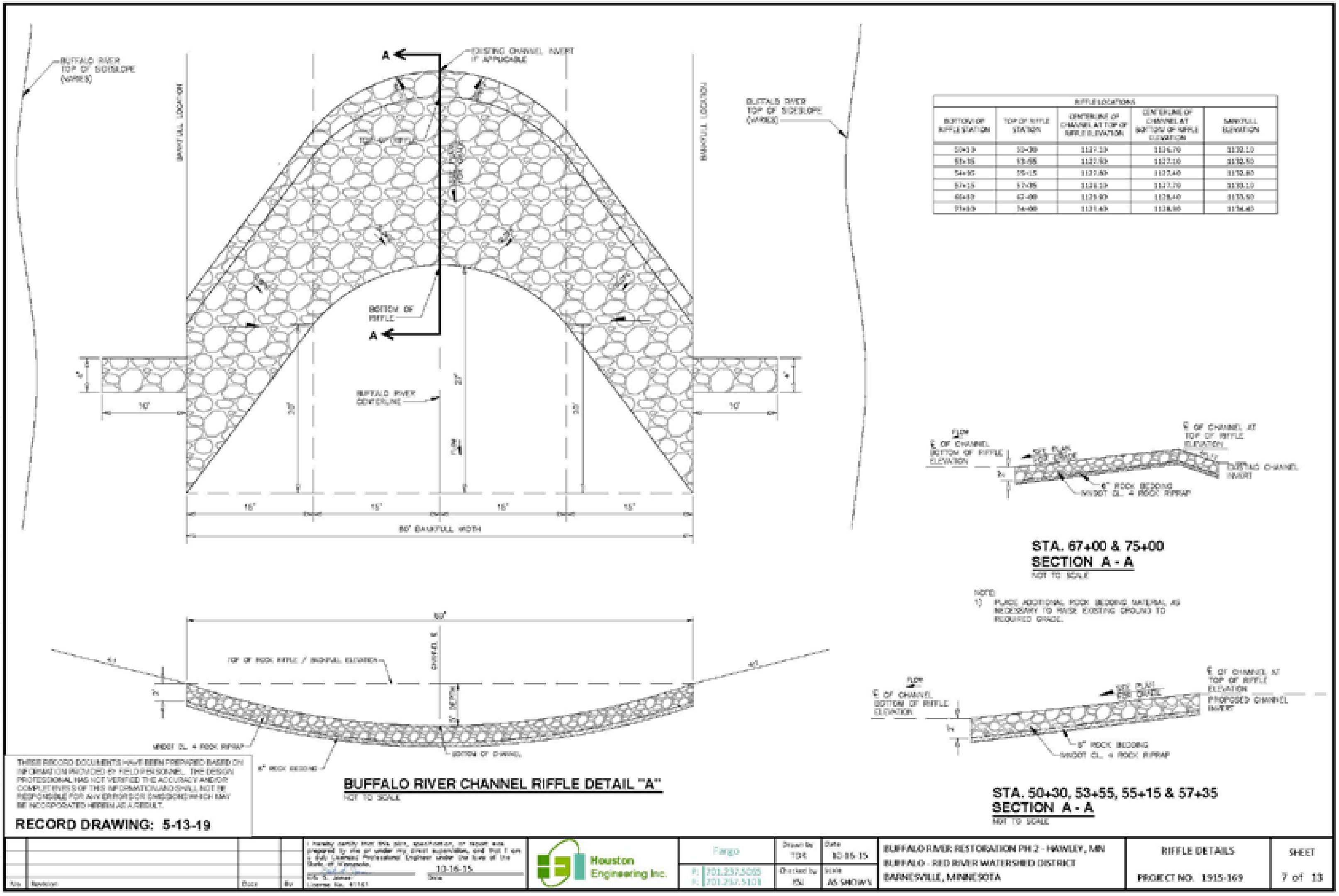


Figure 17-3. Construction plans sheet 7 of 13, riffle detail.

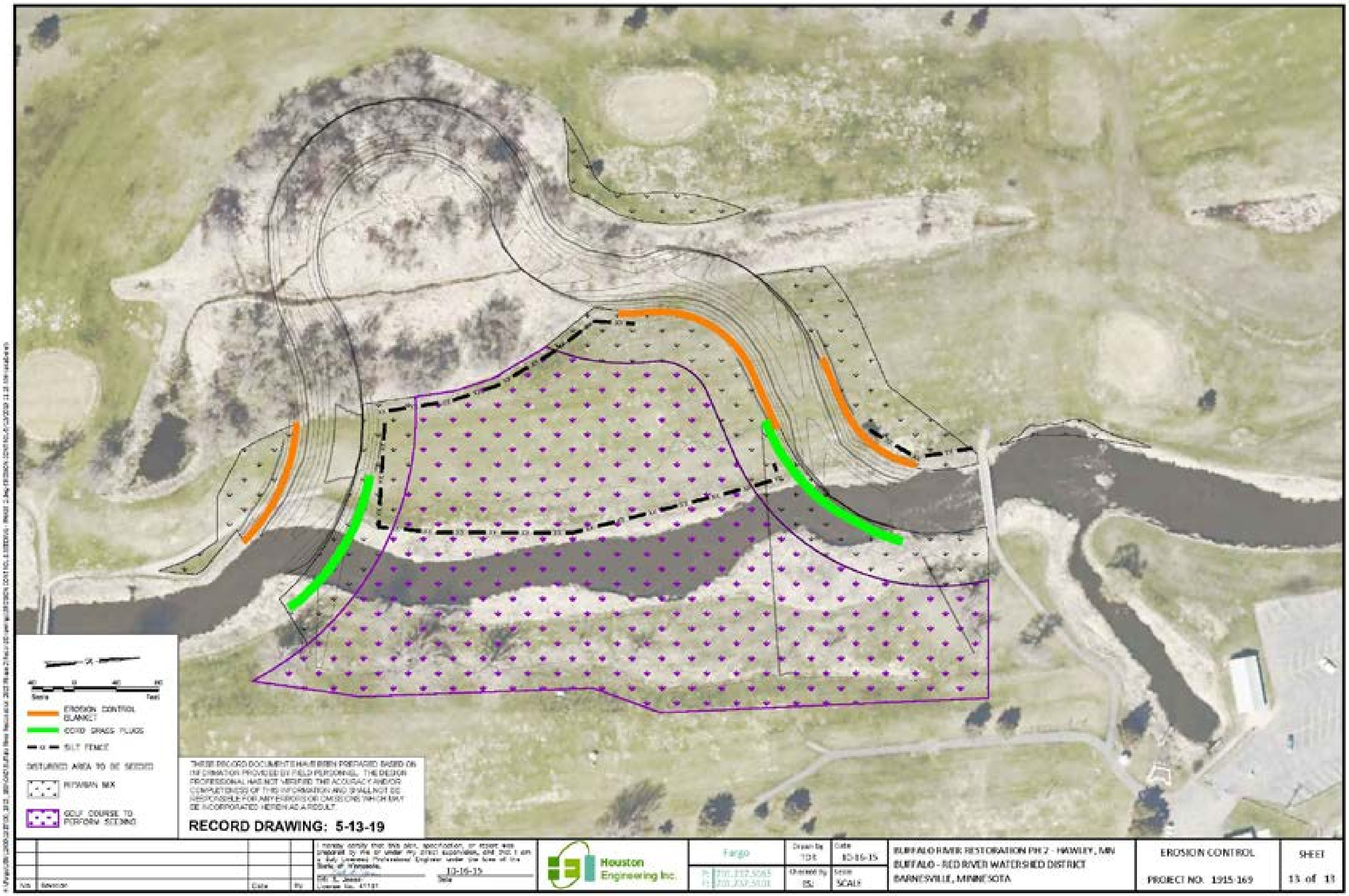


Figure 17-4. Construction plans sheet 13 of 13 erosion control map.

Figure 17-5. Aerial imagery of project site pre and post construction. Imagery provide by Google Earth (https://www.google.com/earth/)

Table 17-1 Plants observed from photos taken during site visit on 8/12/2019. Photos were taken along a meander survey route for plant ID.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Andropogon gerardi	big bluestem	Common	Yes	Native
Solidago canadensis	Canada goldenrod	Common	No	Native
Monarda fistulosa	bergamot	Common	No	Native
Rudbeckia laciniata	wild goldenglow	Common	No	Native
Solidago gigantea	giant goldenrod	Common	Yes	Native
Sicyos angulatus	bur cucumber	Common	No	Native
Echinochloa crus-galli	barnyard grass	Common	No	Native
Helianthus grosseserratus	sawtooth sunflower	Rare	No	Native
Elymus canadensis	Canada wildrye	Common	Yes	Native
Rudbeckia hirta	black-eyed Susan	Rare	No	Native
Schoenoplectus tabernaemontani	softstem bulrush	Rare	No	Native
Symphyotrichum lateriflorum	side-flowering aster	Rare	No	Native
Asclepias syriaca	common milkweed	Rare	No	Native
Spartina pectinate	prairie cordgrass	Rare	Yes	Native
Artemisia ludoviciana	prairie sage	Rare	No	Native
Carex spp.	sedge spp.	Rare	No	Native
Sagittaria latifolia	common arrowhead	Rare	No	Native
Eleocharis palustris	spike rush	Rare	No	Native
Bidens frondosa	beggar ticks	Rare	No	Native
Scirpus atrovirens	dark green bulrush	Rare	Yes	Native
Cirsium arvense	canada thistle	Common	No	Non-native
Melilotus officinalis	sweet clover	Common	No	Non-native
Phalaris arundinacea	reed canary grass	Rare	No	Non-native
Typha x glauca	hybrid cattail	Rare	No	Non-native

Appendix B: Site Photographs

Photo 17-1. Buffalo River constructed riffle. Photo taken by Anna Varian during site visit (8/12/2019).

Photo 17-2. Buffalo River looking downstream into project area. Photo taken by Anna Varian during site visit (8/12/2019).

Photo 17-3. Buffalo River looking downstream at riffle, standing on point bar collecting sediment. Photo taken by Anna Varian during site visit (8/12/2019).

Photo 17-4. View from the top of the bank through the riparian buffer adjacent to the mowed golf course. Photo taken during site visit (8/12/2019).

18) Buffalo River Stream Channel Restoration

Project Background

Project Name: Buffalo River Stream Channel Restoration

Project Site: Buffalo River

Township/Range Section: Township 139N Range 45W Section 1

Project Manager / Affiliated Organization: Bruce Albright/Buffalo Red River Watershed District

Fund: OHF ***Fiscal Year Funds:*** 2011

Project Start Date: 2014

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase

County: Clay

Primary Activity: Stream/River Restoration

Project Size: 6,000 Linear Feet

Project Completed: 2015

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   This project includes the construction of additional channel length incorporating meanders, toe-wood, and constructed riffles. The decommissioning of a road was also a part of this project.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Record Drawings for Buffalo River Restoration Project 2014 Clay County Minnesota – Prepared by Houston Engineering, May 13th, 2019. 2014-2015 Buffalo River Restoration, Hawley MN – MN DNR, Buffalo River Restoration at Hawley MN – Buffalo-Red River Watershed District.

3. ***What are the stated goals of the project?***
   From statements in the EAW the goals were to restore habitat in the Buffalo River and to reduce erosion and sedimentation by re-meandering the channel.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Improvements to spawning habitat for fish and mussels, wildlife habitat through the riparian buffer, and water quality along with increased flood storage capacity are expected.
5. ***Were measures of restoration success identified in plans?*** *No*

If yes, list specific measurements.

Expected project benefits were identified as increased flood storage by adding length to the river and improving connection of the river with its floodplain, reduction of erosion and sediment, and increased spawning habitat for fish and mussels.

6. ***Are plan Sets available?*** **Yes** ***Have project maps been created?*** No

   If yes, provide in Appendix A and list Maps provided:

   Record Drawings for Buffalo River Restoration Project 2014 Clay County Minnesota – Prepared by Houston Engineering, May 13th, 2019. Document includes project location, longitudinal profile, treatment locations, riffle typical sections, toe-wood locations, riffle details, road decommissioning details, SWPPP notes, wetland impacts and erosion control plans.

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***

   Toe wood is an industry standard for stabilizing banks while also providing fish habitat, constructed riffles are also an industry standard for improving in-stream habitat. Restoring a straightened channel to a longer meandered channel to dissipate stream energy is also based on current science. The new channel was constructed in phases off-channel from the existing channel to reduce sedimentation into the stream. After each phase of the channel was complete it was connected to the existing stream and then off channel work would begin on the next phase. Typical erosion control BMPs were used during construction such as having a SWPPP in place that requires rapid stabilization of excavated areas and sediment control elements.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***

   No

   Click here to enter text.

9. ***In what ways did alterations change the proposed project outcome?***

   Click here to enter text.

Site Assessment

Field Review Date: **8/12/2019**

Field Visit Attendees: Bruce Albright (Buffalo-Red River Watershed District Administrator), Erik Jones (BRWD District Engineer Houston Engineering), Amanda Hillman (MN DNR Restoration Coordinator), Nicholas Kludt (MN DNR Fisheries), Nathan Olson (MN DNR Fisheries), Gina Quiram (MN DNR Restoration Evaluation Specialist), and Anna Varian (Stantec Site Assessor)

10. ***Surrounding Landscape Characteristics:***

This project site has forested city property to the north and homes and private property along the southern boundary. The river flows through a broad valley with gentle slopes and well-developed floodplains associated with lacustrine deposits. The primary land use in the watershed is agricultural.

11. ***Site Characteristics:***

    a. ***Soil Series:***

    Haplaquolls and Udifluvents, level is the most common soil type in the project area, this is a hydric soil type.

    b. ***Topography:***

    The Buffalo River flows through a broad valley with gentle slopes.

    c. ***Hydrology:***

    The Buffalo River (H-026-056) at the project site has a drainage area of 316 square miles and is impaired for turbidity. Land use is 55 percent agricultural and 21 percent forest.

    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***

    Vegetation along the Buffalo River restoration project is composed primarily of herbaceous vegetation. Riverbank and buffer areas are composed of a mix of native and nonnative vegetation, which varies in total cover from area to area. Some portions of the project are largely dominated by nonnative, invasive vegetation, including areas where reed canary grass and Canada thistle comprise the vast majority of cover with natives interspersed. Other areas have a higher proportion of native vegetation, including the commonly observed natives Virginia wildrye, bergamot, wild goldenglow, giant sunflower, big bluestem and lesser amounts of several other native species. A few native species have recolonized the site on their own, including wild cucumber and Indian hemp. Weedy natives Canada goldenrod and giant goldenrod are common and present in large patches along portions of the restoration. Also, of note is the presence of common tansy, a species on the "Control" list of Minnesota Prohibited Noxious Weeds.

    Some upland areas are dominated by natives; however, many areas are dominated by invasive, nonnative grasses and weeds. The most common native forbs and grasses in upland areas include bergamot, big bluestem, oxeye false sunflower, and switchgrass, as well as the volunteer weedy species native Canada goldenrod and giant goldenrod. The nonnatives white sweet clover and Canada thistle are abundant in some areas. Overall, the vegetation at this site is in need of management and is being negatively impacted by the prevalence of invasive, nonnative vegetation.

    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***

    Click here to enter text.

12. ***Is the plan based on current science?*** Yes

    Adding length and meanders to a previously straightened channel is based on science and will dissipate stream energy and provide bedform diversity by allowing pools to form in meanders and riffles in straight sections. Toe wood is an industry standard for stabilizing banks while also providing fish habitat, constructed riffles are also an industry standard for improving in-stream habitat by creating better spawning substrate.

13. ***List indicators of project goals at this stage of project:***

    Length and meanders have been added to the stream channel, banks are stable and have withstood high flow events with only minor points of erosion. A riparian buffer, toe wood, and riffles are present. Some sediment is collecting on point bars indicating a functioning stream channel.

14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Yes, laterally connecting a stream to its floodplain and adding length and meanders will allow for better flood management, reduced sedimentation, and reduced bank erosion which all lead to improved water quality and better aquatic habitat as well as increased flood storage.
15. ***Are corrections or modifications needed to achieving proposed goals?***
    No, but continued monitoring of the project site should occur, and corrective actions should take place if needed.
16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    The watershed district conducts annual monitoring of their projects and the board determines if corrective action is needed. Additionally, the MN DNR river ecology group is conducting geomorphology surveys along the project and DNR fisheries plans to conduct surveys in the area as well. All these post-project monitoring efforts are important and unfortunately rarely occur on stream restoration sites.
    Given the constraints of the surrounding area with houses near the stream, the goals are reasonable and there would not be much opportunity to improve on these. Invasive species in the riparian area will always be a challenge for stream restoration projects as there is a constant source of seed coming from upstream locations, monitoring by the watershed district should help deal with any vegetation issues.
    A private landowner appears to be mowing up to the edge of the stream, monitoring for this activity needs to happen and corrective action taken.
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No
18. ***Are follow-up assessments needed? Explain.***
    No
19. ***Additional comments on the restoration project.***
    The project engineer was only on site about once every other week; however, the location of this project in relation to the DNR's River Ecology group's office allowed trained professionals from the River Ecology group to make frequent visits during construction. Having trained professionals on site during construction is an important aspect of stream restoration and likely contributed to a stabile product.
    Additionally, the DNR will continue to monitor the geomorphological features of the project to determine its success and stability over time, this type of monitoring is unfortunately rare in stream restoration projects and should lead to a better understanding of treatments used and alert the project partners if problems arise.
    This was Phase 1 of a two phase restoration project, the second phase involved restoring length and meanders to a smaller section of river downstream from this project location within a golf course.
    Combined the two phases added 1710 feet of length to the river. Both phases involved the cooperation of multiple partners including the DNR, Buffalo-Red River Watershed District, and the city of Hawley

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    The project has adding length and meanders to the stream channel, restored floodplain connectivity, and protected banks with toe wood which all are known to reduce erosion. The project has experienced high flows and remains intact. Outside banks are fully vegetated which is an important component to bank stability. Combined the two phases of this project added 1,710 feet of length to a previously straightened river. The DNR is conducting geomorphological monitoring on this project, an important post-project activity that is rarely conducted. This monitoring will alert the project partners to any potential issues. The watershed district's commitment to monitor the riparian habitat and the DNR's geomorphology monitoring will ensure long term success.

23. ***Site Assessor(s) Conducting Review:***
    Anna Varian, Stantec

Appendix A: Site maps, Project plans or Vegetation tables

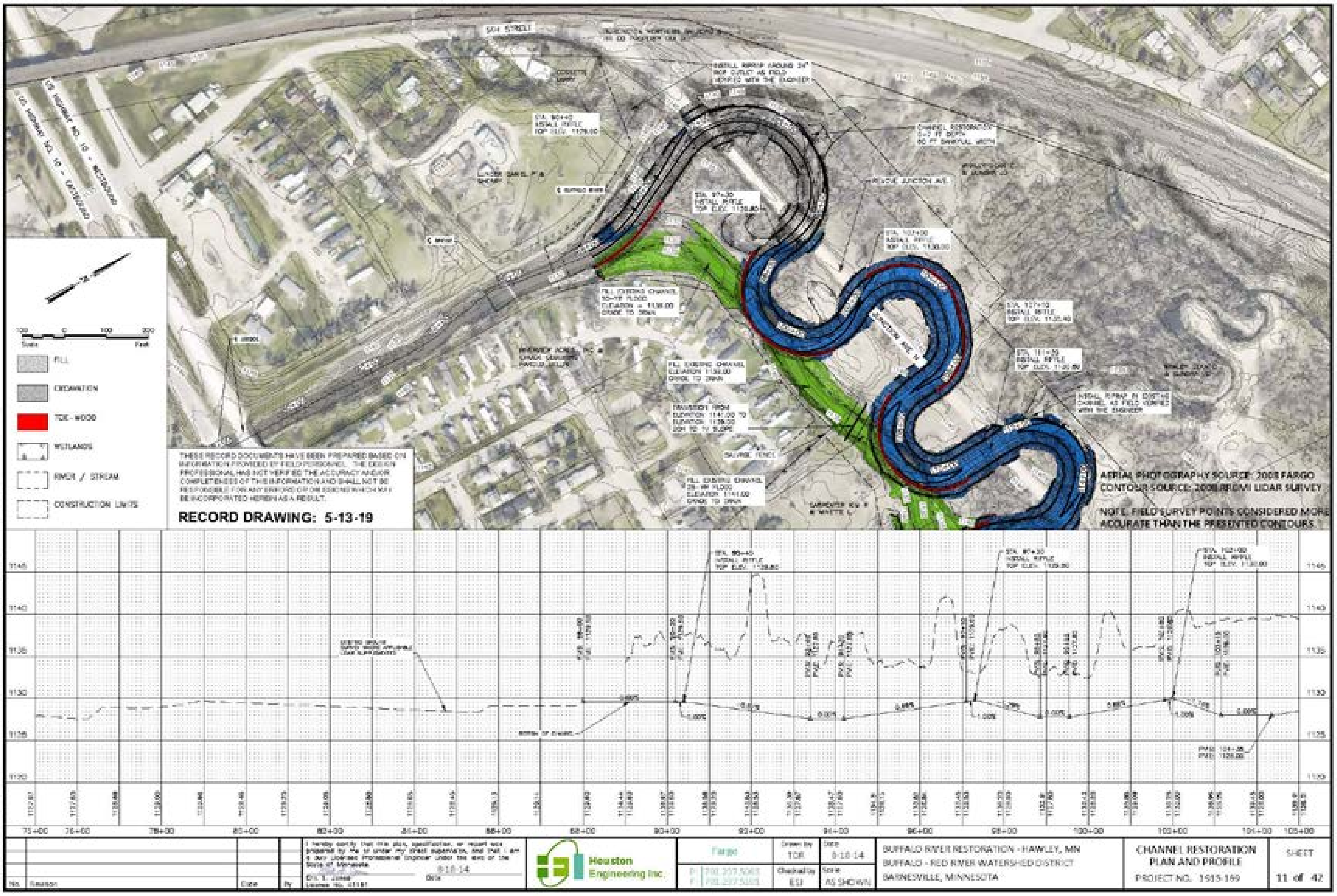


Figure 18-1. Construction plans sheet 11 of 42, project starting location and profile.

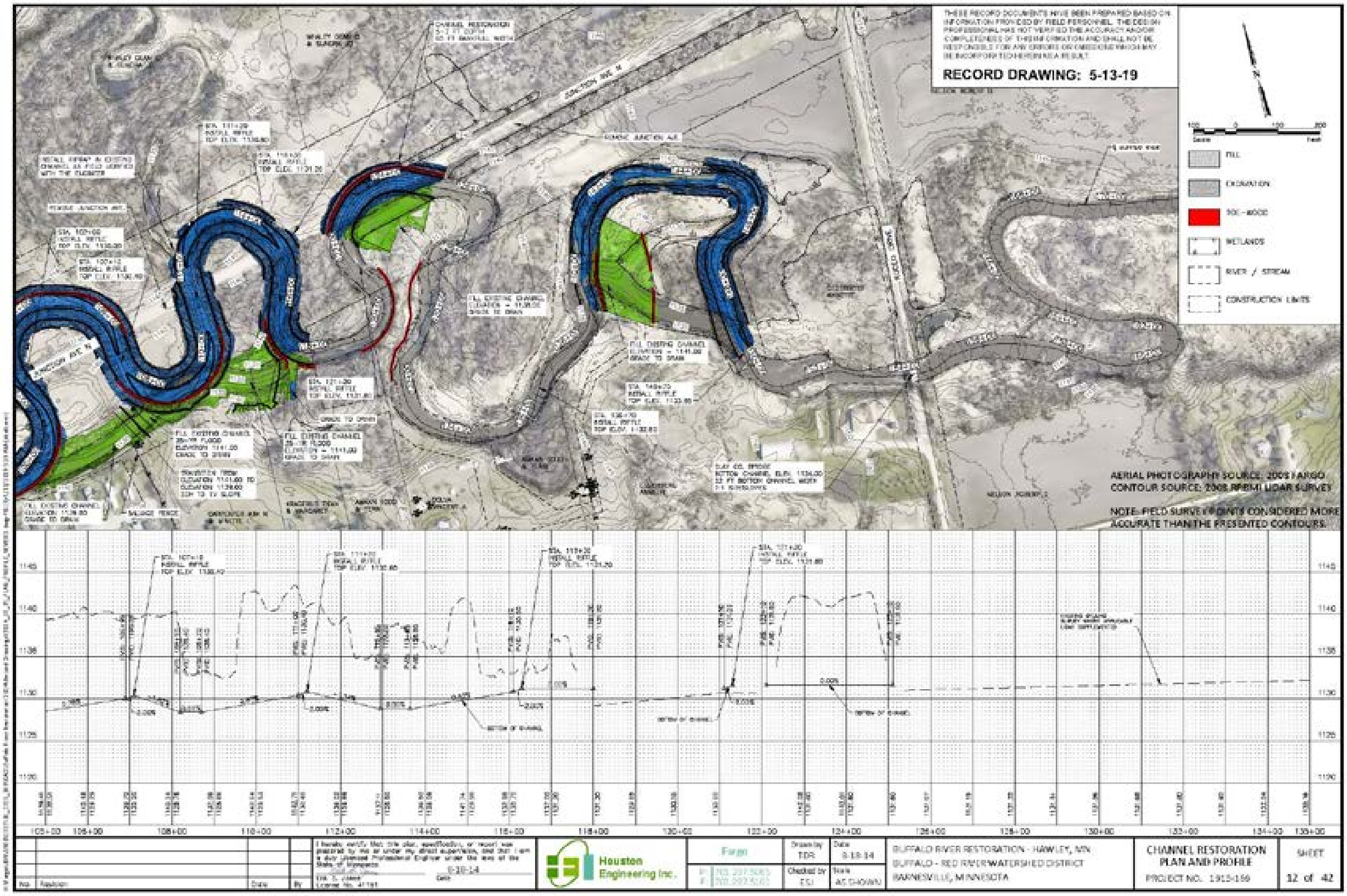


Figure 18-2. Construction plans sheet 12 of 42, continuation of project location and profile.

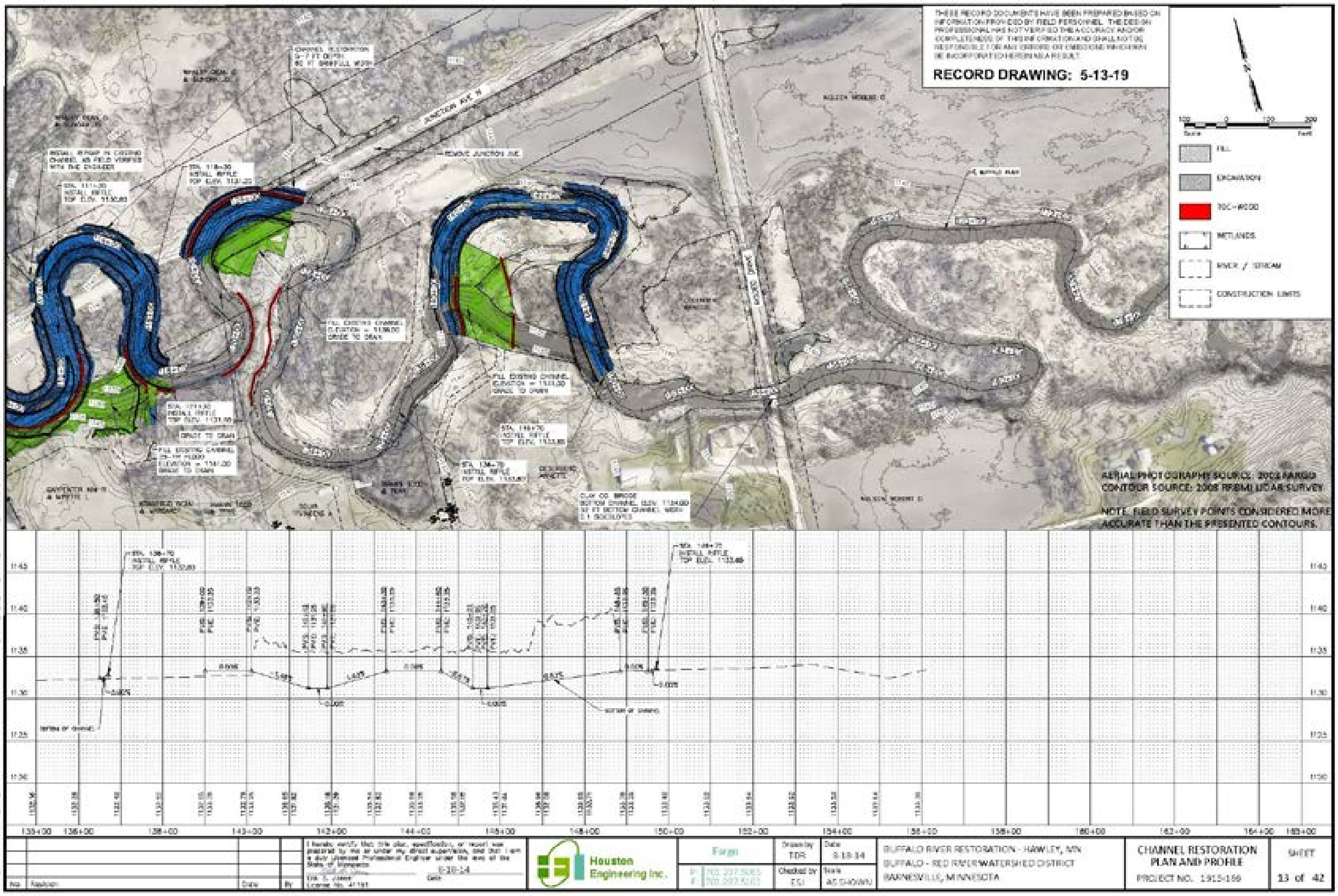


Figure 18-3. Construction plans sheet 13 of 42, continuation of project location and profile.

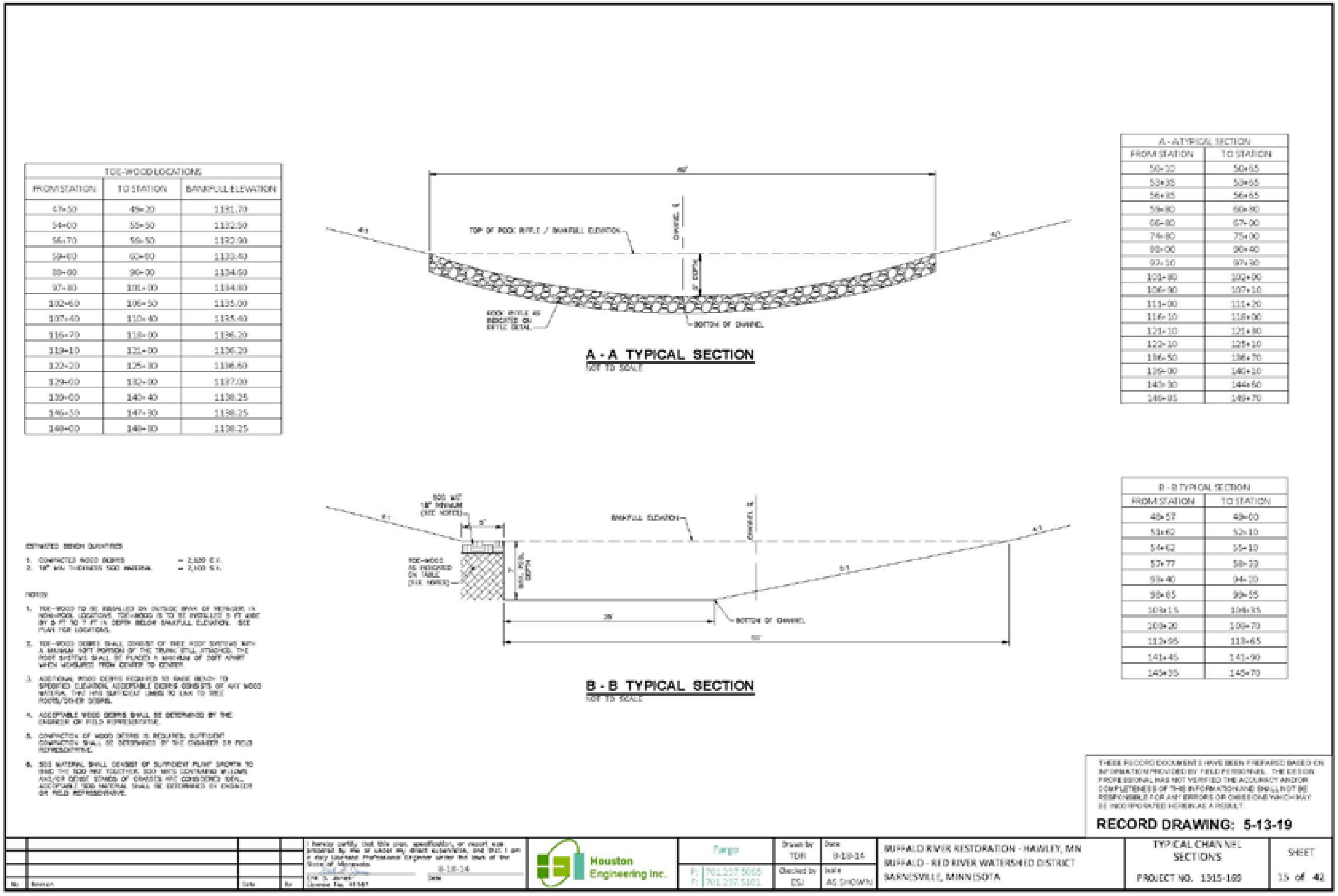


Figure 18-4. Construction plans sheet 15 of 42, typical cross sections.

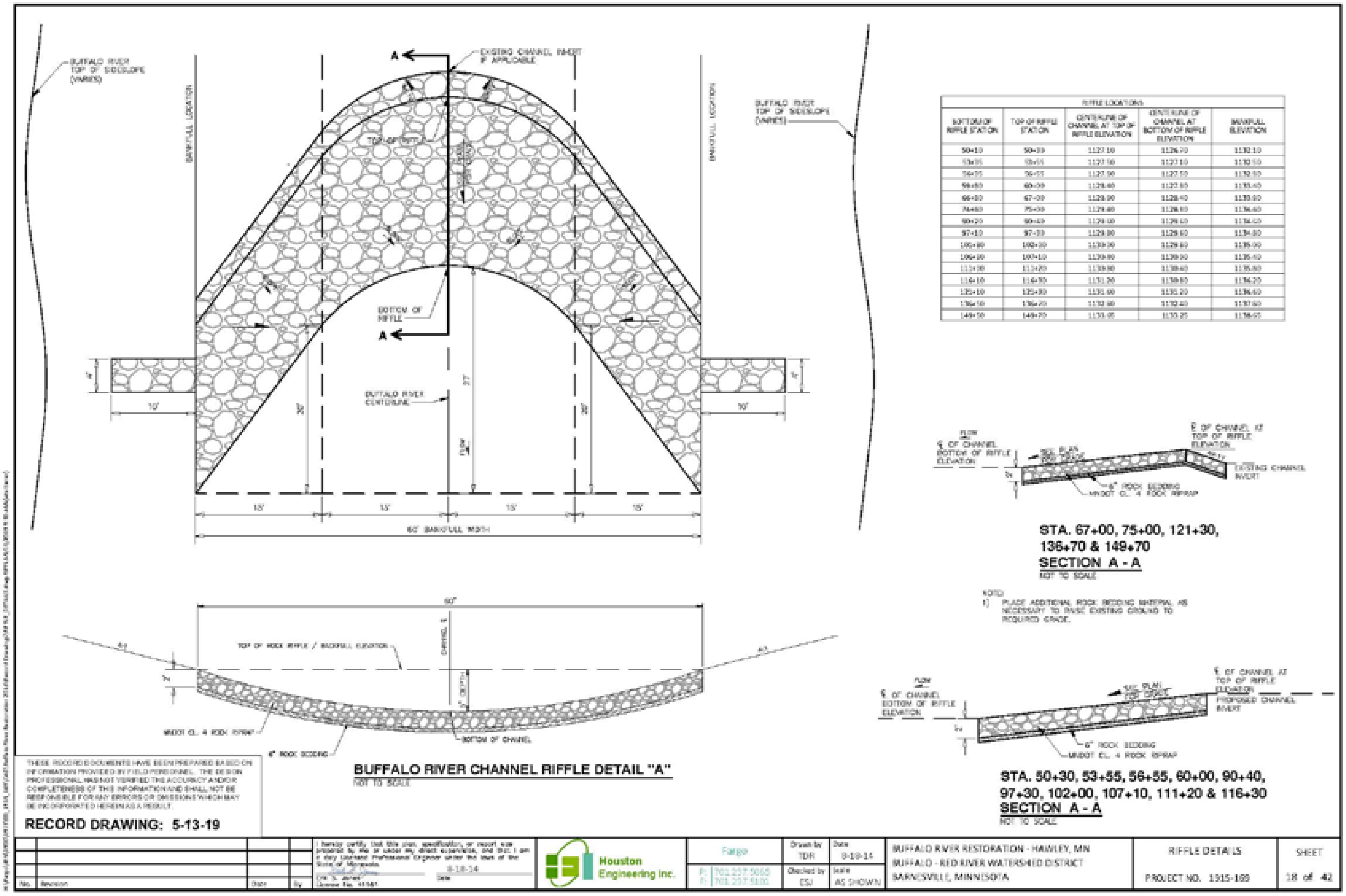


Figure 18-5. Construction plans sheet 18 of 42, riffle detail.

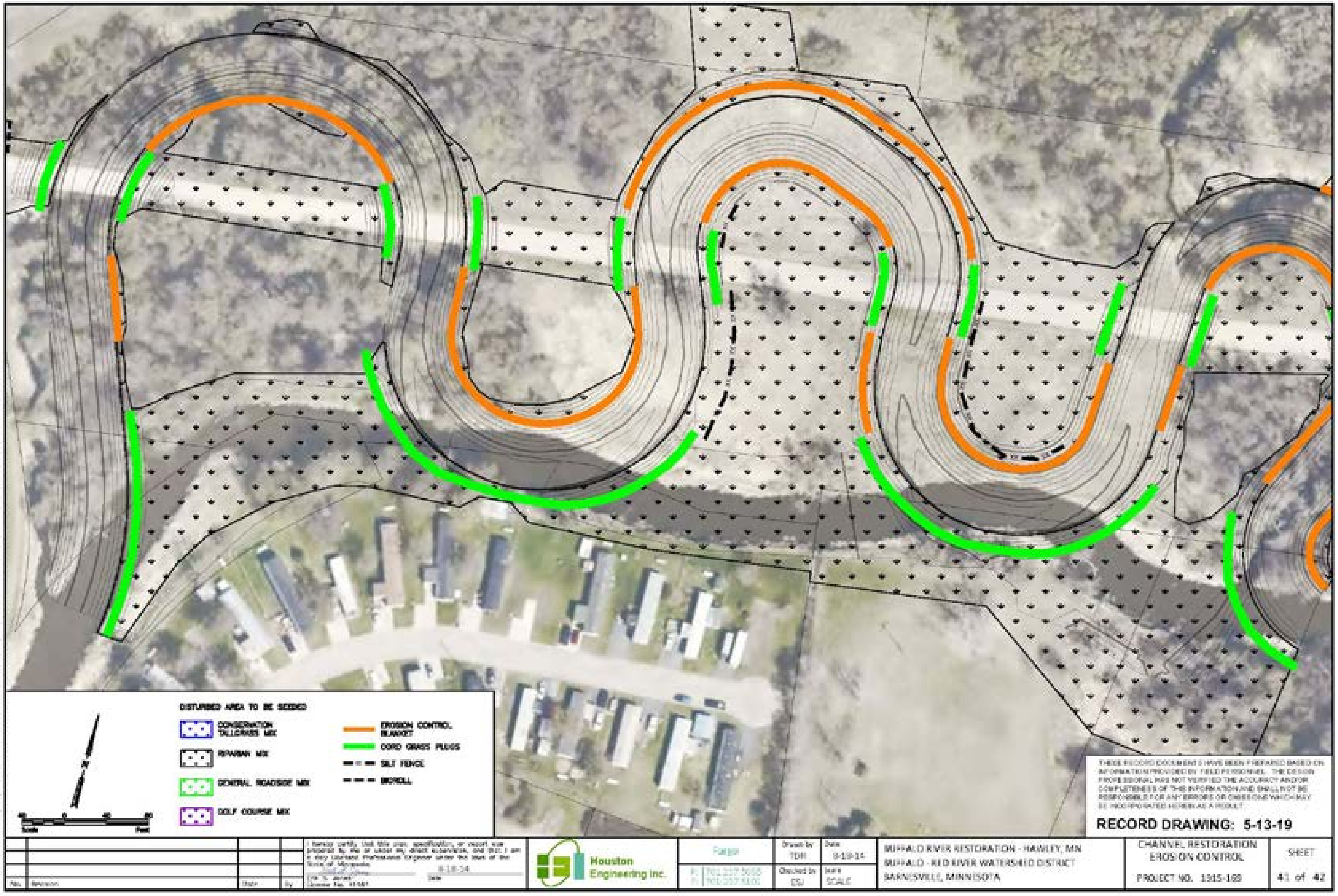


Figure 18-6. Construction plans sheet 41 of 42 erosion control map.

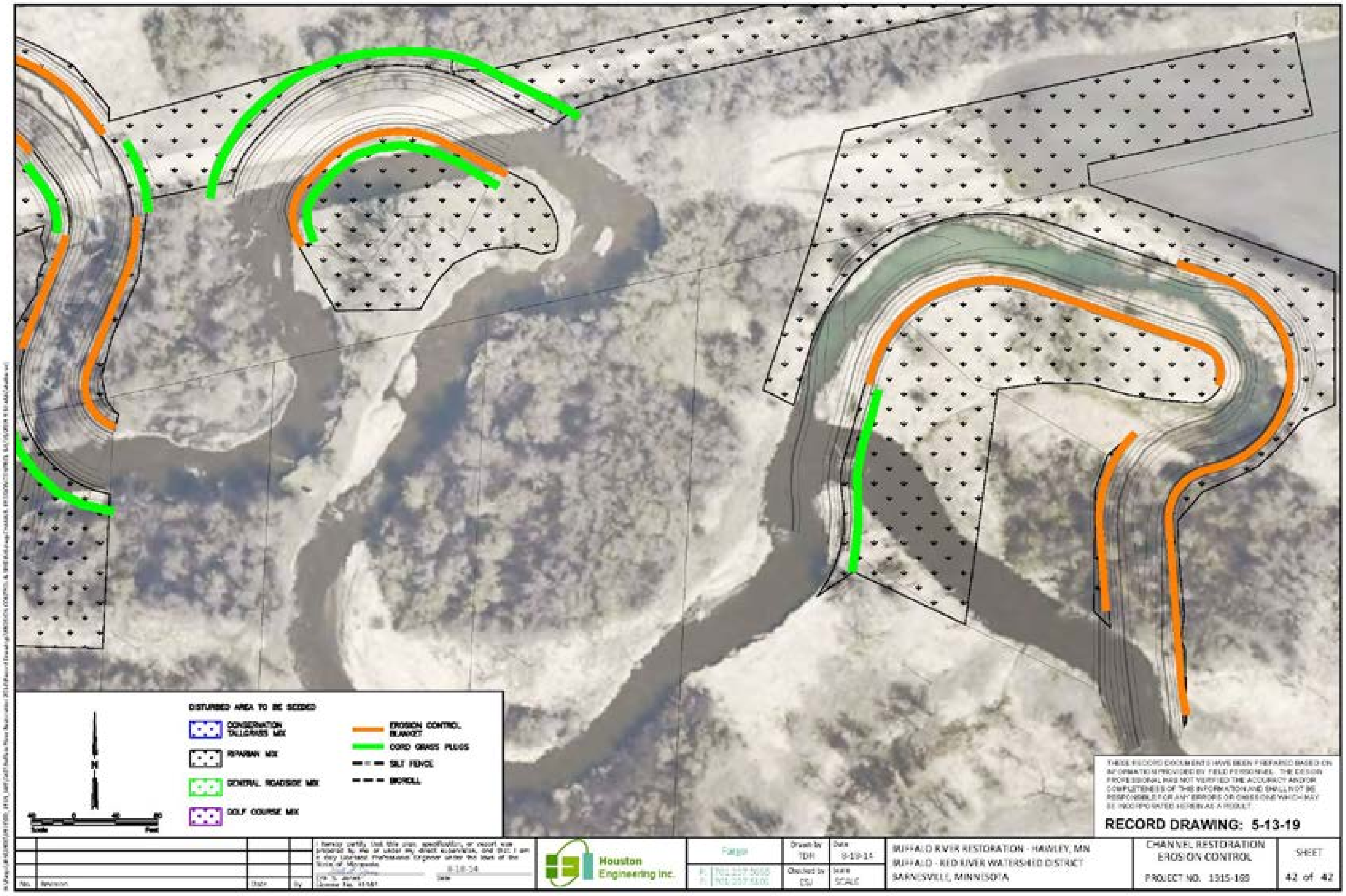


Figure 18-7. Construction plans sheet 41 of 42 erosion control map.

Figure 18-8. Aerial imagery of project location pre and post construction. Imagery provided by Google Earth (https://www.google.com/earth/)

Table 18-1 Plants observed from photos taken during site visit on 8/12/2019. Photos were taken along a meander survey route for plant ID.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Solidago canadensis	Canada goldenrod	Common	No	Native
Monarda fistulosa	bergamot	Common	No	Native
Solidago gigantea	giant goldenrod	Common	Yes	Native
Andropogon gerardi	big bluestem	Common	Yes	Native
Rudbeckia laciniata	wild goldenglow	Common	No	Native
Elymus virginicus	Virginia wildrye	Common	Yes	Native
Elymus canadensis	Canada wildrye	Common	Yes	Native
Rudbeckia hirta	black-eyed Susan	Rare	No	Native
Helianthus giganteus	giant sunflower	Rare	Yes	Native
Heliopsis helianthoides	oxeye false sunflower	Common	No	Native
Panicum virgatum	switchgrass	Common	Yes	Native
Apocynum cannabinum	Indian hemp	Rare	No	Native
Verbena hastata	blue vervain	Rare	Yes	Native
Sicyos angulatus	bur cucumber	Rare	No	Native
Impatiens capensis	spotted touch-me-not	Rare	Yes	Native
Asclepias incarnata	marsh milkweed	Rare	Yes	Native
Calamagrostis canadensis	bluejoint grass	Rare	No	Native
Spartina pectinate	prairie cordgrass	Rare	Yes	Native
Bouteloua curtipendula	sideoats grama grass	Rare	Yes	Native
Vernonia fasciculata	ironweed	Rare	Yes	Native
Cirsium arvense	Canada thistle	Common	No	Non-native
Melilotus albus	white sweet clover	Common	No	Non-native
Phalaris arundinacea	reed canary grass	Common	No	Non-native
Carduus acanthoides	plumeless thistle	Rare	No	Non-native
Elymus repens	witchgrass	Rare	No	Non-native
Sonchus oleraceus	sow thistle	Rare	No	Non-native
Bromus inermis	smooth brome	Rare	No	Non-native
Verbascum thapsus	common mullein	Rare	No	Non-native
Elymus repens	quackgrass	Rare	No	Non-native
Tanacetum vulgare	common tansy	Rare	No	Control list
Agrostis gigantea	redtop	Rare	No	Non-native

Appendix B: Site Photographs

Photo 18-1. View of restored meander. Photo taken by Anna Varian during site visit (8/12/2019).

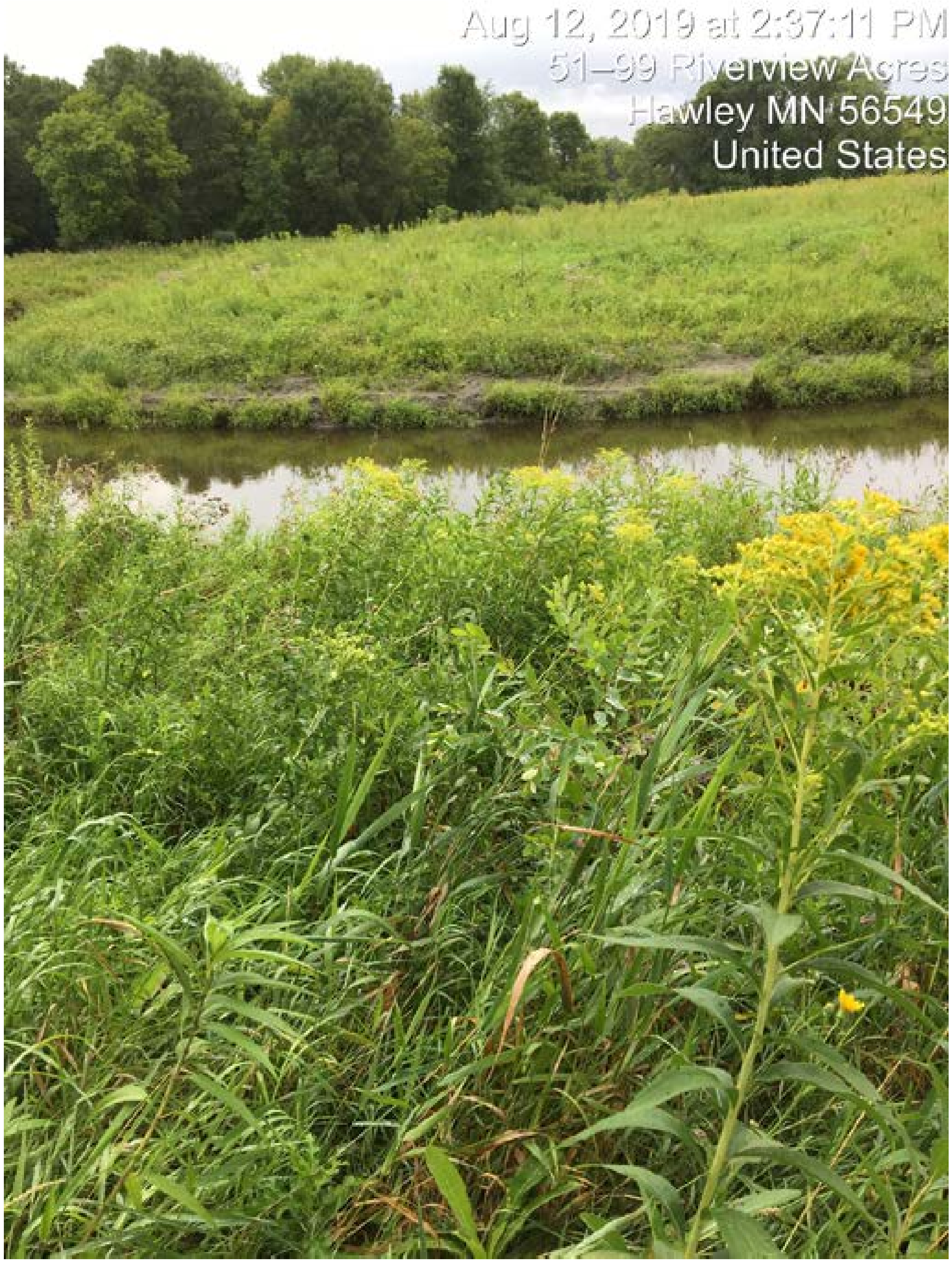


Photo 18-2. View of restored meander with decommissioned and restored Junction Ave across the bank. Photo taken by Anna Varian during site visit (8/12/2019).

Photo 18-3. Restored meander with sediment depositing and mowing activity on the inside bend and fully vegetated outside bend. Photo taken by Anna Varian during site visit (8/12/2019).

19) East Indian Creek Habitat Enhancement

Project Background

Project Name: East Indian Creek Trout Habitat Enhancement Project

Project Site: East Indian Creek

Township/Range Section: Township 109N Range 10W Section 28

Project Manager / Affiliated Organization: John Lenczewski, Trout Unlimited

Fund: OHF ***Fiscal Year Funds:*** 2013

Project Start Date: 2016

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase

County: Wabasha County

Primary Activity: Stream/River Enhancement

Project Size: 4,250 Linear Feet

Project Completed: 2016

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   This project involved installation of rock weirs, rock vanes, boulder toe, random boulders, toe wood, large wood habitat, rootwads, wood crib walls, constructed riffles, and the reshaping of banks.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Minnesota Trout Unlimited East Indian Creek – FY 2015 Trout Habitat Enhancement Project, Watopa twsp, Wabasha Co., MN – prepared by Emmons & Olivier Resources Inc.
3. ***What are the stated goals of the project?***
   Goals were to reduce stream bank erosion and associated sedimentation downstream, reconnect the stream to the floodplain and increase natural reproduction of trout, habitat biodiversity and trout angling.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Increase brook trout fishing opportunities.
5. ***Were measures of restoration success identified in plans? No***
   If yes, list specific measurements.
   Click here to enter text.

6. ***Are plan Sets available?*** **Yes** ***Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   Click here to enter text.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   The banks were sloped back to allow the stream to access its floodplain. Toe wood was used to enhance habitat for the native brook trout. Brook trout do particularly well in complex woody debris; skyhook structures were specifically not used at this location as they are generally favored by brown trout. These are based on current science. Additionally, Trout Unlimited requires a 2 year contract after installation for the designer and contractor to monitor and repair.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No
   Changes were not made during implementation but in 2019 some additional rock was added on top of the root wads and toe wood where some erosion was occurring.
9. ***In what ways did alterations change the proposed project outcome?***
   These changes did not change the proposed outcome.

Site Assessment

Field Review Date: 10/21/2019

Field Visit Attendees: John Lenczewski (Trout Unlimited Executive Director), Wade Johnson (MN DNR Restoration Evaluations Program Coordinator), and Anna Varian (Stantec Site Assessor).

10. ***Surrounding Landscape Characteristics:***
    Valley slopes are forested, the valley floor is dominated by agriculture and sparsely populated. The entire reach of the project area is within a DNR angling easement, allowing anglers to access and fish the stream.
11. ***Site Characteristics:***
    a. ***Soil Series:***
    The dominant soil type within the project area is Arenzville silt loam, 0 to 3 percent slopes, occasionally flooded (USDA).
    b. ***Topography:***
    East Indian Creek flows through a wide valley with agriculture dominating the valley floor and forested valley slopes.
    c. ***Hydrology:***
    East Indian Creek (M-032) has a drainage area of 9.5 square miles. The creek eventually flows into the Mississippi River.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***

All disturbed areas outside of bank shaping and floodplain were seeded with state mix 33-262 - Dry Swale / Pond at a rate of 2 tons per acre, lower stream banks and floodplain areas were seeded with 34-261 - Riparian South and West. Volunteer willows were growing in several areas of the project, no trees were planted as part of the project. Areas not disturbed during the additional 2019 construction were well vegetated, cover crops were growing well in the disturbed areas.

e. Vegetation B: Meander Search Species List (as appropriate for site)

See Table 19-1 in Appendix A for species observed during the site visit.

12. *Is the plan based on current science?* Yes

A geomorphological survey including BEHI and Bancs model was evaluated prior to design. Specific considerations (such as avoiding skyhook structures) were given to native brook trout habitat versus non-native brown trout. A habitat quality index survey was conducted pre-construction to evaluate the condition of the existing habitat and future assessments are planned but have not been completed at this time.

13. List indicators of project goals at this stage of project:

No significant erosion was visible during the site visit. Anecdotal information from DNR employees indicate habitat has improved. Visual assessment of habitat improvements was difficult during the site visit due to high and turbid water. Future assessment of the habitat is planned but has not been completed at this point.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes. Installing rock vanes to create deep pools and woody habitat will improve trout habitat. Additionally, reshaping the banks to allow the stream to access its floodplain will reduce shear stress on both banks and therefore reduce erosion and improve water quality. The reshaping of the banks also has allowed for easier access for anglers.

15. Are corrections or modifications needed to achieving proposed goals?

No.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

Yes, Trout Unlimited' s current contractor and designer contract includes 2 years of post-construction monitoring and repair which has been put to use on this site with the addition of rock. Vegetation contracts also currently include 2 years of management and will likely include 3 years in the future. This project was a habitat improvement project and not a full restoration project, as a habitat improvement project the treatments used will improve habitat and reduce sedimentation downstream. The number of locations that required additional rock is a little concerning in regards to continued stability, these locations need to be monitored for any future erosion.

17. Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.

No.

18. Are follow-up assessments needed? Explain.

Yes. The recent site visit was conducted during high and turbid water making it difficult to fully assess habitat. In addition, this year rock was added in multiple locations that had experienced some erosion since construction, a few years and bankfull events should be allowed to pass before a follow-up assessment is conducted to evaluate the stability at these locations.

19. ***Additional comments on the restoration project.***
    This is a more recent habitat improvement project conducted by Trout Unlimited and over the years Trout Unlimited has learned that small repairs post-construction are needed and their current designer and contractor contract includes 2 years post-construction repairs including 2 years of vegetation management. Additionally, an engineer was on site full time during construction and is a requirement of their contract.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium
22. ***Provide explanation of reason(s) for determination.***
    A geomorphological survey including BEHI and Bancs model was evaluated prior to design, conducting these surveys are important in evaluating the needs of the sites. Several locations needed extra rock added, this is a little concerning in regards to continued stability and the site should be evaluated again to ensure these locations remain stable. The recent site visit was conducted during high and turbid water making it difficult to fully assess fish habitat. Depth of pools, complexity of woody habitat, and bed material where not visible but anecdotal information from the DNR indicates improved habitat.
23. ***Site Assessor(s) Conducting Review:***
    Anna Varian, Stantec

Appendix A: Site maps, Project plans or Vegetation tables

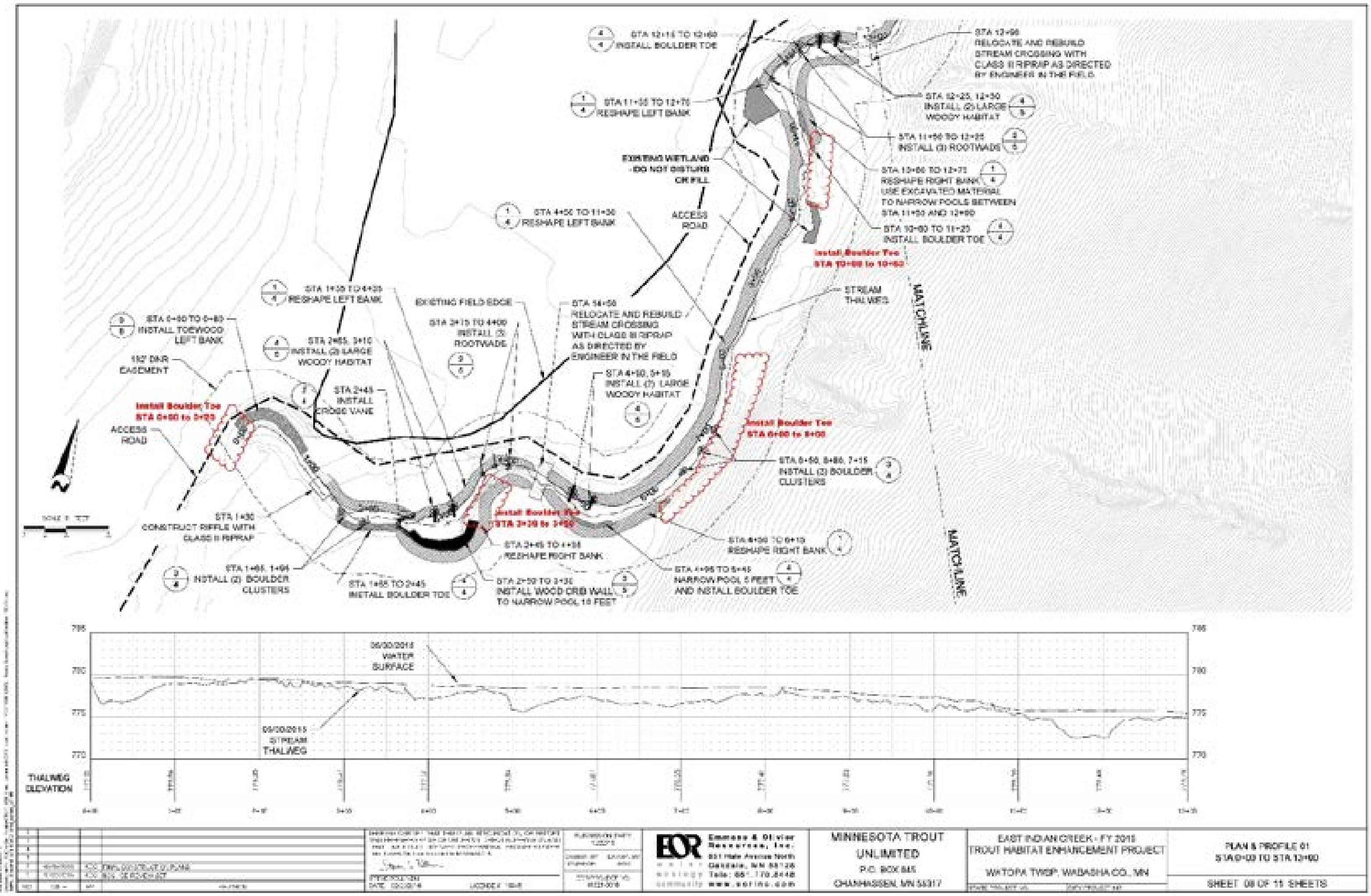


Figure 19-1 Construction plans with profile and locations of additional rock added in 2019.

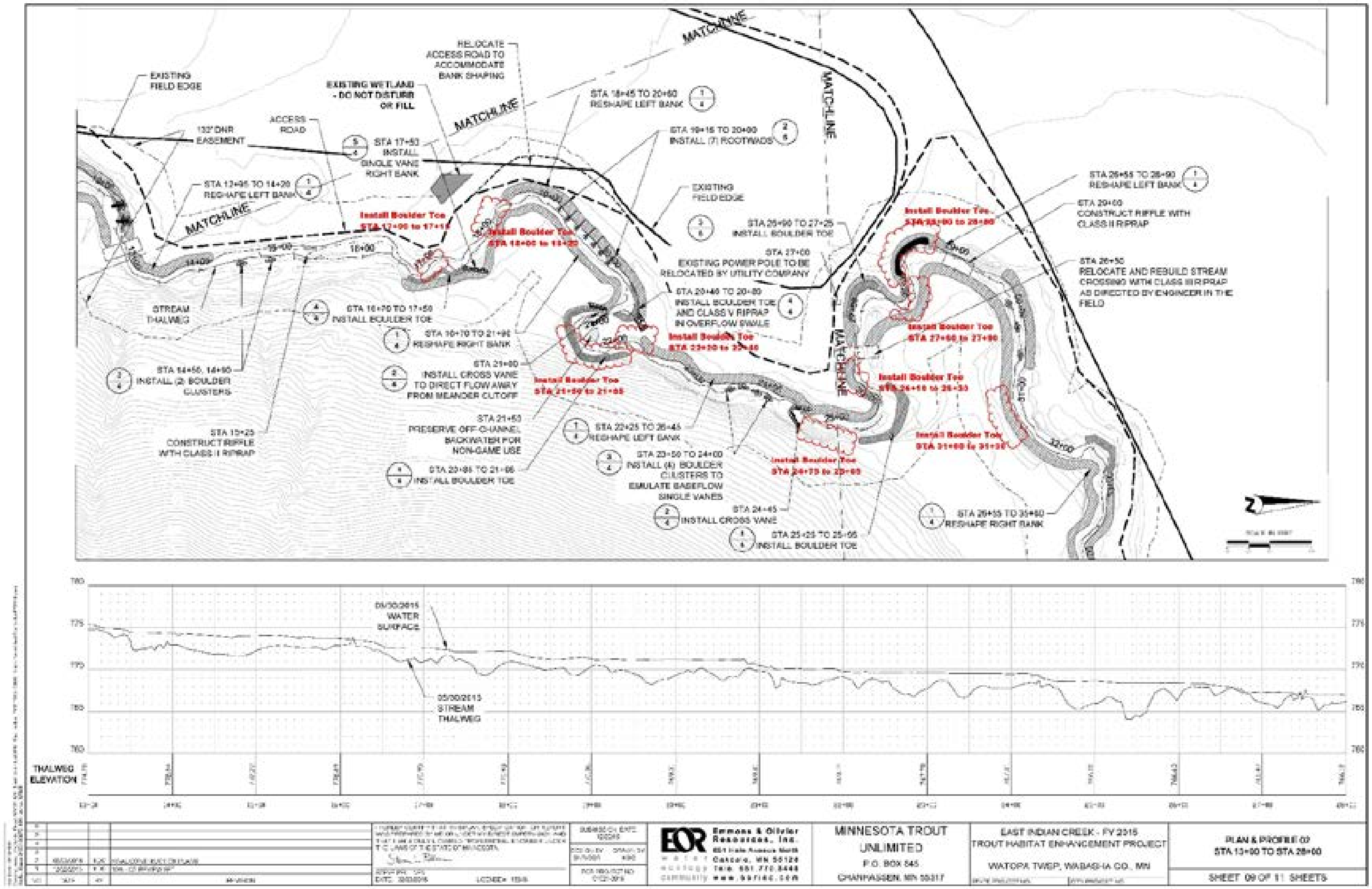


Figure 19-2 Construction plans with profile and locations of additional rock added in 2019.

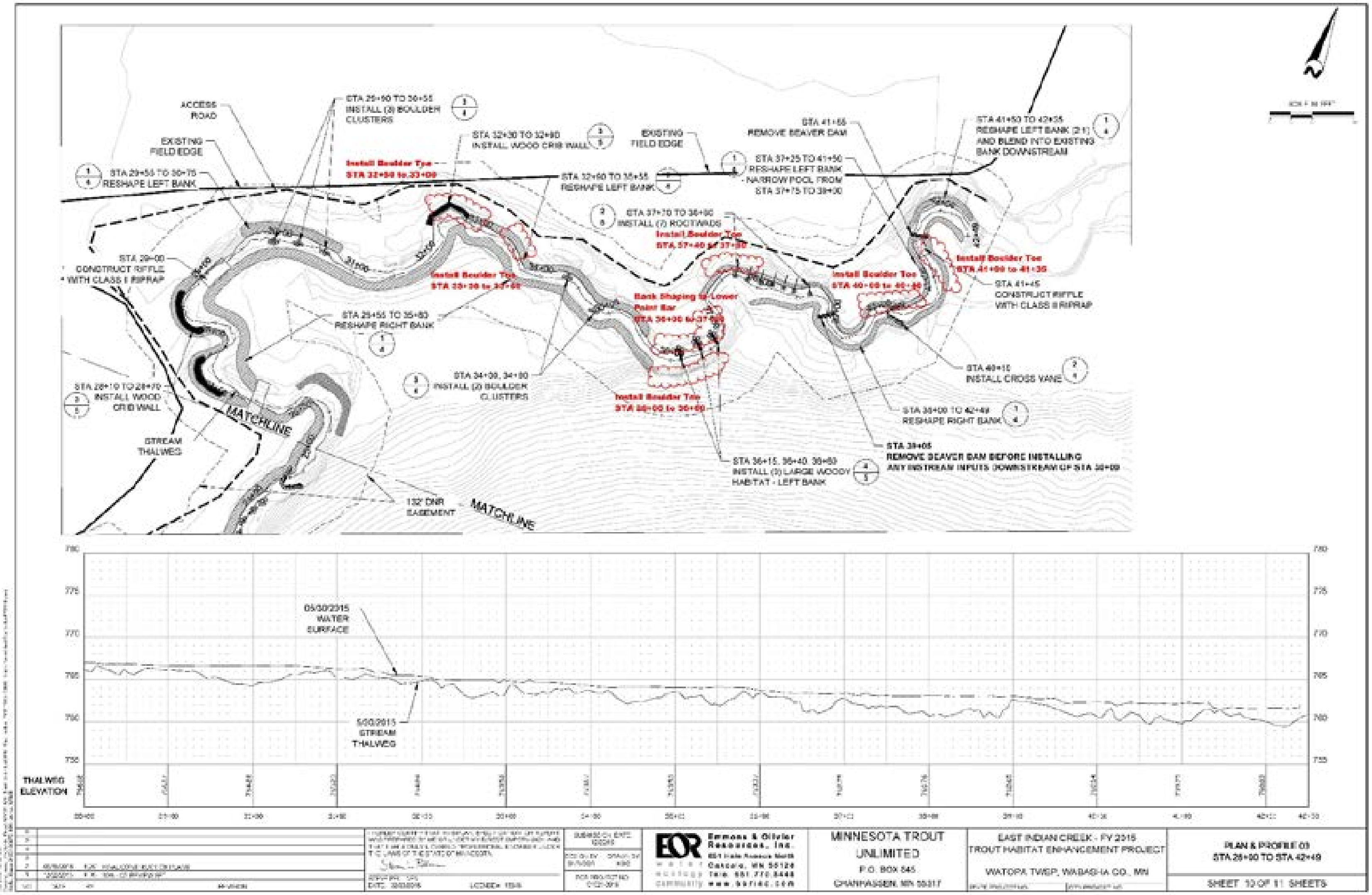


Figure 19-3 Construction plans with profile and locations of additional rock added in 2019.

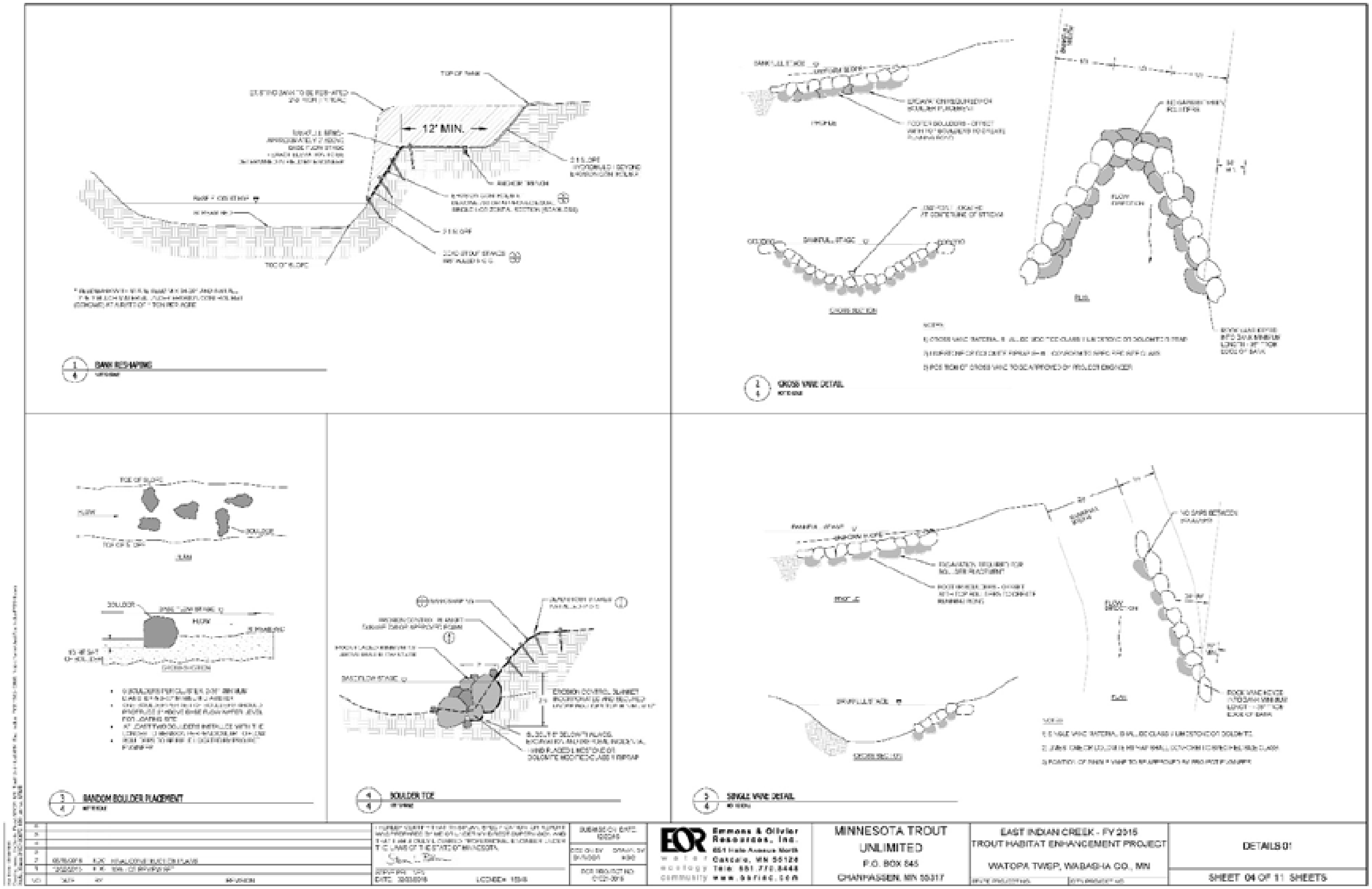


Figure 19-4 Construction plans with treatment details.

Table 19-1 Results of meander survey through project area. Cover ranges were estimated visually. Meander survey occurred between 1:00–1:45 PM, 10/21/19 by Wade Johnson, MN DNR and Anna Varian, Stantec.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Phalaris arundinacea	Reed Canary Grass	50-75%	No	Native/Non-Native
Setaria pumila	Yellow Foxtail	10-25%	No	Non-Native
Sorgastrum nutans	Indian Grass	10-25%	Yes	Native
Elymus canadensis	Canada Wild Rye	10-25%	Yes	Native
Elymus virginicus	Virginia Wild Rye	5-10%	Yes	Native
Andropogon gerardii	Big Bluestem	5-10%	Yes	Native
Panicum virgatum	Switchgrass	5-10%	Yes	Native
Leersia oryzoides	Rice Cut Grass	1-5%	Yes	Native
Echinocholoa crus-galli	Barnyard Grass	1-5%	No	Non-Native
Carex vulpinoidea	Fox Sedge	1-5%	Yes	Native
Scirpus atrovirens	Green Bulrush	1-5%	Yes	Native
Heliopsis helianthoides	Common Ox Eye	5-10%	Yes	Native
Asclepias incarnata	Swamp Milkweed	1-5%	Yes	Native
Ambrosia trifida	Great Ragweed	1-5%	No	Native
Brassica rapa	Field Mustard	1-5%	No	Non-native
Bidens sp.	Beggerticks	1-5%	No	Native
Eupatorium perfoliatum	Boneset	1-5%	Yes	Native
Helenium autumnale	Sneezeweed	1-5%	Yes	Native
Helianthus giganteus	Giant Sunflower	1-5%	Yes	Native
Heracleum maximum	Cow Parsnip	1-5%	No	Native
Impatiens capensis	Spotted Jewelweed	1-5%	Yes	Native
Monarda fistulosa	Wild Bergamot	1-5%	No	Native
Solidago gigantean	Giant Goldenrod	1-5%	Yes	Native
Symphyotrichum novae-angliae	New England Aster	1-5%	Yes	Native
Rudbeckia laciniata	Tall Coneflower	1-5%	Yes	Native
Rudbeckia hirta	Common Black-eyed Susan	1-5%	Yes	Native
Verbena hastata	Blue Vervain	1-5%	Yes	Native
Xanthium strumarium	Rough Cocklebur	1-5%	No	Native

Appendix B: Site Photographs

Photo 19-1 Pre-project conditions, photo taken in November 2012.

Photo 19-2 Bend in the river where toe-wood was installed, and rock added in 2019. Photo taken 10/21/2019 by Anna Varian.

Photo 19-3 Additional rock added in 2019. Photo taken 10/21/2019 by Anna Varian.

Photo 19-4 View of a location where a rock vane was added to the stream. Photo taken 10/21/2019 by Anna Varian.

20) Little Stewart River Habitat Enhancement Tree Planting

Project Background

Project Name: Little Stewart Tree Planting Project - Coldwater Fish Habitat Enhancement, Phase 4

Project Site: Dallos/ Sines properties

Township/Range Section: Township 53 Range 11 Section 23

Project Manager / Affiliated Organization: John Lenczewski / Minnesota Trout Unlimited

Fund: OHF ***Fiscal Year Funds:*** 2013

Project Start Date: 2014 with additional plantings conducted through June 2016

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Wetland

Project Status: Post Establishment Phase

County: Lake County

Primary Activity: Stream/River Enhancement

Project Size: 5,800 LF

Project Completed: June 2016

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   The main component for this project was tree planting along the riparian corridor. A total of at least 1,800 native trees were planted between 2014 and 2016. Weed suppression and animal browse protection devices were installed around all planted stock. No other treatments occurred for this project.

2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Coldwater Fish Habitat Enhancement, Phase 4. Minnesota's Legacy website. Legislative Coordinating Commission. 2017. https://www.legacy.mn.gov/projects/coldwater-fish-habitat-enhancement-phase-4. Accessed on 7/23/2019.

3. ***What are the stated goals of the project?***

Restore long-lived tree species along the riparian corridor to provide shade in the long-term to reduce water temperatures during the summer months, increase leaf litter inputs to the stream to benefit the food chain for juvenile fish, and provide stream bank stabilization via dense root growth.

4. ***What are the desired outcomes of achieving the stated goals of the project?***
    - Reducing stream temperatures during the summer months
    - Increasing organic matter to drive the aquatic food chain
    - Stabilizing stream banks

5. ***Were measures of restoration success identified in plans?*** No
   If yes, list specific measurements.
   No project plans provided
6. ***Are plan Sets available?*** No ***Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   Aerial photo of the project site is included in Appendix A (created by EOR for location reference).
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Tree planting guidelines followed included weed suppression via geotextile fabric and installation of animal browse protection devices.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Unknown - no plan provided
9. ***In what ways did alterations change the proposed project outcome?***
   Unknown

Site Assessment

Field Review Date: **10/8/2019**

Field Visit Attendees: John Lenczewski-MNTU, Jaime Juenemann-DNR, Gina Quiram-DNR, Mike Majeski-EOR

10. ***Surrounding Landscape Characteristics:***
    Current land use is comprised of a large wetland complex with several hayfields adjacent to the riparian corridor. Rural residential homes occur in low density in the watershed. The site occurs within the Laurentian Mixed Forest Province, Northern Superior Uplands Section, North Shore Highlands Subsection. Vegetation at the project site consists of a mix of conifer, dogwood, alder, and willow. The river flows through a dense corridor of grasses, sedges, and forbs. The Little Stewart River is a designated trout stream with steelhead and brook trout present in the reach.
11. ***Site Characteristics:***
    a. ***Soil Series:***

The primary soil mapped within the project site is E2-30B—Cuttre-Fluvaquents, frequently flooded complex, 0 to 8 percent slopes (silt loam, silty clay loam, and clay).

b. Topography:

Fairly flat floodplain with a low stream gradient. An E-type channel is present within the project reach.

c. Hydrology:

The drainage area at the upstream end of the project site is 3.8 square miles. The general stream flow is influenced by a well-vegetated riparian corridor (primarily grasses and sedges with mixed alder and willow) and a low stream gradient (<1%).

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

Shrub-carr plant community dominated by speckled alder and willow with a sedge meadow dominated by Canada bluejoint and tussock sedge. Scattered tamarack, black spruce, and white pine occur away from the stream channel. Invasive species observed included reed canary grass (10-25%) and Canada thistle (1-5%). No other invasive species were observed during the site visit.

e. Vegetation B: Meander Search Species List (as appropriate for site)

See Table 20-1 for a list of species observed during the meander survey.

12. ***Is the plan based on current science?*** Yes

Native tree species selected were appropriate to the site conditions. Tree planting guidelines included weed suppression via geotextile fabric and installation of animal browse protection devices.

13. List indicators of project goals at this stage of project:

Numerous tree planting stakes with weed suppression mats and animal browse protection devices were observed through the project area. The tamarack and white pine plantings have established well, with several individual trees over 7 feet in height.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

It will take over a decade before the planted trees begin providing shade along the river. However, the distribution and density of the plantings will likely provide ample shade in the long-term barring no further tree die-off or animal browse issues.

15. Are corrections or modifications needed to achieving proposed goals?

Yes, some tree sapling die-off has occurred near the downstream end of the project on the south side of the river. It appears this planting area was only comprised of a single species, white cedar. Any new tree plantings should follow the species distribution and density that was successful in other sections of the project site, particularly the use of tamarack and white pine.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

Yes, long-term management appears practical in this setting. There is opportunity for MNTU and other stakeholders to plant additional trees within the project reach. It appears the biggest challenge for this site is planting large enough trees to grow above the dense riparian vegetation. Weed/ grass mat suppression will be necessary for any future planting efforts.

17. Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.

No, but habitat conversion is likely in the long-term as the existing sedge meadow gives way to forested wetland habitat. This eventual conversion from sedge meadow to forest will subsequently increase shade over the channel and held reduce summer water temperatures. Pre-settlement vegetation maps suggest tamarack and spruce were dominant species in the area before logging activities occurred in the watershed.

18. ***Are follow-up assessments needed? Explain.***
    Yes, it is advised that monitoring be continued in the near future to determine growth rates and survivorship of the species planted. Additional trees should be planted if further die-off is observed.
19. ***Additional comments on the restoration project.***
    Re-planting tamarack and white pine is recommended within the area where die-off has occurred. White cedars do not appear to grow well in this particular soil and landscape setting.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. The project has yet to achieve the stated goals as the trees are too short to provide shade over the river.

21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium
22. ***Provide explanation of reason(s) for determination.***
    Being a recent tree-planting effort using sapling trees, the project has yet to achieve the stated goals. It will likely take decades before the trees provide effective shade over the river. However, the project will likely meet the intended objectives if the trees continue to grow and are not affected by flooding (beaver dams in project reach), disease, climate change, or animal browse. It appears the existing soils and hydrologic conditions are well suited for tamarack based on the strong growth rates observed of planted tamarack stock. Planted white pine also seemed to do well within the project reach.
23. ***Site Assessor(s) Conducting Review:***
    Mike Majeski - EOR

Appendix A: Site maps, Project plans or Vegetation tables

Photo 20-1 Aerial photo of the Little Stewart River tree planting project area. The yellow box highlights the approximate planting area.

Table 20-1 Vegetation observed during the project meander survey.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Calamagrostis canadensis	Canada bluejoint	25-50%	No	Native
Carex stricta	Tussock sedge	25-50%	No	Native
Phalaris arundinacea	Reed canary grass	10-25%	No	Non-native
Urtica dioica	Stinging nettle	1-5%	No	Native
Cirsium arvense	Canada thistle	1-5%	No	Non-native
Rubus spp.	Raspberry spp.	5-10%	No	Native
Thuja occidentalis	White cedar	1-5%	Yes	Native
Picea glauca	White spruce	1-5%	Yes	Native
Pinus strobus	White pine	1-5%	Yes	Native
Alnus incana	Speckled alder	5-10%	No	Native
Larix laricina	Tamarack	1-5%	Yes	Native
Picea mariana	Black spruce	1-5%	No	Native
Salix petiolaris	Meadow willow	5-10%	No	Native
Asclepias incarnata	Swamp milkweed	1-5%	No	Native
Symphyotrichum spp.	Aster spp. (possibly Panicled aster)	1-5%	No	Native

Appendix B: Site Photographs

Photo 20-2. Little Stewart River tree planting area. The taller trees within the sedge meadow are primarily planted tamarack, white pine, and white spruce.

Photo 20-3. Little Stewart River tree plantings. The conifer in the background is a planted white pine.

Photo 20-4. Little Stewart tree planting area with tamarack, white spruce, white pine, and white cedar. The browse protection devices surround the small planted stock.

Photo 20-5. Close-up image of weed suppression geotextile and browse protection installed around a planted tree.

Photo 20-6. Tree planting die-off area on the south side of the Little Stewart River. It appears most of the planted trees in this area were white cedar.

21) Little Stewart River Restoration/Enhancement

Project Background

Project Name: Little Stewart River Restoration Project

Project Site: Juenemann & Larson properties

Township/Range Section: Township 53 Range 10W Section 19

Project Manager / Affiliated Organization: John Lenczewski / MNTU

Fund: OHF ***Fiscal Year Funds:*** 2013

Project Start Date: 2014

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest

Project Status: Post Establishment Phase

County: Lake

Primary Activity: Stream/River Restoration

Project Size: 1050 LF

Project Completed: 2015

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***

The project components for the Little Stewart River restoration project included the following:

- Channel re-alignment and creation of a natural profile and pattern that required significant excavation and grading
- Installation of boulder grade control structures
- Installation of log j-hooks and large woody habitat
- Planting of 1,050 native trees and shrubs along riparian corridor as well as seeding banks with native seed mixes

2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
    - Final construction plan set from Stantec, dated February 2015.
    - Lessard-Sams OHC Laws of Minnesota 2012 Final Report dated December 28, 2017

3. ***What are the stated goals of the project?***

The following excerpt was taken from the MNTU Gitche Gumee Chapter website for the Little Stewart River project:

"Restore a free flowing channel in the Little Stewart River after devastating 2012 floods to provide fish passage for migratory salmonids and provide spawning and rearing habitat for steelhead, brook trout and other fish. Re-vegetate the upper riparian corridor of the Little Stewart with native tree species to cool the stream and lower overall stream water temperatures."

4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Desired outcomes of the stated goals include the establishment and long-term maintenance of deep-pool habitat within the project site, restore fish passage and overwintering refugia for fish species, particularly steelhead and brook trout, and re-establish near-stream riparian forest habitat for thermal benefits in the long-term.
5. ***Were measures of restoration success identified in plans?*** Yes
   If yes, list specific measurements.
   The following monitoring plan was provided by the DNR:

"Geomorphology: Geomorphic surveys were completed in 2014 and 2015, after construction and shall be repeated in 2018 by DNR Stream Habitat and DNR EWR staff. In 2018, DNR EWR and Stream Habitat shall repeat a geomorphic survey with pebble counts.

Water Quality: Temperature: Duluth area fisheries monitored stream temperature at five stations in 1999, 2013 and 2014. The two stations closest to the restoration reach were stations 0.3 and 3.4. No temperature monitoring occurred in 2015 and there is no index station on the Little Stewart River that will be monitored annually for temperature. Future temperature monitoring should include stations 0.3, 3.4 and a station at the upstream boundary of the restoration. In 2018, MNTU will purchase loggers to be installed.

Biology: Fisheries: Duluth fisheries electrofished station 2.3 almost annually from 1985 to 1998 and five stations were sampled in 1999. In 2014 four stations were sampled including one within the restoration reach, one directly above the restoration reach and two control stations above the restoration reach. In 2015 three of the four stations were repeated. No trout were sampled at station 6.5 in 2014 and the station was discontinued in 2015. A post construction sampling was completed in 2017.

Habitat: Pool mapping and woody debris sampling was completed in 2015 prior to construction. This will be repeated in 2018 once methods have been established regarding structures."

6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   See Appendix A for excerpts from the Final Construction Plan provided by Stantec.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   The practices implemented for this project included log J-hooks, woody debris toe protection, and boulder riffle grade control structures, all of which are commonly used in current stream restoration projects, especially along rivers of the North Shore. These practices are aligned with current science based approaches to stream restoration.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes,
   Due to a limited supply of large hardwood trees in the project reach, some of the woody debris toe protection structures were not installed in Reach 1. In addition, Reach 2 as identified in the final construction plan was not constructed due to concerns regarding impacts related to site access. Reach 2 contains steeper topography that would have been difficult to traverse with heavy machines and to import materials. Reach 2 was approximately 590 LF.
9. ***In what ways did alterations change the proposed project outcome?***
   The alterations to the implemented project design did not detract considerably from the proposed project outcome. The implemented project in its current state is providing numerous pools over 18" in depth, with several pools over 24" deep (at baseflow). The inclusion of large woody habitat within the project reach is providing additional pool habitat with overhead cover complexity and structure.

Site Assessment

Field Review Date: **10/8/2019**

Field Visit Attendees: John Lenczewski-MNTU, Jamie Juenemann-DNR, Gina Quiram-DNR, Cory Goldsworthy-DNR, Dean Paron-DNR, Mike Majeski-EOR

10. ***Surrounding Landscape Characteristics:***

Current land use is privately owned, undeveloped forest land with rural residential homes. The site occurs within the Laurentian Mixed Forest Province, Northern Superior Uplands Section, North Shore Highlands Subsection. Vegetation in the project site consists of a mix of conifers and softwood and hardwood trees. Riparian vegetation is comprised of forbs, grasses, sedges, willow and alder.

11. ***Site Characteristics:***
    a. ***Soil Series:***
    The primary soil is mapped as E2-34E—Miskoaki-Udifluvents, frequently flooded complex, 1 to 45 percent slopes (silt loam, silty clay loam, and clay)
    b. ***Topography:***
    High gradient stream, water surface slopes between 2-4%
    c. ***Hydrology:***
    The drainage area at the upstream end of the project site is 5.0 square miles. The project site contains a few small tributaries that feed into the Little Stewart River. The general stream flow is flashy due to the prevalence of tight soils, shallow depth to bedrock, and steep topography.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
    The dominant plant community is a mixed coniferous/ deciduous forest. Dominate herbaceous species observed included Canada bluejoint (5-10%), goldenrod spp. (5-10%), golden alexanders (5-

10%), horsetail (5-10%), and large-leaved aster (5-10%). Invasive cover included several species such as reed canary grass (5-10%), redtop (5-10%), common tansy (5-10%), clover spp. (1-5 %), ox-eye daisy (1-5%), common burdock (1-5%), common dandelion (1-5%), and orange hawkweed (1-5%), among others. Dominant tree and shrub species present included balsam fir, black spruce, quacking aspen, yellow birch, green ash, black willow, balsam poplar, elm, thimbleberry, and speckled alder. The native vegetation within the project site was quite diverse and beginning to become well-established along the restored reach.

e. Vegetation B: Meander Search Species List (as appropriate for site)

Refer to Table 21-1 for a list of species observed during the meander survey.

12. ***Is the plan based on current science?*** Yes

Stream restored using Natural Channel Design methods for a “B” channel with boulder grade control structures, log j-hooks, and woody toe protection.

13. List indicators of project goals at this stage of project:

Following the flood of 2012, a massive amount of coarse sediment including cobble and boulders aggraded within the project site and completely filled in the stream channel. Significant channel excavation and bank grading was required to re-construct a free-flowing channel. The end result was a stable “B” step-pool channel with numerous boulder grade control structures, pools, and large woody habitat structures. Sediment and debris jams have been removed and fish passage has been restored throughout the project reach.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes. The re-establishment of a free-flowing stable channel with boulder grade control structures allows for the formation and maintenance of deep pool habitat. Large woody habitat and log j-hooks are providing ample overhead cover and localized scour pools that will provide overwintering refugia for both game and non-game species.

15. Are corrections or modifications needed to achieving proposed goals?

Yes, a few log j-hooks will require re-adjustment of existing boulder material to prevent flows around the sides of the structures and subsequent localized bank erosion. Additional rock may be required to key the j-hooks further into the banks to reduce the threat of structure cut-off. In addition, a few boulder grade control structures will need to be adjusted to maintain a thalweg along the center of the channel. A few of these structures in their current condition are deflecting flows into the near bank and could cause localized bank erosion during high flow events.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

The site corrections mentioned above are currently being addressed. MNTU has stated that the contractor is planning to conduct the repairs in the fall of 2019. In addition, access paths occur within the project area that will allow for any future maintenance or repair work.

17. Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.

No. Pre-project stream habitat was severely limited due to significant channel aggradation. The implemented grade control and habitat structures have greatly improved the number of deep pools present within the project reach.

18. ***Are follow-up assessments needed? Explain.***
    Yes, follow-up site inspections should occur to determine if the planned repairs are meeting the designed plan specifications; therefore, these inspections should occur concurrently with the repair work.
19. ***Additional comments on the restoration project.***
    Considering the daunting task to re-construct a stable stream channel within an area that had been obliterated by a significant flood, the new stream channel and habitat features were well-constructed and functional. The project also allowed for the creation of near-stream wetland features that are currently providing non-game habitat for a variety of flora and fauna. The tree plantings are still small in size but are mostly alive and growing. Additional browse protection devices are needed due to loss from high water events.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    Considering the condition of the channel after the 2012 flood, the project has dramatically improved fish passage, deep-pool habitat, and riparian vegetation. Spawning substrates have been restored within the river and near-stream wetland habitats have been created. Tree planting efforts have been largely successful but will require regular maintenance of browse protection devices until the trees reach a taller height. Minor site repairs will be completed in the near future which will enhance existing instream habitat once competed.
23. ***Site Assessor(s) Conducting Review:***
    Mike Majeski - EOR

Appendix A: Site maps, Project plans or Vegetation tables

Figure 21-1 Little Stewart River Project Plan Set (Page 1 of 17) provided by Stantec.

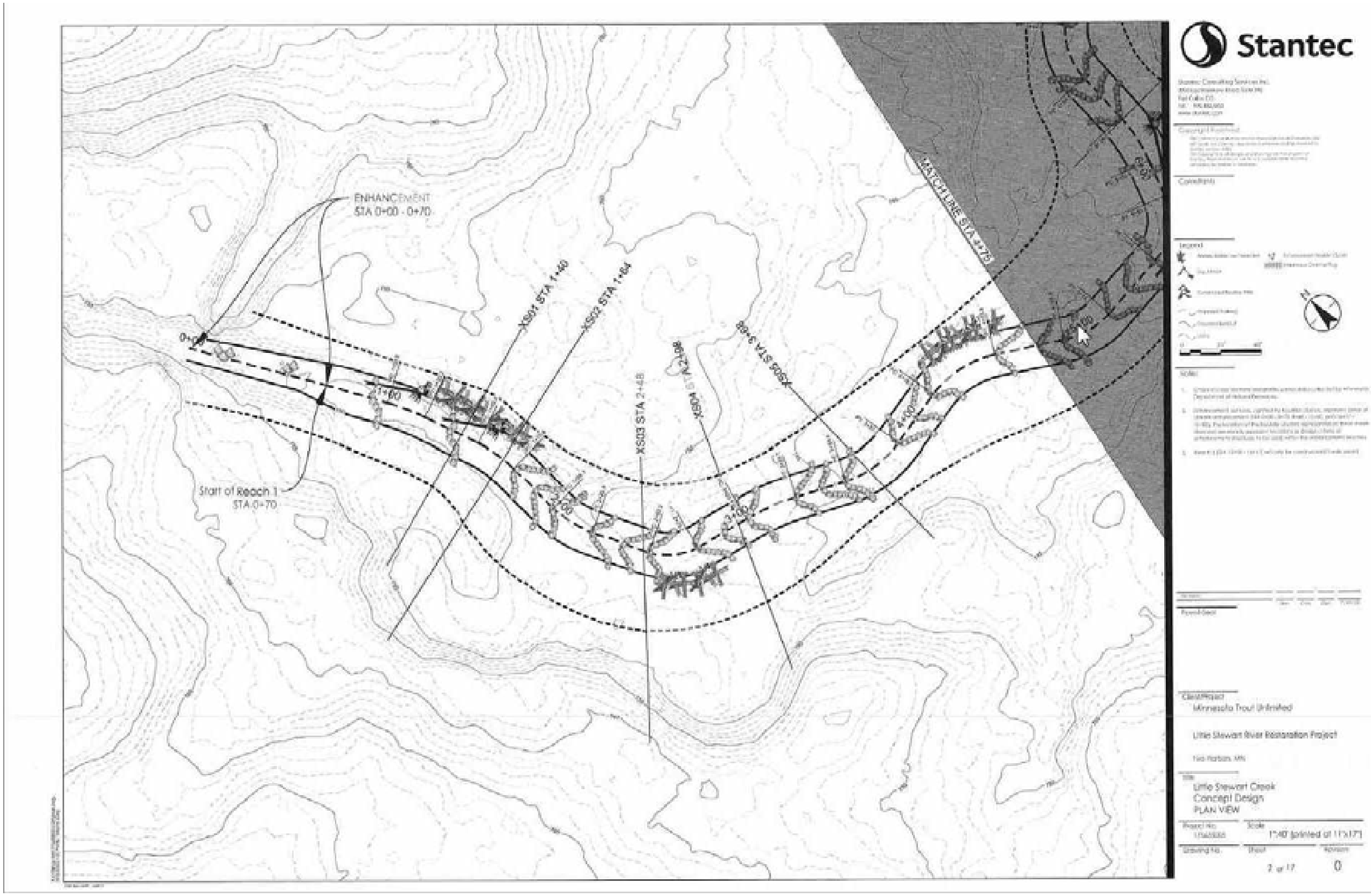


Figure 21-2 Little Stewart River Project Plan Set (Page 2 of 17) provided by Stantec.

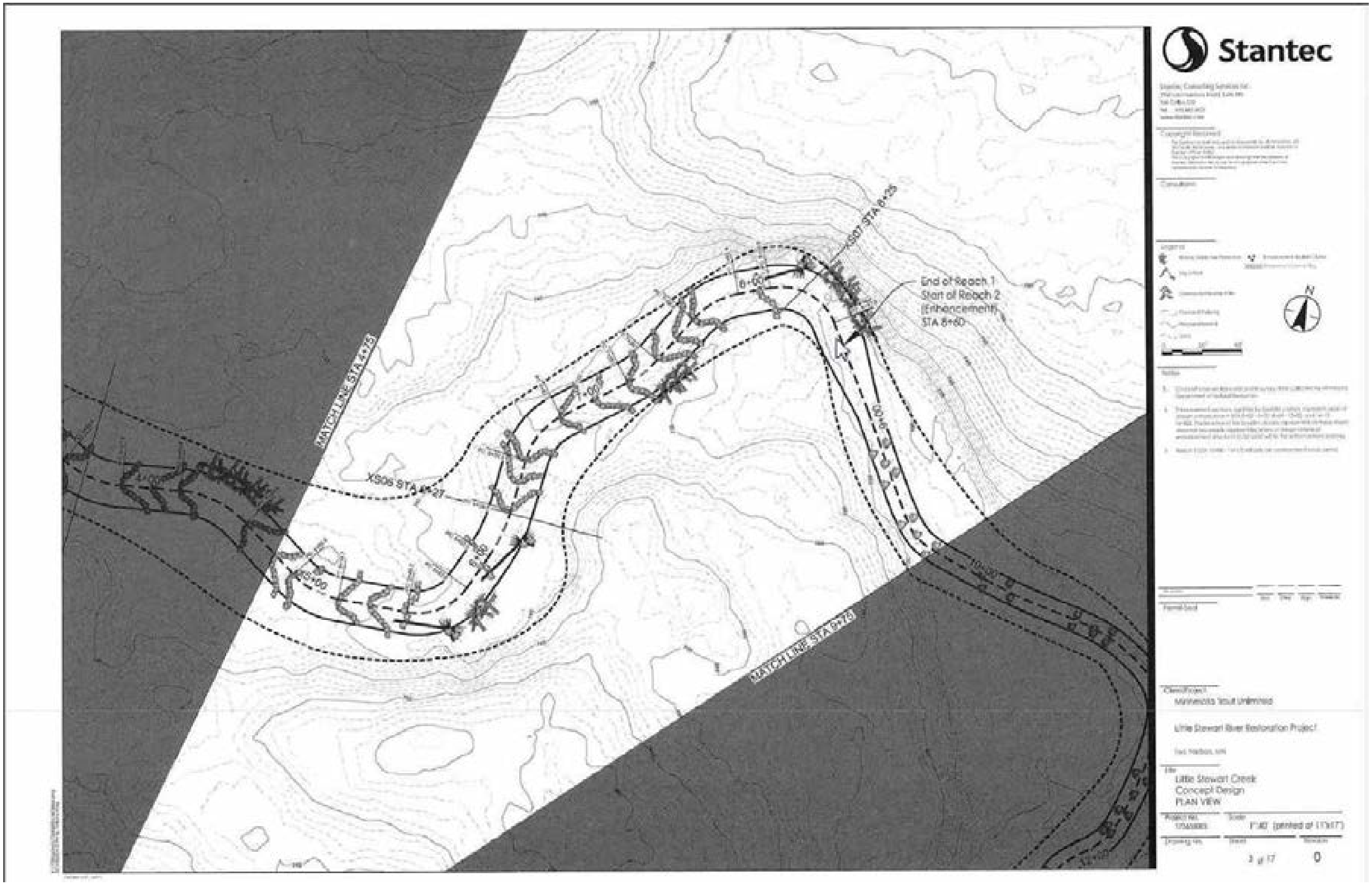


Figure 21-3 Little Stewart River Project Plan Set (Page 3 of 17) provided by Stantec.

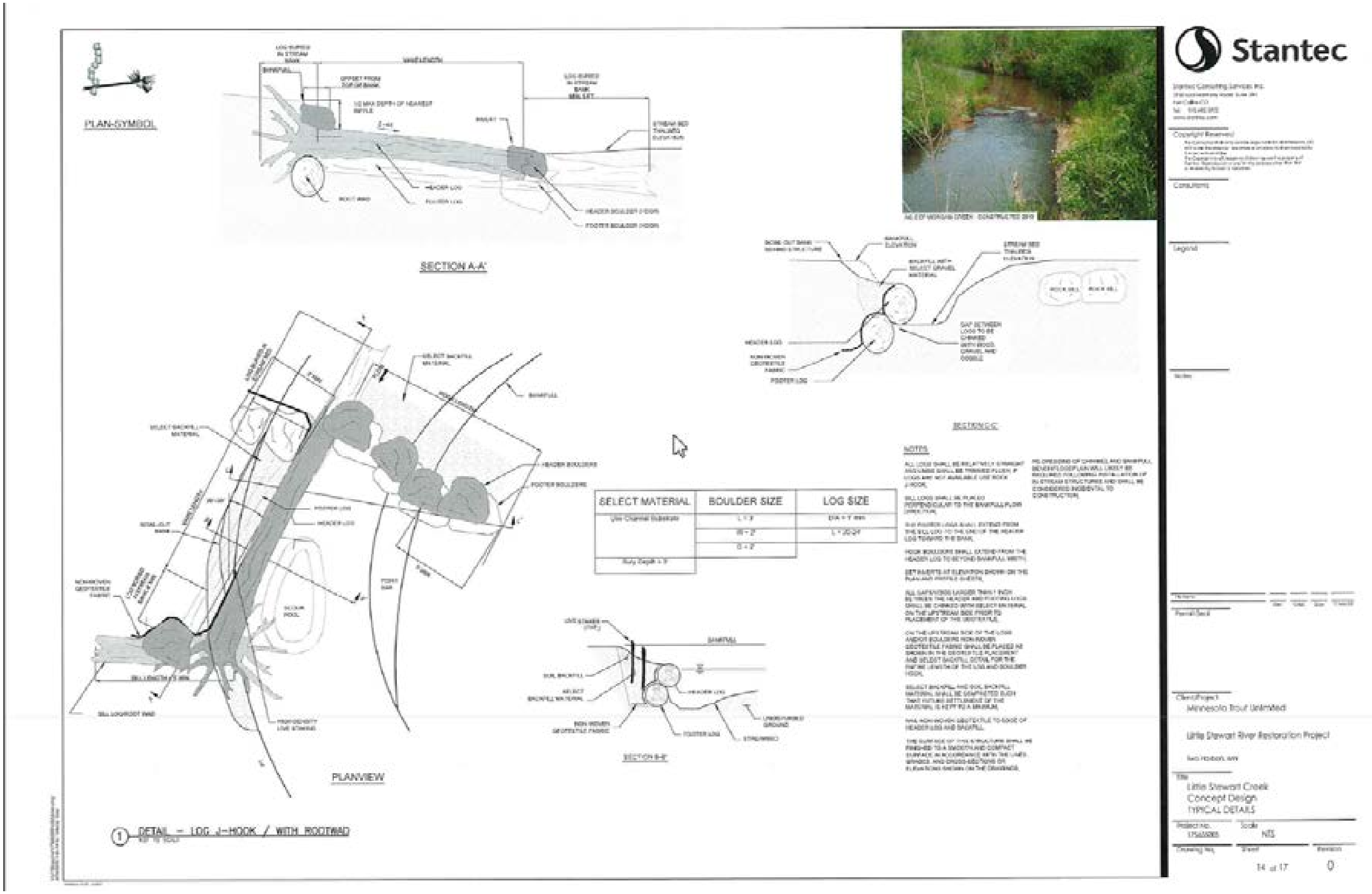


Figure 21-4 Little Stewart River Project Plan Set (Page 14 of 17) provided by Stantec.

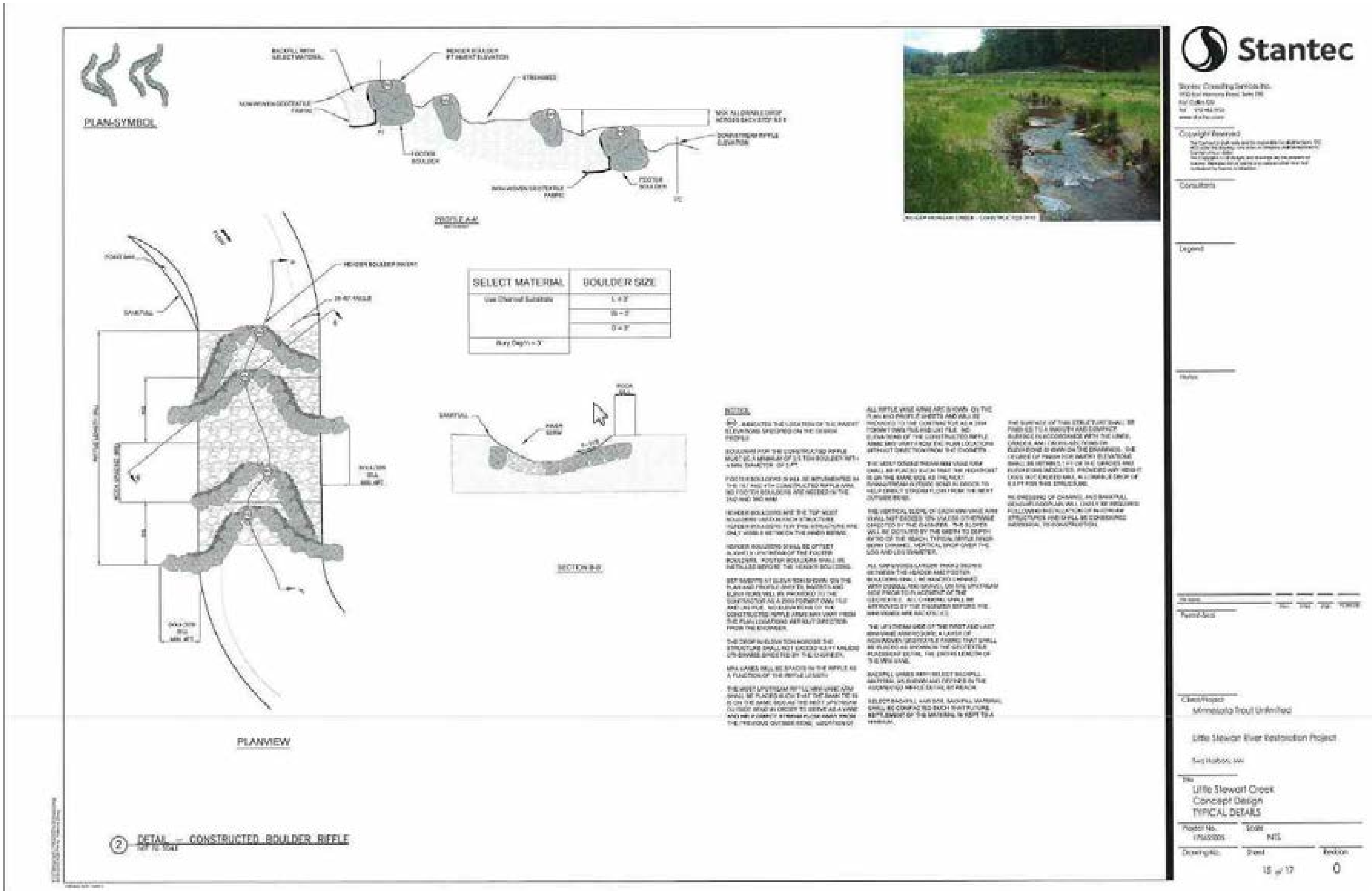


Figure 21-5 Little Stewart River Project Plan Set (Page 15 of 17) provided by Stantec.

Table 21-1. Vegetation observed during the project meander survey.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Agrostis gigantea	Redtop	5-10%	Unknown	Non-native
Eutrochium maculatum	Spotted joe-pye weed	1-5%	Yes	Native
Solidago spp.	Goldenrod spp.	5-10%	Unknown	Native
Eupatorium perfoliatum	Common boneset	1-5%	Yes	Native
Verbena hastata	Blue vervain	1-5%	Yes	Native
Achillea millefolium	Common yarrow	1-5%	Yes	Native
Tanacetum vulgare	Common tansy	5-10%	No	Non-native
Rubus spp.	Raspberry spp.	1-5%	No	Native
Phalaris arundinacea	Reed canary grass	5-10%	No	Non-native
Asclepias incarnata	Swamp milkweed	1-5%	Yes	Native
Spartina pectinata	Prairie cordgrass	1-5%	Unknown	Native
Rudbeckia hirta	Black-eyed Susan	1-5%	Yes	Native
Calamagrostis canadensis	Canada bluejoint	5-10%	Yes	Native
Andropogon gerardii	Big bluestem	1-5%	Yes	Native
Oenothera spp.	Evening primrose spp.	1-5%	No	Native
Arctium minus	Common burdock	1-5%	No	Non-native
Leersia oryzoides	Rice cutgrass	1-5%	Unknown	Native
Sorghastrum nutans	Indian grass	1-5%	Yes	Native
Equisetum spp.	Horsetail spp.	5-10%	No	Native
Scirpus cyperinus	Woolgrass	1-5%	Yes	Native
Taraxacum officinale	Common dandelion	1-5%	No	Non-native
Trifolium spp.	Clover spp.	1-5%	No	Non-native
Leucanthemum vulgare	Ox-eye daisy	1-5%	No	Non-native
Eurybia macrophylla	Large-leaved aster	5-10%	Yes	Native
Athyrium Filix-femina	Lady fern	1-5%	No	Native
Bidens frondosa	Devil’s beggarticks	1-5%		Native
Fragaria spp.	Strawberry spp.	1-5%	No	Native
Hieracium aurantiacum	Orange hawkweed	1-5%	No	Non-native
Solanum dulcamara	Bittersweet nightshade	1-5%	No	Non-native
Thalictrum dasycarpum	Tall meadow rue	1-5%	Yes	Native
Zizia aurea	Golden alexanders	5-10%	Yes	Native
Rubus parviflorus	Thimbleberry	5-10%	No	Native
Alnus incana	Speckled alder	1-5%	No	Native
Populus balsamifera	Balsam poplar	1-5%	No	Native
Cornus spp.	Dogwood spp.	1-5%	Yes	Native
Populus tremuloides	Quaking aspen	5-10%	No	Native
Thuja occidentalis	White cedar	1-5%	Yes	Native
Pinus strobus	White pine	1-5%	Yes	Native
Picea glauca	White spruce	1-5%	Yes	Native
Betula alleghaniensis	Yellow birch	1-5%	Yes	Native
Quercus macrocarpa	Bur oak	1-5%	Yes	Native
Picea mariana	Black spruce	1-5%	No	Native

Appendix B: Site Photographs

Photo 21-1 Pre-project image of the upper reach of the Little Stewart River on 9/29/2014. Photo credit MNTU.

Photo 21-2 Post-project image of the upper reach of the Little Stewart River taken on 10/08/2019.

Photo 21-3 Post-project image of the upper reach of the Little Stewart River taken on 10/09/2019.

Photo 21-4 Pre-project image of the lower reach of the Little Stewart River taken on 10/10/2013. Photo credit MNTU.

Photo 21-5 Post-project image of the lower reach of the Little Stewart River taken on 10/8/2019.

Photo 21-6 Pre-project image of the lower reach of the Little Stewart River taken on 10/10/2013. Photo credit MNTU.

Photo 21-7. Post-project image of the lower reach of the Little Stewart River taken on 10/8/2019.

Photo 21-8. Post project image of tree plantings in the lower reach of the Little Stewart River taken on 10/8/2019.

22) Pickwick Creek Restoration/Enhancement

Project Background

Project Name: Pickwick Creek Habitat Improvement Project

Project Site: Pickwick, MN

Township/Range Section: Township 106N Range 6W Section 23, 24

Project Manager / Affiliated Organization: John Lenczewski, MNTU

Fund: OHF ***Fiscal Year Funds:*** FY 10

Project Start Date: August 2011

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase

County: Winona

Primary Activity: Stream/River Enhancement

Project Size: 6,800 linear feet

Project Completed: 2011

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   The project used a variety of stream habitat improvement practices throughout the entire 6,800 feet reach including:
   - Invasive tree removal
   - Bank grading and channel shaping
   - Random boulder clusters
   - Cross channel logs
   - Log deflectors
   - LUNKER structures
   - Skyhook structures
   - Rock deflectors
   - Vortex weirs
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***

Project plans include an aerial identifying each bank throughout the entire reach, a set of standard construction details, and a worksheet containing codes for the proposed treatments by bank identification number.

3. ***What are the stated goals of the project?***
   Project goals identified in a cover letter for the MN DNR Public Waters Work permit application and include:
   Enhanced stream quality.
   Elimination of streambank erosion.
   Increased stream productivity including trout populations.
   Increased wild trout reproduction and biomass.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Based on the a review of the MN DNR Public Waters Work permit application, the desired outcomes are that aquatic habitat of Pickwick Creek will be enhanced to support more trout and provide improved opportunities for anglers.
5. ***Were measures of restoration success identified in plans?*** No
   If yes, list specific measurements.
   Click here to enter text.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   The construction plan set is a combination of location maps with banks numbered and a corresponding list of stream practices by bank along with typical construction details. A standard construction plan set outlining existing and proposed longitudinal profile and cross sections is not available for this project.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   The project used typical NRCS streambank stabilization and habitat enhancement features such as bank grading, random boulder clusters, log deflectors, rock deflectors, and vortex weirs. Reviewing the post-project construction photos, it appears that disturbed areas were seeded and straw mulched upon completion.

   The practices were based on standard NRCS-style methods and operational procedures current at the time of construction.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Based on the review of the project information and interviews conducted during the assessment visit, it’s hard to determine what modifications may have been made during implementation. The project information is relatively limited. Construction occurred under the constant and direct supervision of the stream design consultant so there likely was minor changes and adaptions that were occurred during the course of the project.
9. ***In what ways did alterations change the proposed project outcome?***

Based on the interview conducted on-site, the stream design consultant was heavily involved with the construction process and directed the excavating contractor with a high-level of detail. Any alterations likely resulted in a positive impact to project success. Eight years after the work was completed, the stream appears to be meeting many of the goals outlined at the outset.

Site Assessment

Field Review Date: 10/17/2019

Field Visit Attendees: Melissa Wagner, MN DNR; Wade Johnson, MN DNR; John Lenczewski, MNTU; Mark Pranckus, Cardno (Contracted Assessor) here to enter text.

10. ***Surrounding Landscape Characteristics:***
    Mix of forested, steep bluffs with row crop agriculture and hayland/pastures on flat to gentle slopes.
11. ***Site Characteristics:***
    a. ***Soil Series:***
       Newalbin silt loam, channeled
       Littleton silt loam
       Huntsville silt loam
    b. ***Topography:***
       Part of the Driftless portion of Minnesota. Characterized by narrow to wide valleys bounded by steep bluffs. The project site was located where the valley was generally between 1,000 and 1,500 feet wide. Relatively flat floodplain.
    c. ***Hydrology:***
       Perennial stream with a groundwater influence enough to support a coldwater fishery.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
       The project is located in a non-native, cool season pasture actively grazed by cattle.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
       Not applicable. At the time of the assessment, the pasture had actively been grazed making plant identification difficult. It can most accurately be described as a cool season pasture with a limited native species influence.
12. ***Is the plan based on current science?*** Portions
    The project plans used NRCS construction details, which was an accepted practice at the time. The details provide general construction specifications. However, there is no additional information such as channel sizing or material sizing. It's difficult to determine how much analysis went into the design and how much is based on the best science. Overall, structures are generally placed in appropriate locations and the project has produced quality trout habitat.
13. ***List indicators of project goals at this stage of project:***
    Overall, the project has good habitat quality. There is significant deep pool habitat with cover. Riffles are present and stable. Bank erosion is minimal through the entire project area. Based on interviews conducted on-site and observations, the trout fishery has improved since pre-project and has provided significantly improved of opportunities for anglers.
14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***

Yes. The project is achieved the proposed goals and will likely continue to achieve them given no changes in local land use (such as conversion of pasture to row-crop, change in grazing management along the stream).

15. ***Are corrections or modifications needed to achieving proposed goals?***
    None at this point.
16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    The pasture adjacent to the stream has actively been grazed with little to no limitations on keeping cattle off the banks. However, cattle appear to accessing and cross the stream at designated points and minimizing hoof shear along the banks. It's difficult to determine if this is the result of intensively managed grazing or just managing the cattle to prevent overuse before moving to the next pasture. Regardless, the grazing appears to not be impacting the overall stream stability and the robustness of the vegetation. Continued grazing practices in a similar manner will likely support the overall success of this project.
    The design and implementation relies heavily on the use of stone either along the toe or to create the instream structures. Because of the long length of the project, there may have been opportunity to incorporate more natural wood in bank structures in lieu of Lunker structures and use log vanes in place of stone vanes. This would have added variability to the habitat elements and offered the opportunity to see project performance between the two different types of materials.
    The stream appears to have good connection with its floodplain and relatively low bank heights. A bankfull discharge is likely getting out into the floodplain throughout most of the reach. There may have been the opportunity to reduce the amount of stone used along the toe, especially on the inside bends. Point bar grading could have also improved, which would also limit the need for stone.
    Increased duration, intensity, and frequency of flooding will present future challenges and limitations to maintaining project success. The stream valley through this portion of the project is wide and flat and the stream has access to the floodplain. Currently, the project area is grazed and appears to be limiting woody vegetation establishment including low quality trees like boxelder and invasive species like buckthorn. If grazing were to stop without additional vegetation management, the site would likely revert back to being lined with boxelders impacting both fishing access and eventually reducing understory vegetation by shading out herbaceous vegetation.
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No.
18. ***Are follow-up assessments needed? Explain.***
    None at this time.
19. ***Additional comments on the restoration project.***
    It was mentioned during the assessment interviews that the landowner allowed excess spoils to be spread on his property outside of the public easement and he was open to doing whatever was necessary to support the project. Having the ability to remove and spread spoils outside of the easement was likely a valuable and important component that helped make this project successful.
    A significant factor in this project's success was the stream design consultant's consistent direction of the excavation and construction. Their level of experience can be observed in the final product.

Although not always possible given funding and contractual limitations, it emphasizes the importance of the involvement of the stream designer during construction.

The valley setting likely has contributed a lot to the success of this project. Low banks and easy access to the floodplain has likely reduced shear stress against banks during high flows. During the assessment, a previous project directly upstream of this reach completed by MN DNR was observed. This section used larger rock and was constructed in a similar manner; however, there was a higher rate of bank erosion. One difference between the two projects was that the MN DNR section had steeper banks and was slightly incised and entrenched.

Based on the interview during the assessment, this section of Pickwick Creek was overwidened and shallow. The design narrowed the channel creating a more efficient channel and overall deeper habitat and stream facets. Having existing (pre-project) and proposed cross sections, the stream channel sizing could be evaluated against standard methods such as regional curve analysis.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    The project was completed 8 years ago. The stream and valley has experienced several significant floods over that time period. The vegetation is well-established and covering over the majority of the stone that was used to line the toe of slope. The stone protection along the channel will likely prevent or limit the amount of lateral movement occurring in the stream, which will prevent erosion. The bank heights and flat valley also supports future achievement of the goals.
23. ***Site Assessor(s) Conducting Review:***
    Mark Pranckus, Cardno

Appendix A: Site maps, Project plans or Vegetation tables

Figure 22-1. Aerial of the Pickwick project area. The total project length was 6,800 feet. In this figure, water flow is from the bottom to the top of the figure. Aerial photography is from September 2015 and provided by Google Earth.

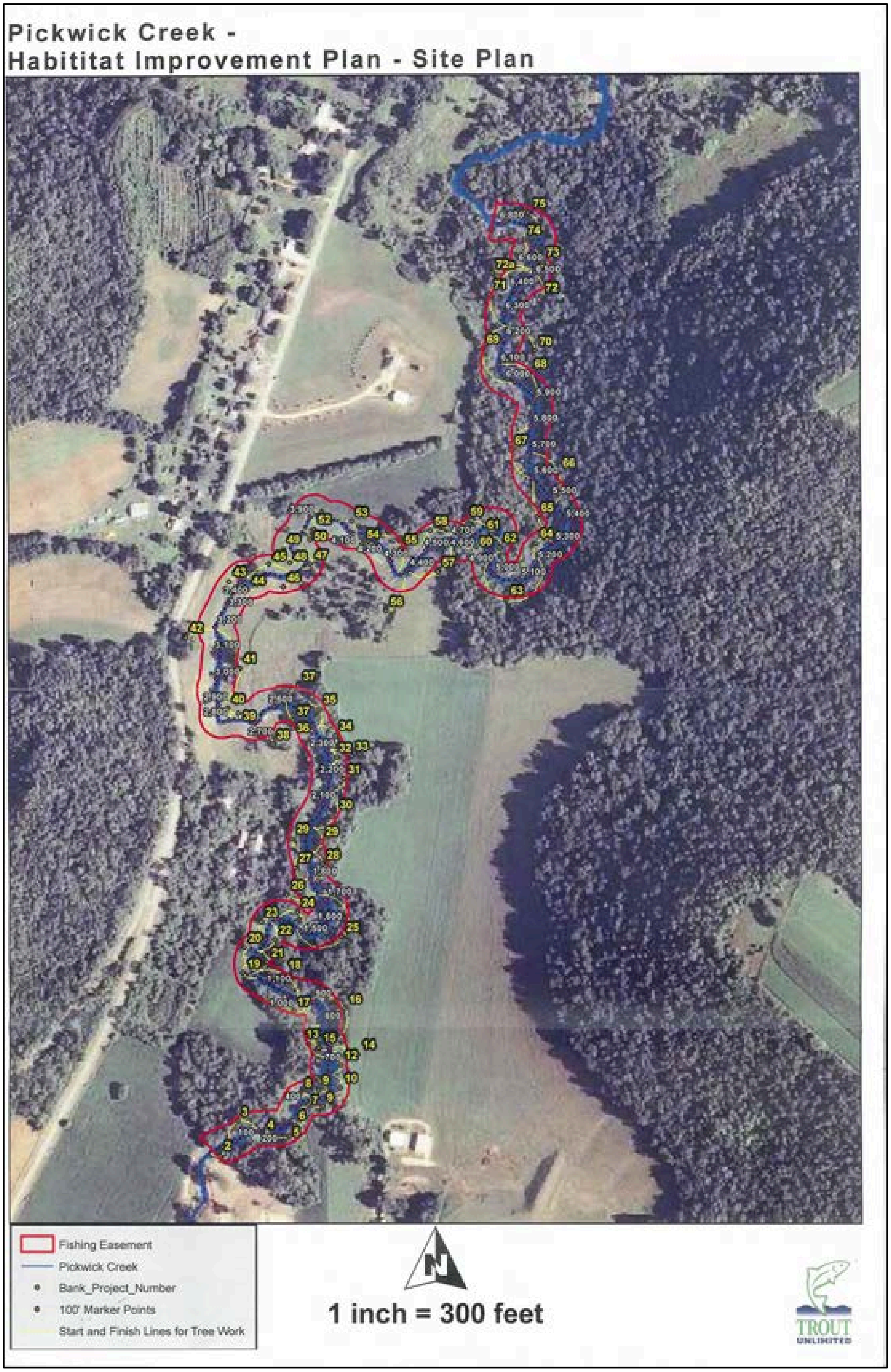


Figure 22-2. Project map used for design and construction. Each bend and section of stream was assigned a number, which corresponds to a proposed treatment.

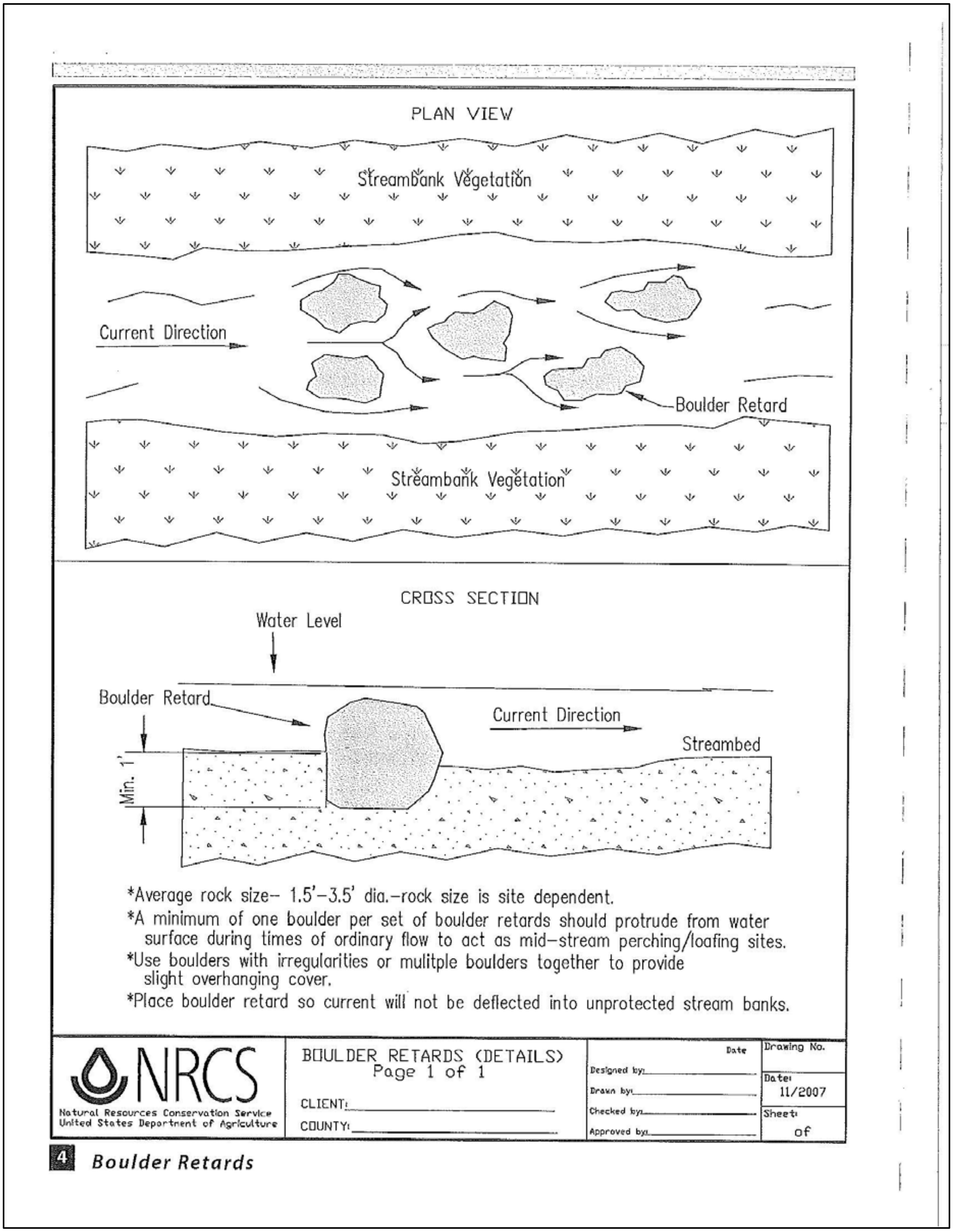


Figure 22-3. Example of construction details for the random boulder cluster used to design and construct the project.

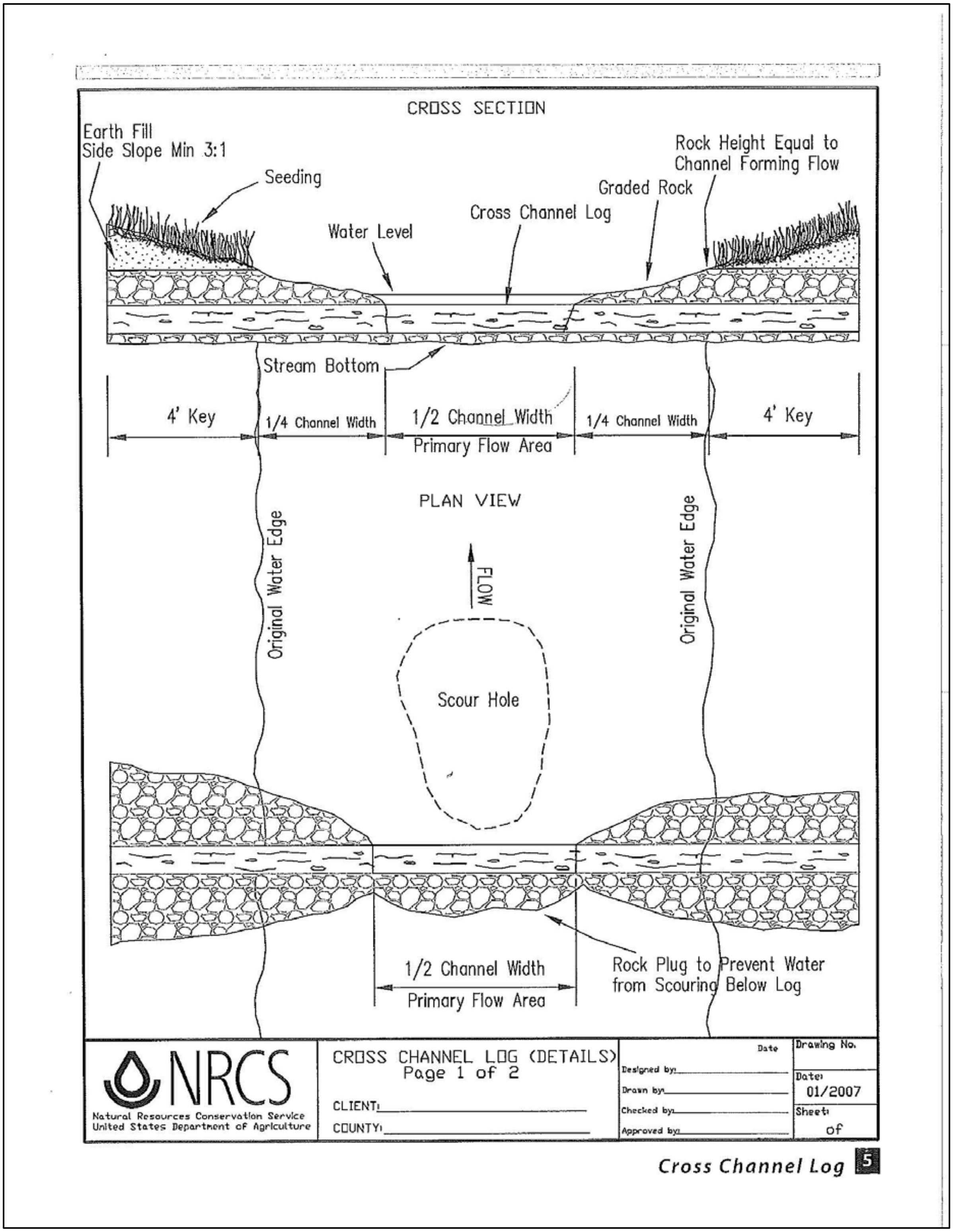


Figure 22-4. Example of construction details for the cross channel logs used to design and construct the project.

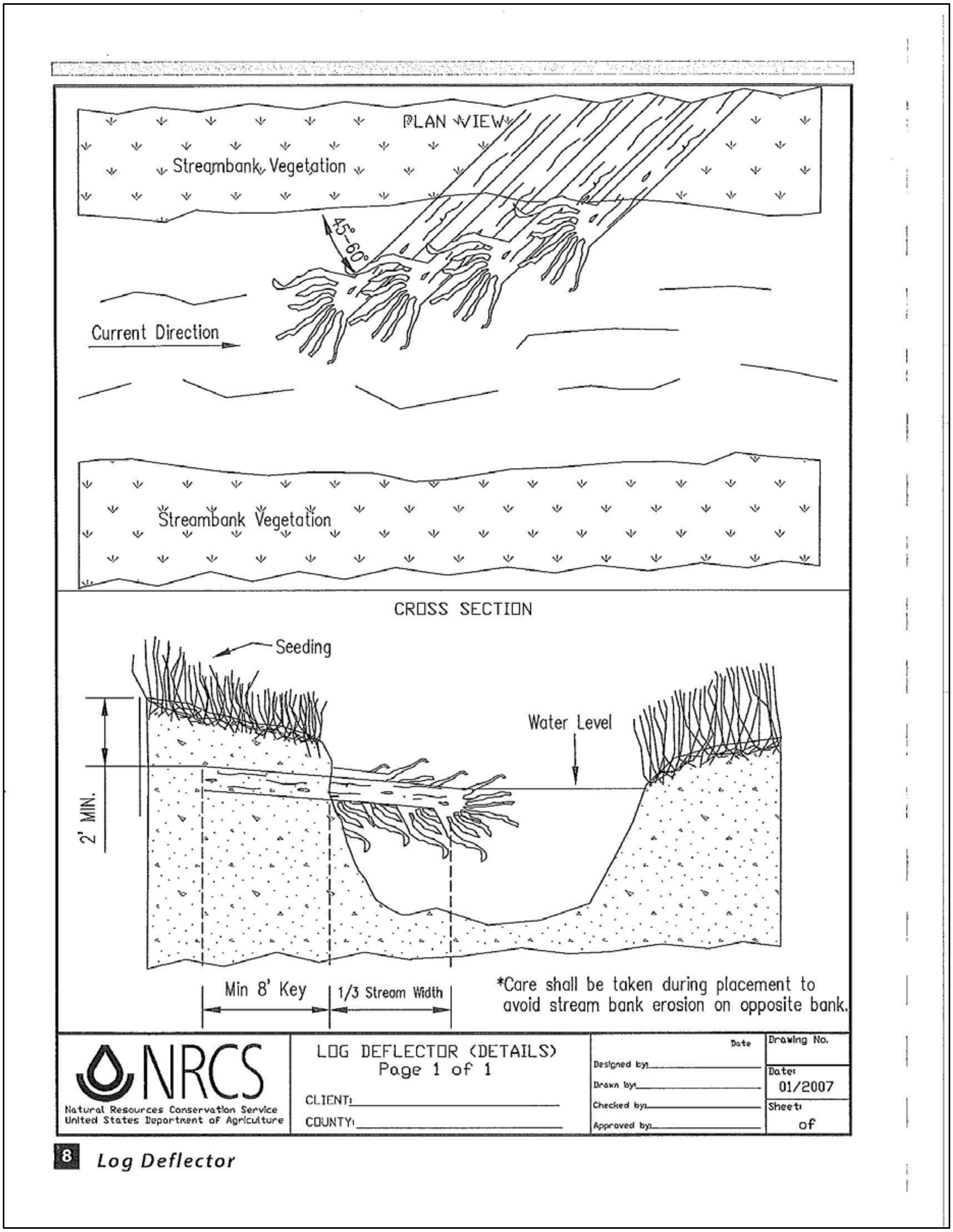
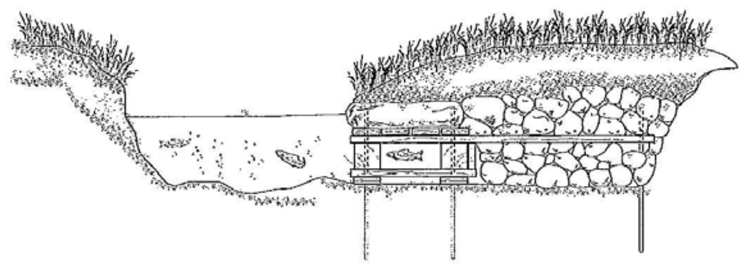


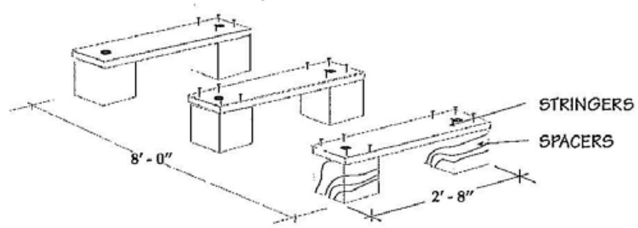
Figure 22-5. Example of construction details for the log deflectors used to design and construct the project.

LUNKER
ASSEMBLY INSTRUCTIONS



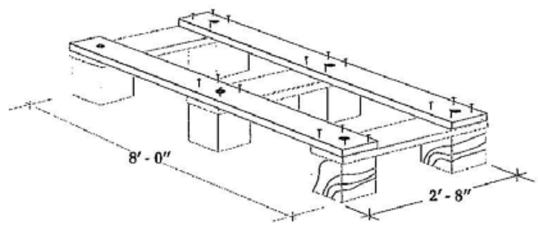
STEP 1

CUT SIX SPACERS, 8"X 8"X 8" AND PLACE THEM ON THE GROUND IN PAIRS WITH THE OUTSIDE EDGES 2' -8" APART AS ILLUSTSRATED BELOW. NAIL A 2"X 8" X 2'-8" OAK STRINGER BOARDS TO THE TOP OF THE SPACERS, MAKING SURE NOT TO PUT THE NAILS IN THE CENTER OF THE SPACERS BECAUSE THAT WILL BE DRILLED LATER TO ACCOMODATE A 3/4" RE-ROD.



STEP 2

PLACE 2 - 2" X 8" X 8' LONG BOARDS ACCROSS THE 2' -8" STRINGERS AND NAIL IN PLACE TO TIE THE PAIRS TOGETHER,



10 *Lunker*

Figure 22-6. Example of construction details for the LUNKER structures used to design and construct the project.

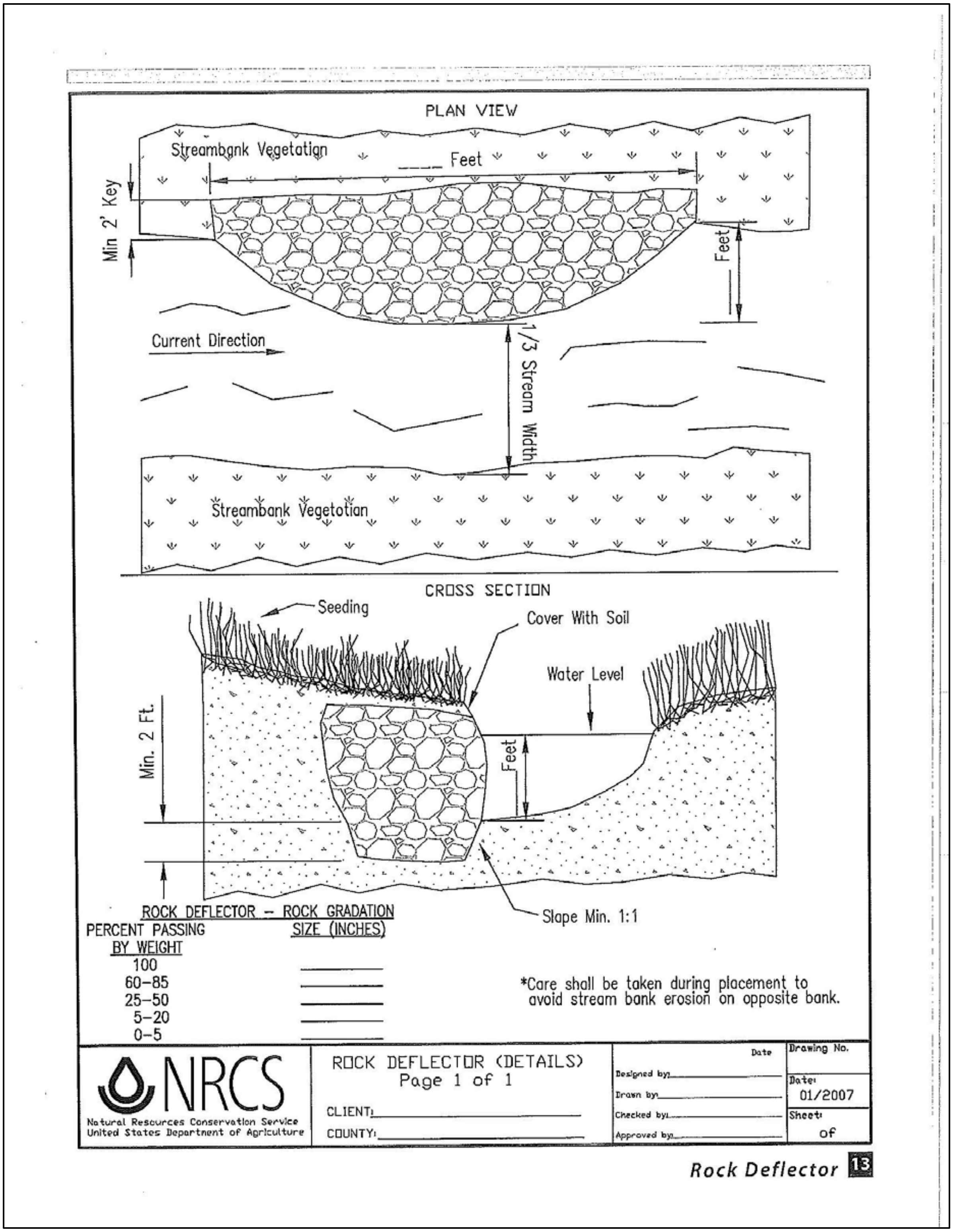


Figure 22-7. Example of construction details for the rock deflector used to design and construct the project.

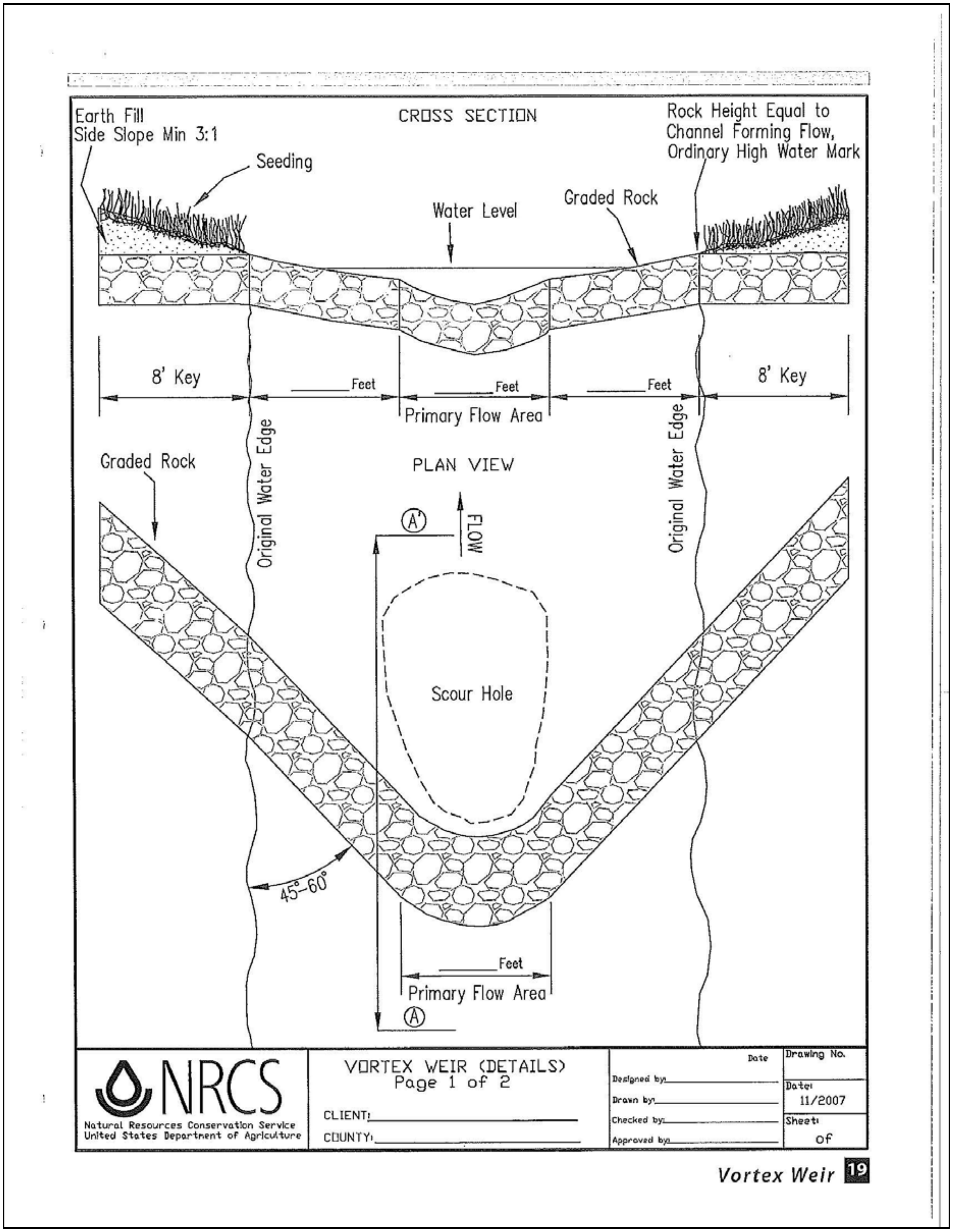


Figure 22-8. Example of construction details for the vortex weir structures used to design and construct the project.

Habitat Improvement Plan Summary

Stream name:	Date:	Stream mile:
Pickwick Creek	3-2-2010	

Downstream UTM:	Length:
	7200 feet

Bank	Side	Length (ft.)	Rip Rap (yds.)	Flat Rock (yds)	Structures	Comments
1	Both	0	48 BR		SC	Crossing for equipment/rock access
2	RB	0-45	24 RR		RR	RR just below frog pond SS
3	LB	80-190	60 RR		RR	RR, SS
4	RB	200-225	24 RR	24 FR	RW, 3RLS	RR, install 1 RW, 3 RLS, SS
5	RB	225-400	96 RR		RR	RR around bend, SS
6	RB	340		12 FR	2 RLS	Install 2 RLS, keep low
7	RB	400-450	24 RR		RR	RR eroding bank, SS
8	LB	450		12 FR	1 RW	Make weir U shaped
9	Both	450-525	60 RR		RR	RR, SS eroded banks
10	RB	525-600	60 RR		RR, CR	RR, add CR as needed, SS
11	LB	525	24 RR Sm		RR	Repair high flow channel bank erosion problem, SS
12	RB	600-700	12 RR Sm		RR	RR, SS
13	LB	675-800	48 RR		RR	RR, SS eroded bank
14	RB	700	12 RR		RW	Remove dead tree debris, SS
15	LB	700-800	36 RR	12 FR	RR, 1 RLS	RR, install 1 RLS, SS
16	RB	725-920	60 RR	24 FR	RR, RV, FRCR	Remove large Willow @ 860, RR Add RV and flat rock cover rocks
17	LB	920-1010	36 RR	36 FR	2 SH, 1 RW 2 RSH, RR	Remove dead tree from channel, RR upper LB, install RW then SHs
18	RB	960-1160	204 RR	36 FR	6 SH, RR	Install SHs, RR, SS
19	LB	1140-1200	36 RR		RR	Pull island into R channel, SS RB
20	LB	1180-1300	144 RR	48 FR	8 SH, RR	Install 8 SH, RR, SS
21	RB	1180-1250	24 RR		RR, SS	Use RB rubble/fill to slope LB up To corn field best as possible
22	RB	1250-1375	48 RR		RR, SS	RR and slope and seed eroded bank
23	LB	1300-1400	24 RR	12 FR	2 LS, RR	Install to LS, RR, SS

Figure 22-9. Example of the design plan worksheet. Each numbered section of the stream was assigned a treatment (Structures column) along with comments. Stone material quantities were estimated along with the total length of treatment. This information was used to construct the project.

Page 2 Pickwick HI Plan 3-2-2010

24	LB	1400-1500	60 RR		RR, SS	Add frog/turtle pond, sunning area wintering pond
25	RB	1480-1730	180 RR	24 FR	6 SH	At approximately 1600' put in 6 SH
26	LB	1750	48 RR		RR, SS	RR, SS eroded bank
27	LB	1800-1900	96 RR	24 FR	3 RSH, RR	Install 3 RSH, RR, SS
28	RB	1800-1900	96 RR 72 BR		RR, SC	Install SC, bring RB out 25%, RR SS
29	Both	1900-2000	12 RR Lg		CR	Add cover rocks
30	RB	2000-2150	120 RR	24 FR	1 RW, 3 LS or .5 SH	Install RW, LS, keep left side of weir real low
31	RB	2150-2250	108 RR	12 FR	RR, SS	Remove huge tree from stream before doing any other work
32	RB	2250-2300	48 RR		RR	RR bank damage downstream of Tree dam
33	RB	2300	48 BR		SC	Stream crossing
34	RB	2300-2400	96 RR	36 FR	1RW, 3 SH RR, SS	POR, remove large tree damming stream before doing other work
35	RB	2400-2500	96 RR		RR, SS	Fix eroding bank
36	LB	2400	24 RR		1 RV	Install rock V vane in place of log
37	Both	2550	60 BR		SC	Stream Crossing, SS
38	LB	2700	48 RR		RR, CR	Keep CR low
39	RB	2760-2800	36 RR		RR, SS	Fix eroding bank
40	RB	2800-2900	24 RR	24 FR	3 RSH	Install 3 RSH, RR, SS
41	RB	2900-3200	220 RR	12 FR	1 RSH, RR CR	RR major bank, install 1 RSH, add CR as needed/available, SS
42	LB	3200	12 RR		RR, SS	Fix eroding bank
43	LB	3325-3450	48 RR		RR, SS	Cut back large leaning trees
44	RB	3390-3460	48 RR	24 FR	1 RW, 3 RSH RR, SS	Old tire in stream, remove repair eroded bank
45	LB	3420-3600	96 RR		RR, SS	RR, stop head cutting on high flow channel, watch channel width
46	RB	3600	48 RR	36 FR	3 RSH, RR SS	WATCH OUT FOR CABLE
47	RB	3650-3710	24 RR, 24 BR		1 SC, RR SS	Install cattle crossing, SS
48	LB	3710	24 RR		RW	Install RW, RR, SS
49	LB	3710-3800	48 RR	24 FR	5 LS, RR SS	Install 5 LS below weir

Figure 22-10. Example of the design plan worksheet. Each numbered section of the stream was assigned a treatment (Structures column) along with comments. Stone material quantities were estimated along with the total length of treatment. This information was used to construct the project.

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50	RB	3850	24 RR		RR	Fix eroding bank
51	LB	3910-3975	36 RR	36 FR	1 RW, 4 SH RR, SS	Install RW and 4 SH
52	RB	3900	36 RR		RR, SS	Rip Rap eroding bank, slope and seed
53	LB	4040-4120	96 RR		RR, SS	RR long eroding bank, SS
54	RB	4120-4200	84 RR	36 FR	1 RW, 4 SH RR, SS	Fix long eroding bank, add 1 RW 4 SHs
55	LB	4175-4350	144 RR		RR, SS	Repair long bank
56	Both	4380	72 BR		SC	Install stream crossing, SS
57	RB	4400-4600	240 RR	48 FR	1 RW, 5RSH RR, SS	Fix long bank, install RW, 5 RSHs
58	LB	4450-4600	60 RR		1 RV	RR bank install 1 rock vane
59	LB	4600-4775	120 RR		RR, SS	Repair long eroding bank
60	RB	4620-4790	60 RR		RR, SS	Fix eroding bank, slope and seed
61	RB	4790-4850	60 RR		RR, SS	Fix eroding bank, slope and seed
62	LB	4850-4920	120 RR	36 FR	RR, CR, SS	Use flat rock for low CR clusters
63	RB	4920-5220	324 RR		RR, CR SS	Fix large-long eroding bank, add CR as needed
64	LB	5200-5350	144 RR		RR, CR SS	Fix bank, add cover rocks
65	LB	5300-5600			SS	Straight stretch, slope and seed
66	RB	5475-5700	120 RR		RR, SS	Add cover rocks as needed, fix bad bank
67	LB	5600-5800	168 RR		RR, CR SS	Remove huge tree damming stream
68	RB	5900-6100	216 RR		RR, CR SS	Fix long bank, add CR, try and create cover best as we can, SS
69	LB	6000-6250	324 RR		RR, CR SS	Fix long bank, add CR, try and create cover best as we can, SS
70	RB	6250	60 RR		RR, SS	Fix bank, lower toe
71	LB	6250-6500	216 RR		RR, CR SS	Fix long bank, add CR, try and create cover best as we can, SS
72	RB	6500	84 BR		SC	Install stream crossing for heavy equipment, rock
72a	Both	6500				Remove abandoned beaver dam, do first, affects flow, water level
73	RB	6500-6600	72 RR		RR, SS	Fix bank
74	LB	6600-6700	48 RR	36 FR	1 RW, 5.5SH RR, SS	Install RW, 5 .5SHs, CR, RR, SS

Figure 22-11. Example of the design plan worksheet. Each numbered section of the stream was assigned a treatment (Structures column) along with comments. Stone material quantities were estimated along with the total length of treatment. This information was used to construct the project.

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75	RB	6650-6800	216 RR		RR Terrace	Monster sand bank, terrace using RR and rubble from high LB bank
76	LB	6800-7200	324 RR		RR, CR SS	Repair long eroding high bank, add cover were possible
77	RB	7000-7150	60 RR		RR, CR SS	Repair eroding bank
78	Both	7150-7200			SS	End of project, SS-blend into surrounding banks

Totals	
Breaker Run—408 yds	Lunker Structures—10
Rip Rap—6088 yds	Stream Crossings—7
Flat Rock—648 yds	Rock Lunker Structures—6
Rock Weir—13	.5 (1/2 width version) Sky Hook—5
Sky Hook—33	Rock Vanes—3
Rock Sky Hook—20	

Notes:

Yellow highlighted rows are marking obstructions that on 3-2-2010 would need to be removed before in stream work up stream of the obstruction was done.

Allow four to six days prep work to create access road, install stream crossings and remove stream obstructions that will interfere with water levels and flow.

Sloping and seeding will be done as needed to prevent soil erosion or reestablish vegetative or stable bank cover. (Stable bank cover includes grasses, rock, trees, shrubs and other materials that prevent soil erosion)

Blue highlighted row signifies area of concern or special interest.

Key

LB—Left Bank	BR—Breaker Run	RW—Rock Weir	RSH—Rock Sky Hook
RB—Right Bank	CR—Cover Rock	RV—Rock Vein	RLS—Rock Lunker Structure
RR—Rip Rap	LS—Lunker Structure	RD—Rock Deflector	SS—Slope and Seed
FR—Flat Rock	SH—Sky Hook	WD—Woody Debris	SC—Stream Crossing
POR-Point of Reference	SRR—Small Road Rock	.5SH—1/2 Sky Hook	

Figure 22-12. Example of the design plan worksheet. Each numbered section of the stream was assigned a treatment (Structures column) along with comments. Stone material quantities were estimated along with the total length of treatment. This information was used to construct the project.

Appendix B: Site Photographs

Photo 22-1. Example of Pickwick Creek eight years after construction. Much of the stone toe used to line the channel is overgrown with vegetation. Low banks help to support the stability of the stream. Photo taken 10/17/19 by Mark Pranckus, Cardno.

Photo 22-2. Example of Pickwick Creek following construction. Notice the stone used along the toe of the bank to provide stabilization. In later years, this has been covered by vegetation. Photo taken August 2011 and provided by MN DNR.

Photo 22-3. Example of Pickwick Creek in 2019. Banks are stable with well-developed vegetation. Deep pools and riffles present. Photo taken 10/17/19 by Mark Pranckus, Cardno.

Photo 22-4. Example of Minnesota sky hook structure where rock is used instead of lumber. The structure provides overhead cover. This structure had some erosion occurring because the stone should not be visible because soil and vegetation covers it. Photo taken 10/17/19 by Mark Pranckus, Cardno.

Photo 22-5. Example of log deflector used to provide overhead cover. Photo taken 10/17/19 by Mark Pranckus, Cardno.

Photo 22-6. Example of a random boulder cluster used to provide in-stream cover for feeding trout. Photo taken 10/17/19 by Mark Pranckus, Cardno.

Photo 22-7. Example of Minnesota sky hook structure. The structure provides overhead cover for fish. It is assembled in the dry and placed into the bank. Photo taken August 2011 and provided by MN DNR.

Photo 22-8. Example of a vortex weir installed in 2011. It is used to hold the grade of the upstream pool and create a plunge pool on the downstream end. Photo taken August 2011 and provided by MN DNR.

Photo 22-9. Example of Pickwick Creek following construction in 2011. Banks were seeded and straw mulched. The low bank on the left helps to reduce shear stress on the outside bend during high flows. Photo taken August 2011 and provided by MN DNR.

23) Portage Creek Fish Passage Restoration

Project Background

Project Name: Portage Creek Fish Passage Restoration

Project Site: Portage Creek, between Leech Lake and Portage Lake.

Township/Range Section: Township 145 Range 29 Section 36

Project Manager / Affiliated Organization: Todd Tisler/USFS=Chippewa NF

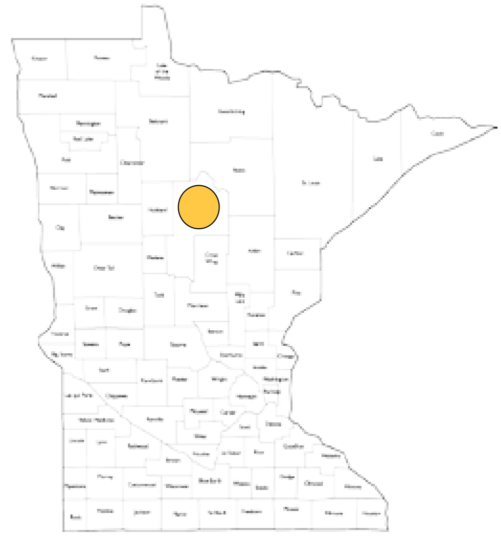
Fund: OHF - CPL ***Fiscal Year Funds:*** 2012, 2015

Project Start Date: 2015

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase



County: Cass

Primary Activity: Stream/River Restoration

Project Size: 2 Acres

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   This project involved removing a low head dam and constructing a series of rock weirs designed for fish passage and to maintain water levels of Portage Lake slightly lower then recent levels maintained by the dam.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Portage Creek Fish Passage plans, Final CPL Report, Hydrologists Report, Portage Lake and Creek survey and plans, and Decision Memo: Portage Lake Aquatic Organism Passage Project. Documents were provided by USFS Chippewa National Forest.
3. ***What are the stated goals of the project?***
   The goals of this project were to remove an existing low head dam and construct rock weirs that will restore fish passage between Leech Lake and Portage Lake.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   By installing a series of rock weirs fish passage between Leech and Portage lakes is expected. Restoring this historic connection between lakes is expected to improve genetic diversity and reproduction of

game fish in Portage Lake and restore the natural annual stream flows that support a healthy aquatic and riparian ecosystem. By removing the low head dam and managing the lake at a lower level (6 in) than recent years shoreline erosion is expected to decrease.

5. ***Were measures of restoration success identified in plans?*** *Yes*
   If yes, list specific measurements.
   Restoration of connectivity and hydrologic function**.**
6. ***Are plan Sets available?*** **Yes** ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   A watershed and site vicinity map were provided along with plans for the rock weir and Soo Line bridge construction.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Using a series of rock weirs to allow for fish passage after a low head dam removal is an industry standard in MN and has a history of success. Erosion control measures were used including a floating silt curtain. A dewatering plan was required by the USFS before construction.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   The original grant was awarded in 2012, unfortunately the federal government shutdown and a high-water year prevented the project from being constructed within the timeframe of the grant. The project manager and partners re-applied and were awarded the grant in 2015.
9. ***In what ways did alterations change the proposed project outcome?***
   The only effects of these changes were to the timeline of project completion.

Site Assessment

Field Review Date: **5/28/2019**

Field Visit Attendees: Gina Quiram (DNR Ecological and Water Resources, Restoration Evaluation Specialist), Anna Varian (Stantec Site Assessor), Todd Tisler (USFS Project Manager), Steve Mortensen (Leech Lake Band of Ojibwe Department of Resource Management), Bill Evarts (DNR Fisheries), and Craig Taylor (USFS Project Engineer)

10. ***Surrounding Landscape Characteristics:***
    The stream flows through a broad valley with a wide floodplain consisting primarily of forest.
11. ***Site Characteristics:***
    a. ***Soil Series:***
       The primary soil type in the project area is typic borosaprist-bowstring association, this is a hydric soil, frequently flooded consisting of organic material.
    b. ***Topography:***
       Portage Creek flows through a broad valley with a wide floodplain.

c. Hydrology:

Portage Creek (M-146-006) is a four mile connection between Leech Lake (11020301) and Portage Lake (11020400). The project area drains 15.9 square miles and is primarily forested with little development.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

Common riparian plant communities were present. Lake Sedges and horsetails were dominant with raspberries present. A few non-native mulleins were present on site. The only portions of the project that received seeding was the approach used by the construction equipment and stockpile areas. These areas were seeded at 12 pounds/acre with a mix of: perennial ryegrass (40%), Indian grass (15%), and Canada wild rye (15%) Dacotah switchgrass (15%) and bison big bluestem (15%).

e. Vegetation B: Meander Search Species List (as appropriate for site)

Click here to enter text.

12. *Is the plan based on current science?* Yes

Using a series of rock weirs to allow for fish passage after a low head dam removal is an industry standard in MN and has a history of success.

13. List indicators of project goals at this stage of project:

The low head dam has been removed and fish passage looks possible. Attempts were made to conduct a fishery survey downstream of the weirs however otters destroyed the nets preventing completion of the survey. Lowering the water levels of Portage Lake were expected to help reduce ice damage to the shoreline and properties, this expectation would be difficult to measure.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes. The low head dam was removed and the installation of rock weirs in its place will allow fish passage and restore natural hydrology.

15. Are corrections or modifications needed to achieving proposed goals?

No.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

The only future steps planned for the project area is beaver management, if beaver decide to obstruct flow in Portage Creek the USFS will take management steps. The USFS also plans to continue pursuing connectivity throughout the forest.

17. Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.

No, removal of the low head dam and fish passage barrier has only improved habitat at that location and access to habitat for migratory fish.

18. Are follow-up assessments needed? Explain.

No, the project is stable with fish passage possible.

19. Additional comments on the restoration project.

This project was completed as part of a larger effort to restore connectivity on Portage Creek. Receiving funds for this project helped the USFS apply for and receive funds from the USFWS for an additional project to remove an old box culvert downstream of the dam. The culvert was replaced by a bridge allowing for a natural channel and reducing issues with debris blockage at that location.

The U.S. Forest Service partnered with multiple other agencies to accomplish everyone's goal of restoring connectivity in the watershed. This project was supported by the DNR, Midwest Glacial Lakes Partnership, Leech Lake Band of Ojibwe, and residents around the lake. Community meetings were held prior to implementation of the project and while there was some hesitation from lakeshore owners regarding lake levels the project team has heard no complaints since completion.
During construction of the weirs the design engineer was onsite and directed placement of each boulder to ensure proper construction. The engineer indicated no movement of boulders has occurred since construction. The spacing between the weir boulders will allow for fish passage and the deep pools below the weirs provide resting areas for migrating fish.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    Using a series of rock weirs to allow for fish passage after a low head dam removal is an industry standard in MN and has a history of success. Additionally, the fact that the design engineer was onsite during construction directing placement of each boulder provides confidence that the project was constructed as designed. Sufficient pre-design data was collected including hydrology report, cross-section geometry, flow recurrence intervals, sediment analysis, and bankfull elevations and flows.
23. ***Site Assessor(s) Conducting Review:***
    Anna Varian, Stantec.

Appendix A: Site maps, Project plans or Vegetation tables

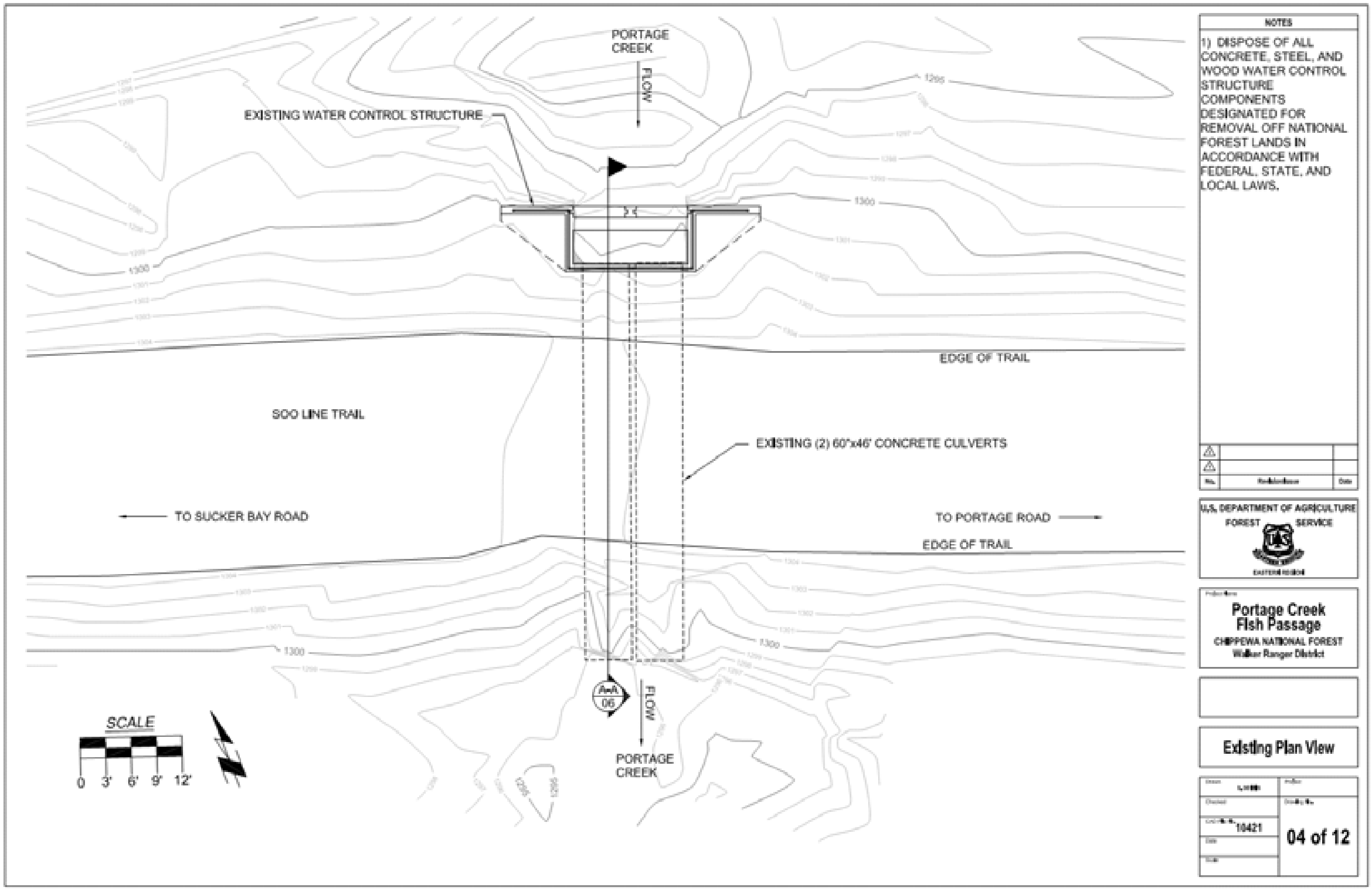


Figure 23-1 Construction plans sheet 4 of 12, existing conditions.

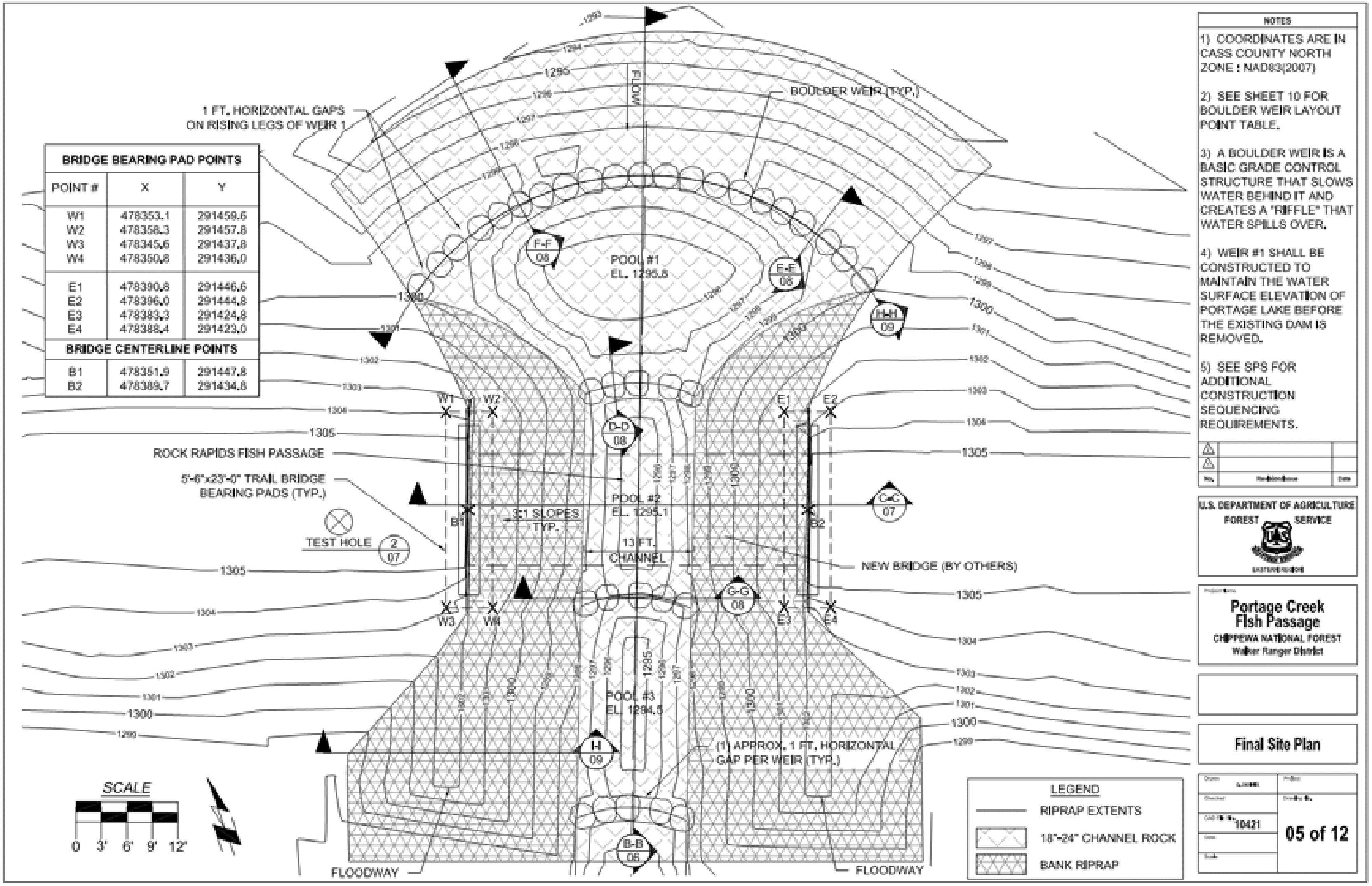


Figure 23-2 Construction plans sheet 5 of 12, project design.

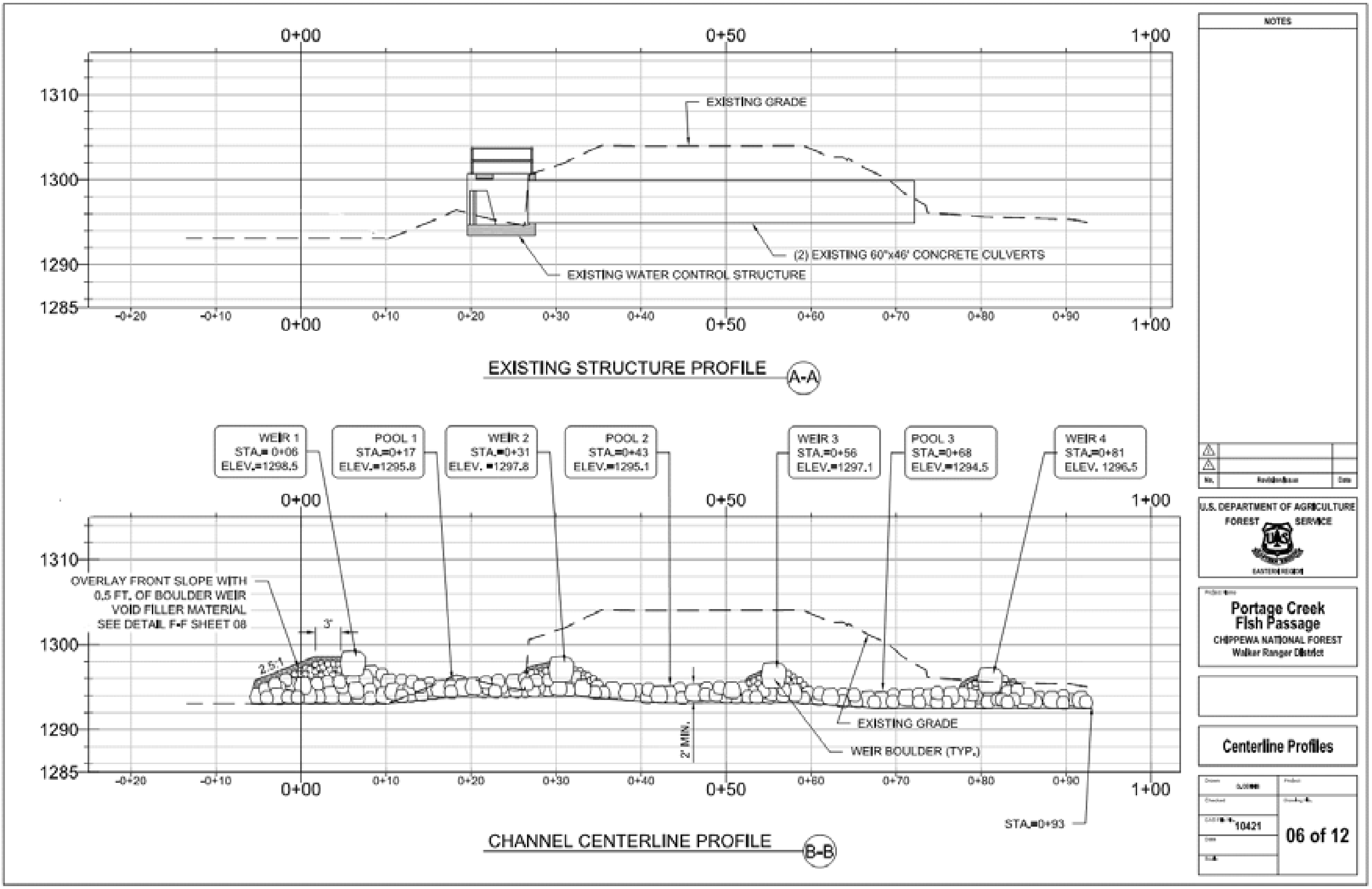


Figure 23-3 Construction plans page 6 of 12, existing and proposed profiles.

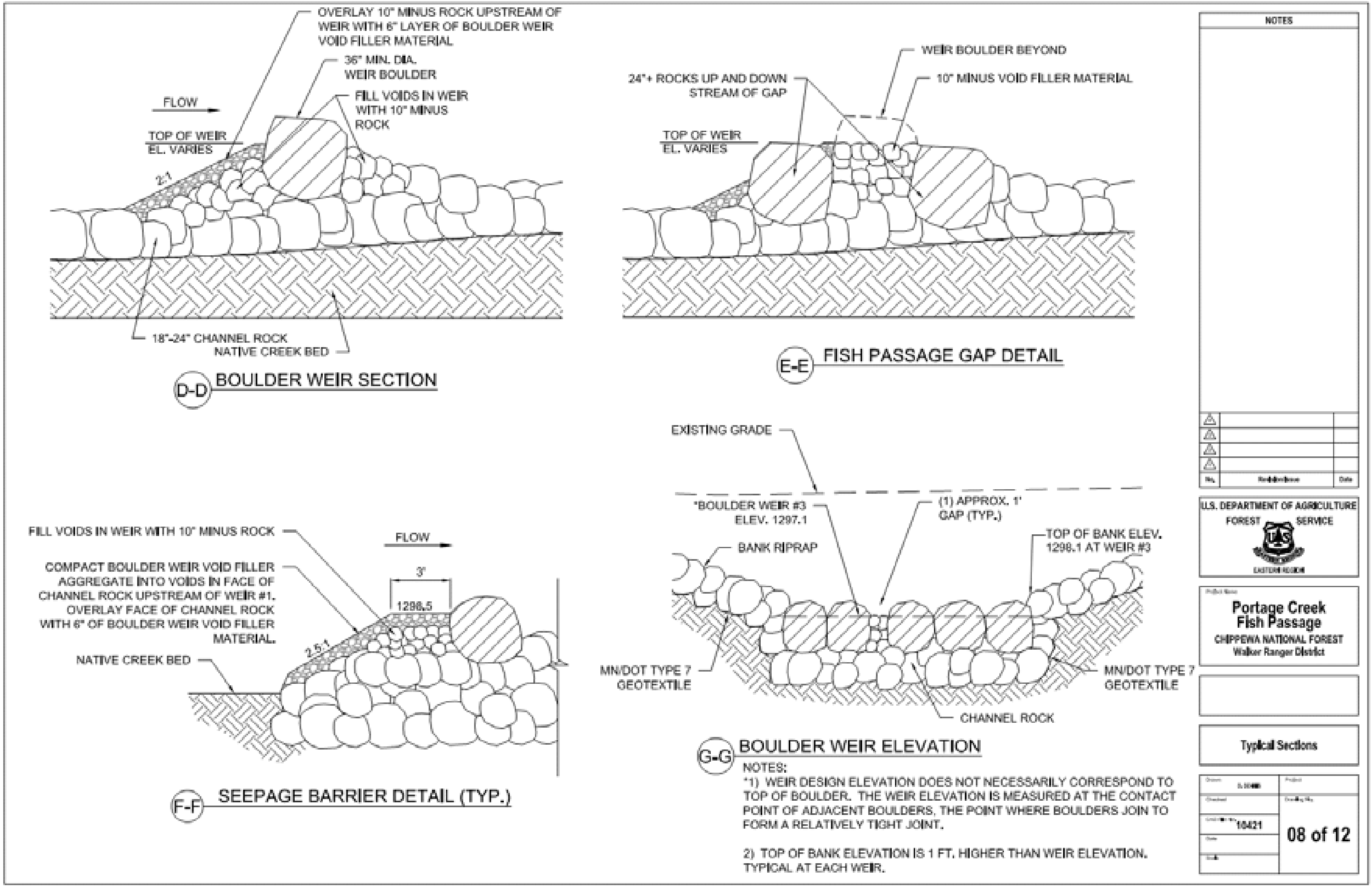


Figure 23-4 Construction plans page 8 of 12, details.

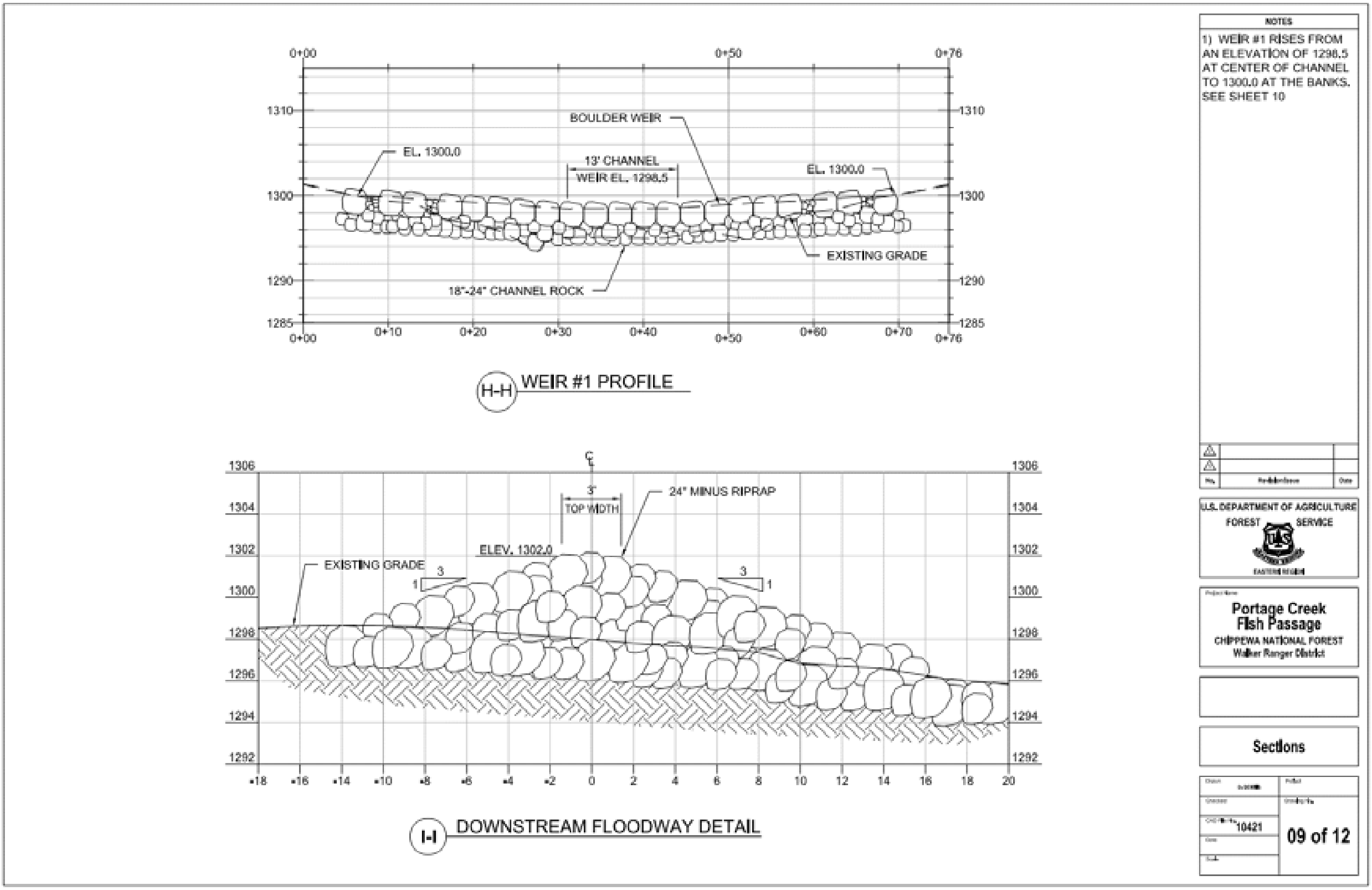
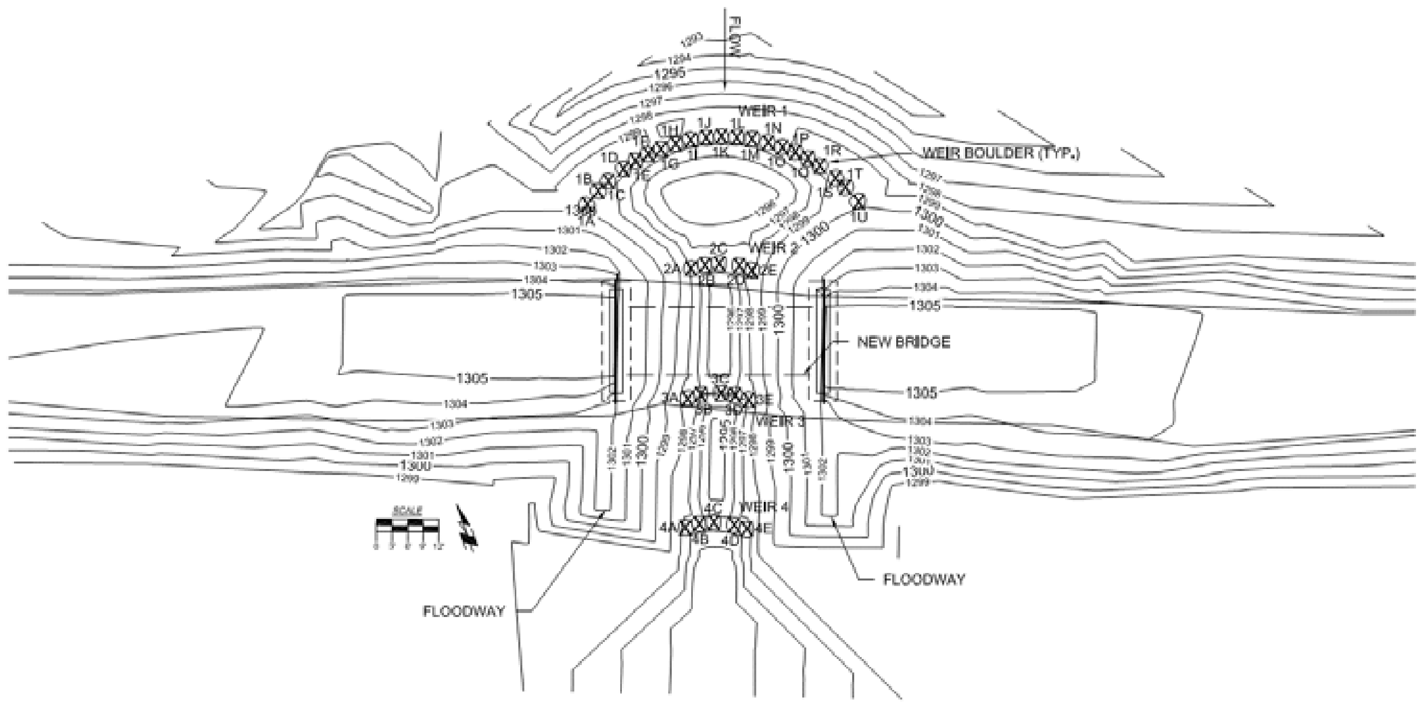


Figure 23-5 Construction plans page 9 of 12, additional details.



BOULDER WEIR LAYOUT PLAN POINT TABLE

POINT #	X	Y	ELEVATION - TOP OF WEIR	POINT #	X	Y	ELEVATION - TOP OF WEIR
1A	478355.0	291474.5	1300.0	1L	478386.8	291477.4	1298.5
1B	478358.1	291476.3	1299.8	1M	478389.5	291476.1	1298.5
1C	478360.5	291477.4	1299.6	1N	478392.0	291474.5	1298.7
1D	478364.1	291478.8	1299.4	1O	478394.4	291472.8	1298.9
1E	478366.7	291479.5	1299.2	1P	478396.5	291470.9	1299.1
1F	478369.5	291479.9	1299.1	1Q	478398.4	291469.0	1299.2
1G	478372.1	291480.1	1298.9	1R	478400.1	291466.9	1299.4
1H	478375.1	291480.1	1298.7	1S	478402.2	291463.7	1299.6
1I	478378.1	291479.8	1298.5	1T	478403.5	291461.4	1299.8
1J	478381.1	291479.3	1298.5	1U	478404.9	291458.0	1300.0
1K	478384.0	291478.5	1298.5				

POINT #	X	Y	ELEVATION - TOP OF WEIR	POINT #	X	Y	ELEVATION - TOP OF WEIR
2A	478370.2	291456.2	1297.8	4A	478352.9	291409.4	1296.5
2B	478372.9	291456.1	1297.8	4B	478355.5	291409.2	1296.5
2C	478375.5	291455.5	1297.8	4C	478358.2	291408.6	1296.5
2D	478379.1	291453.8	1297.8	4D	478361.7	291406.9	1296.5
2E	478381.1	291452.2	1297.8	4E	478363.8	291405.2	1296.5
3A	478361.3	291432.9	1297.1				
3B	478364.0	291432.7	1297.1				
3C	478367.7	291431.7	1297.1				
3D	478370.2	291430.4	1297.1				
3E	478372.3	291428.8	1297.1				

NOTES

1) COORDINATES ARE IN CASS COUNTY NORTH ZONE : NAD83(2007)

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Portage Creek Fish Passage
CHIPPEWA NATIONAL FOREST
Walker Ranger District

Boulder Weir Elevations

10421

10 of 12

Figure 23-6 Construction plans page 10 of 12, boulder placement details.

Table 23-1 Plants observed during field visit.

Scientific Name	Common Name	Observed Abundance	Species Planted/Seeded	Species Status
Equisetum cf. arvense	Field horsetail	Common	No	Native
Tanacetum vulgare	Tansy	Rare	No	Non-native Control
Bromus inermis	Smooth brome	Common	No	Non-native
Solidago gigantea	Giant goldenrod	Rare	No	Native
Elymus canadensis	Canada wildrye	Common	Yes	Native
Rubus idaeus cf. var. idaeus	Red raspberry	Rare	No	Native
Verbascum thapsus	Common mullein	Rare	No	Non-native
Carex lacustris	Common lake sedge	Abundant	No	Native

Appendix B: Site Photographs

Photo 23-1 Upstream view of the Portage Lake dam prior to removal.

Photo 23-2 Downstream view from the Portage Lake dam prior to removal.

Photo 23-3 View from Soo Line Trail looking upstream at topmost boulder weir on Portage Creek, taken 5/28/2019.

Photo 23-4 View from Soo Line Trail looking downstream at pool below one of the boulder weirs on Portage Creek, taken 5/28/2019.

Photo 23-5 View of topmost weir and spaces between weir for fish passage, taken 5/28/2019.

Photo 23-6 Project partners discussing the outcomes of the work on the bridge installed over the riffles to maintain access to the snowmobile trail that previously ran over the dam, taken 5/28/2019.

24) Rat Root River Log Jam Removal

Project Background

Project Name: Rat Root Log Jam Removal

Project Site: Rat Root River

Township/Range Section: Township 68N, 69N Range 23W, 24W Section 11, 6

Project Manager / Affiliated Organization: Pam Tomevi, Koochiching County SWCD

Fund: OHF - CPL ***Fiscal Year Funds:*** FY 11, FY 12, and FY 16

Project Start Date: April 2011

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Treatment Phase

County: Koochiching

Primary Activity: Stream/River Enhancement

Project Size: 18.5 miles

Project Completed: June 2019

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Remove channel-spanning log jams from the Rat Root River using hand tools and labor.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Due to the nature of the project, there are limited plans, records of project decisions, and prescription worksheets available. A report developed by an outside consultant prior to the project identified log jam removal as one treatment to improve walleye spawning habitat on the Rat Root River.
3. ***What are the stated goals of the project?***
   The stated goal of the project was to remove large, channel-spanning log jams along a 15-mile stretch of the Rat Root River to provide better access for walleye migration to spawning habitat on the river. The project was later expanded to an 18.5-mile stretch with additional funds in next phases of the project.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   A reduction in the number of channel-spanning log jams in the Rat Root River is expected to have a positive impact on walleye spawning.
5. ***Were measures of restoration success identified in plans?*** No
   If yes, list specific measurements.

Click here to enter text.

6. ***Are plan Sets available?*** No ***Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   Click here to enter text.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Log jams were removed using labor and hand tools. Wood was either burned on-site, hauled off-site, or placed outside of the floodprone area adjacent to the river. Removing wood from rivers and streams was historically a common practice. The manner in which the project was completed appears to provide the lowest amount of disturbance possible.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Over the course of the project, winter removal of the wood material was the preferred method because jams could more easily be accessed and removed through and on top of the ice.
9. ***In what ways did alterations change the proposed project outcome?***
   Changing from summer to winter removal had minimal impact on the proposed project outcome; however, implementation became more efficient and effective with less disturbance.

Site Assessment

Field Review Date: 9/17/2019

Field Visit Attendees: Eric Olson, Koochiching County SWCD; Jeff Tillma, MNDNR; Gina Quiram, MNDNR, Jason Ellman, Rainy Lake Sportfishing Club; Mark Pranckus, Cardno

10. ***Surrounding Landscape Characteristics:***
    Primarily forested with minimal road crossings. A few scattered shallow lakes and open marshes.
11. ***Site Characteristics:***
    a. ***Soil Series:***

       Bowstring and Fluvaquents, loamy, 0 to 2 percent slopes, frequently flooded

       Morcom-Thistledew complex, 0 to 6 percent slopes

       Haystore-Kooch complex, 1 to 8 percent slopes

       Ratroot-Dora complex, 0 to 1 percent slopes

       Kooch-Kab-Ratroot complex, 0 to 4 percent slopes

       Kab-Ratroot complex, 0 to 2 percent slopes

Kab-Kooch complex, 0 to 4 percent slopes

Dora and Terric Haplohemist soils, kab catena, 0 to 1 percent slopes

Rifle-Rifle, ponded, complex, 0 to 1 percent slopes

Greenwood-Greenwood, ponded, complex, 0 to 1 percent slopes

Greenwood-Lobo complex, 0 to 1 percent slopes

Quetico, bouldery-Insula, bouldery-Rock outcrop complex, 3 to 18 percent slopes

b. Topography:
Generally flat.

c. Hydrology:
Perennial stream with relatively low gradient.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:
Not applicable

e. Vegetation B: Meander Search Species List (as appropriate for site)
Not applicable.

12. ***Is the plan based on current science?*** Portions
Removal of wood from rivers has been a historical practice that has resulted in negative impacts to river processes and habitat. However, the project information references a 2008 study completed by Sandy Verry, a hydrologist with Ellen River Partners that evaluated the historical increase in log jam abundance and size in the Rat Root River. The project was completed with an understanding of the historical change in the river in both habitat and spawning fish abundance.

13. List indicators of project goals at this stage of project:
During the assessment, we floated several miles of the project area in a canoe. No large channel spanning log jams were observed and only few locations where there is currently a log jam that could develop into a larger log jam. Although one major storm event could result in the formation of a large log jam, it appears that most of the locations where large log jams could form have been addressed.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?
Yes. It will likely take periodic maintenance to remove log jams before the jams develop back into channel blocking jams again.

15. Are corrections or modifications needed to achieving proposed goals?
None at this point. Koochiching County SWCD and their local partner, the Rainy Lake Sportfishing Club appear to be engaged in monitoring the sites and addressing small log jams before they become larger, more problematic ones.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?
Future and long term management seem practical and reasonable. One opportunity to improve project goals or outcomes may be to develop a simple monitoring/log jam scoring system to identify which log jams should be removed and which log jams should remain in the river because they don't current pose a risk to forming larger jams and they are currently providing habitat. One concern with the management of wood in rivers is that it alters an important element to many physical, biological, and

chemical processes of a river. In the end, it is likely a balance between providing the benefits of wood in rivers and preventing large jams from forming that reduce walleye spawning habitat and fish migration.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No. No current or planned activity likely detracts from the existing or potential habitat of the Rat Root River. Proactively removing all wood from the river to prevent jams from forming would have negative consequences to the overall habitat of the Rat Root River.
18. ***Are follow-up assessments needed? Explain.***
    No.
19. ***Additional comments on the restoration project.***
    Reviewing the historical and pre-project information and photos, it definitely appears that large log jams were impacting the river. Monitoring of walleye spawning at locations through the project area and upstream of where jams have been removed would be interesting to further understand the impact of the project.
    This project was started in 2011 and log removal has been an on-going activity to prevent large log jams from forming.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Minimally meet proposed outcomes
    Confidence of outcome determination:
    Medium
22. ***Provide explanation of reason(s) for determination.***
    Wood is a dynamic and important component to rivers because it contributes to both biotic and abiotic processes. Many rivers in Minnesota and across the country are missing the wood component that contributes to the ecological integrity and geomorphic stability because it was typically removed for anthropocentric uses of the river or has a riparian zone that doesn't contribute wood inputs anymore. In many cases removing wood from a river wouldn't be an action that would promote improved habitat.

    A combination of the Rat Root River's low-gradient nature and a significant flood of record in 1950 caused an overabundance of log jams that overtime reduced fish passage and increased sedimentation of historical walleye spawning riffles. The ultimate goal of the project was to improve walleye migration further up the Rat Root River so they can get access to areas where spawning historically occurred. Removing large, channel-spanning log jams initially accomplishes this goal and facilitated the additional work completed by Koochiching County and the Rainy Lake Sportfishing Club. The installation of spawning riffles throughout the Rat Root River depended on removing the log jams that impacted fish passage and gravel and hard substrate in riffles. Log jams can create and maintain riffles that can likely be used by walleyes for spawning and provides habitat (cover, areas of decreased velocity) for walleye fry as they migrate back the Rat Root River and into Rainy Lake. The balance will be preventing log jams from block fish passage, but allowing enough wood in the river to support the goal of increased fish passage leading to increased spawning, which ultimately leads to increased walleye populations in Rainy Lake.

23. ***Site Assessor(s) Conducting Review:***

Mark Pranckus, Cardno

Appendix A: Site maps, Project plans or Vegetation tables

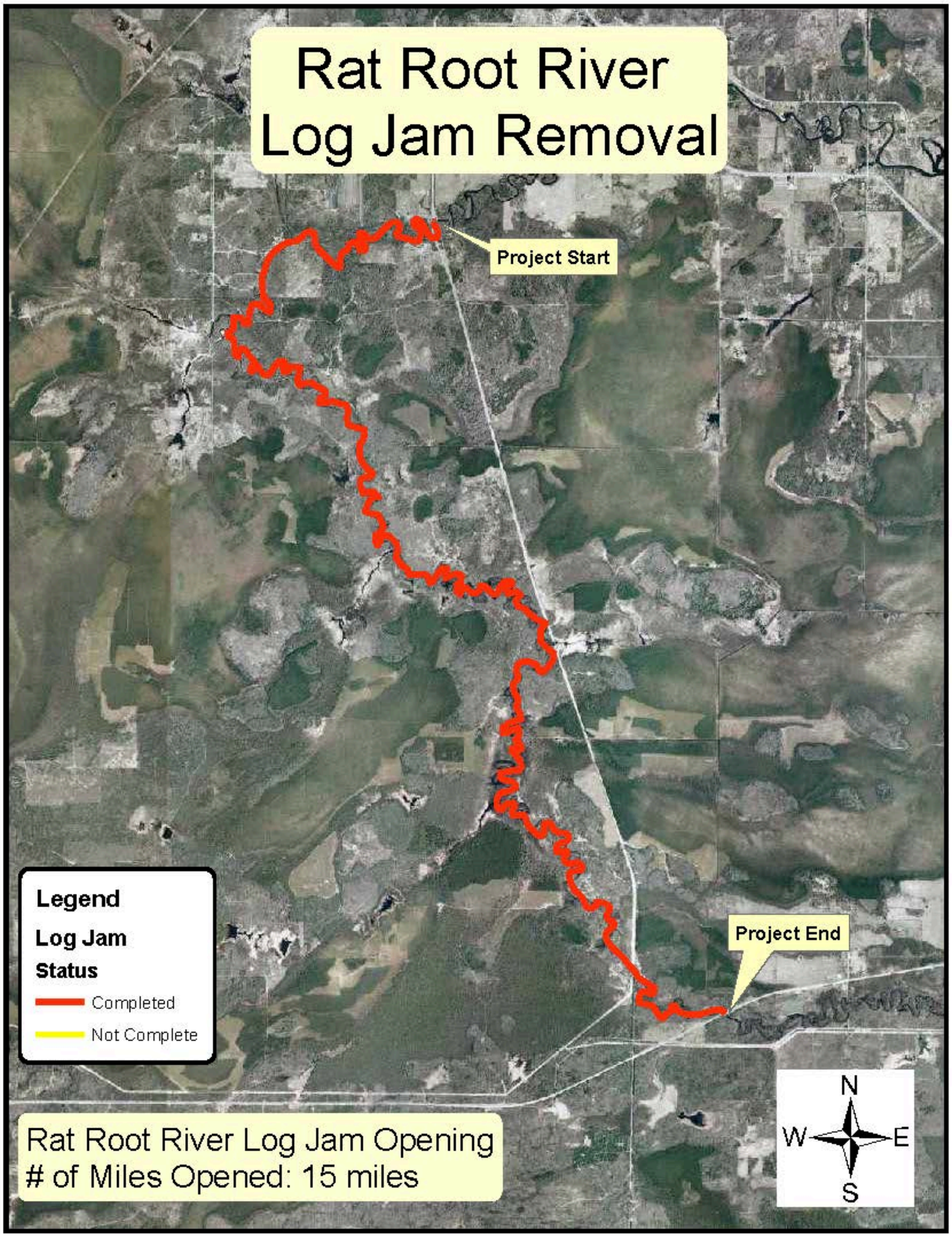


Figure 24-1 Project map of 15 miles of log jam removal completed on the Rat Root River. An additional 3.5 miles was added to the project total in later phases of the project in 2016. Map provided by Koochiching County SWCD.

Appendix B: Site Photographs

Photo 24-1. Example of a large, channel-spanning log jam in the Rat Root River prior to removal. Photo provided by Koochiching County SWCD.

Photo 24-2. Example of a large, channel-spanning log jam in the Rat Root River prior to removal. Photo provided by Koochiching County SWCD.

Photo 24-3. Example of a large, channel-spanning log jam on the Rat Root River prior to removal. To provide scale of the jam, notice the two individuals standing on top of the jam in the middle of the channel. Photo provided by Koochiching County SWCD.

Photo 24-4. Example of the Rat Root River post-log jam removal. Photo is a match to Photo 24-3 above. Photo provided by Koochiching County SWCD.

25) Rat Root River Sediment Control

Project Background

Project Name: Rat Root River Sediment Control

Project Site: Rat Root River

Township/Range Section: Township 70N Range 23W Section 23, 26

Project Manager / Affiliated Organization: Pam Tomevi, Koochiching County SWCD

Fund: OHF - CPL ***Fiscal Year Funds:*** FY 12, FY 16

Project Start Date: Summer 2012

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase

County: Koochiching

Primary Activity: Stream/River Enhancement

Project Size: 900 feet

Project Completed: October 2013

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Stabilize two eroding banks on the Rat Root River in the Black Bay of Rainy Lake using bioengineering methods including:
   - Stone toe rip rap
   - Coir log bank protection
   - Native shrub and plant installation
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   One seven page construction plan set with project plan view, cross sections, and construction details.

   Two follow-up summaries containing narratives of what work was completed, photo documentation, a list and quantities of woody material installed, and maintenance completed.

3. ***What are the stated goals of the project?***
   The stated goal of the project was to reduce bank erosion at two priority sites along the Rat Root River using bioengineering principles as an alternative to hard-armored bank.
4. ***What are the desired outcomes of achieving the stated goals of the project?***

The desired outcome is to have stable banks that are not actively eroding.

5. ***Were measures of restoration success identified in plans?*** No
   If yes, list specific measurements.
   Click here to enter text.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   Rat Root River Streambank Protection, Koochiching County, Minnesota. 2013 seven-page construction plan set developed by North Central Minnesota SWCD's Joint Powers Board. The plan set includes typical construction details, estimated quantities, material sizing, plan views, and cross sections.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   The eroding banks were stabilized using a stone toe approximately 3 to 8 feet wide with a depth of approximately 2 feet. The stone toe was installed up to a normal pool elevation and the use of stone to hard armor the bank was kept to a minimum. On systems where water levels fluctuate rapidly and stay elevated or lower because of control via a dam or other structure, it is common to use a stone toe for stabilizing the base of the slope. Water level changes in conjunction with stream flow or wave action limits the ability of perennial vegetation to keep the toe stable.

   Above the stone toe, the banks were excavated and coir logs were installed and backfilled with soil. Native woody shrubs were installed between and on top of the coir logs. The combination of coir logs and native woody material is a common bioengineering practice used as an alternative to hard armoring banks and shorelines. The 2013 summary document provided by a project partner referenced that the design used information in the NRCS Field Office Technical Guide to design and implement the project (Streambank and Shoreline Protection – 580; Critical Area Planting – 342, and Tree/Shrub Establishment – 612). Additionally, NRCS Technical Supplement 14L of the Streambank Soil Bioengineering Handbook was used to support the implementation of the re-vegetation efforts. Locally-sourced plant material (live stakes) were used for the project.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes

   No significant alterations were made during project implementation; however, greater than 95% of the woody material was re-planted in the second growing season following construction because a prolonged high water period during the summer of 2014.

9. ***In what ways did alterations change the proposed project outcome?***
   Re-planting woody vegetation and re-seeding the areas drowned out by high water kept the project within the proposed outcome. If an effort wasn't made to re-plant, the project would likely be less successful because the vegetation would not be as fully developed or would be compromised of shallow-rooted annual species.

Site Assessment

Field Review Date: 9/17/2019

Field Visit Attendees: Eric Olson, Koochiching County SWCD; Jeff Tillma, MNDNR; Gina Quiram, MNDNR, Jason Ellman, Rainy Lake Sportfishing Club; Mark Pranckus, Cardno

10. ***Surrounding Landscape Characteristics:***
    Primarily forested with minimal road crossings. A few scattered shallow lakes and open marshes.
11. ***Site Characteristics:***
    a. ***Soil Series:***

       Kab-Ratroot complex, 0 to 2 percent slopes

       Ratroot-Dora complex, 0 to 1 percent slopes

    b. ***Topography:***
       Generally flat.
    c. ***Hydrology:***
       Large river with relatively low gradient. Water level is influenced by downstream dam on Rainy Lake. Water level elevations are seasonally-controlled with typical drawdowns occurring during the winter to provide spring flood storage.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
       Riparian plant community. Primarily dominated by woody shrubs, sedges, grasses with minimal forb cover. Both sites are located at areas actively managed for remote (boat-access only), primitive camping so around camp sites, vegetation becomes dominated more by cool season grasses. Invasive species are less than 10% of the total vegetative cover.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
       See Table 25-1 in Appendix A for species observed during the site visit.
12. ***Is the plan based on current science?*** Yes
    The project used common and accepted bioengineering practices. Stone use was kept to a minimum height and appropriate for the project goal of stabilizing eroding banks. Based on the location of the sites, river current and wind-driven fetch, the project appears to have selected and implemented the appropriate bioengineering practice.

13. ***List indicators of project goals at this stage of project:***
    Little to no erosion was observed during the site visit. The banks are becoming well-established with woody vegetation that will provide long-term bank stabilization.

14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Yes. Koochiching County has demonstrated a commitment to establishing the vegetation on the site by hiring a vegetation management contractor to perform maintenance on both the bank stabilization sites and to manage the camp sites to prevent users from negatively impacting the vegetation.
15. ***Are corrections or modifications needed to achieving proposed goals?***

None at this point. Koochiching County SWCD and their local partner, the Rainy Lake Sportfishing Club appear to be engaged in monitoring the sites and working with the vegetation contractor.

16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

    Future and long term management seem practical and reasonable. The sites will continue to be operated as public camping sites and it appears that the County will continue to manage the vegetation to promote bank stability. If water levels were to increase due to either a change in management at the Rainy Lake dam or prolonged flooding, the vegetation could potentially be reduced due to greater inundation making the bank more susceptible to erosion; however, maintaining a diversity of species that can withstand a wide range of environmental conditions will be key.

    The challenge that may impact or limit long-term project success is overuse and "self-management" by camp site users. Maintaining signage that identifies the stabilization project and providing information on the accepted practices should help to prevent loss of vegetation due to human activities. The signage can also be an opportunity for outreach and education on the importance of bioengineering practices over hard armoring practices.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***

    No. No current or planned activity likely detracts from the existing or potential habitat that this project provides to the Rat Root River. Potential impacts to vegetation from campers will need to be monitored, but the project has features such as steps, piers, and designated access points that allow campers to use the Rat Root River. At some point in the future, woody vegetation may need to be trimmed to allow for a view of the river, but the planted species will respond positively to being cut back.

18. ***Are follow-up assessments needed? Explain.***

    No.

19. ***Additional comments on the restoration project.***

    It appeared that water levels on Rainy Lake were elevated at the time of the assessment so it's difficult to get a complete understanding on the amount of erosion that is occurring on banks of the Rat Root River in this section of the system. Based on observations and discussions with the Rainy Lake Sportfishing Club, these two sites had the worst erosion and were the highest priority. Koochiching County SWCD and the Rainy Lake Sportfishing Club appear to be supportive of this type of project and will pursue similar projects in the future.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***

    achieved the stated goals.

21. ***The project will:***

    Meet proposed outcomes

    Confidence of outcome determination:

Medium

22. ***Provide explanation of reason(s) for determination.***

    The eroding banks are currently stable. The vegetation is becoming well-established and the woody species will provide long-term stabilization as the coir fabric deteriorates. The selection of the bioengineering practice is appropriate for the site conditions. Because the sites are located at areas that have historically been public camp sites, there is the potential for foot traffic and camp user to negatively impact the vegetation. Continued future success will likely depend on some level of balance between existing vegetation and maintaining access points and vegetation height that meets the needs of campers.

23. ***Site Assessor(s) Conducting Review:***

    Mark Pranckus, Cardno

Appendix A: Site maps, Project plans or Vegetation tables

Figure 25-1 Project map indicating the locations of two bank stabilizations sites on the Rat Root River. Aerial photography is from July 2016 and provided by Google Earth (link http://www.google.com/earth/download/ge/).

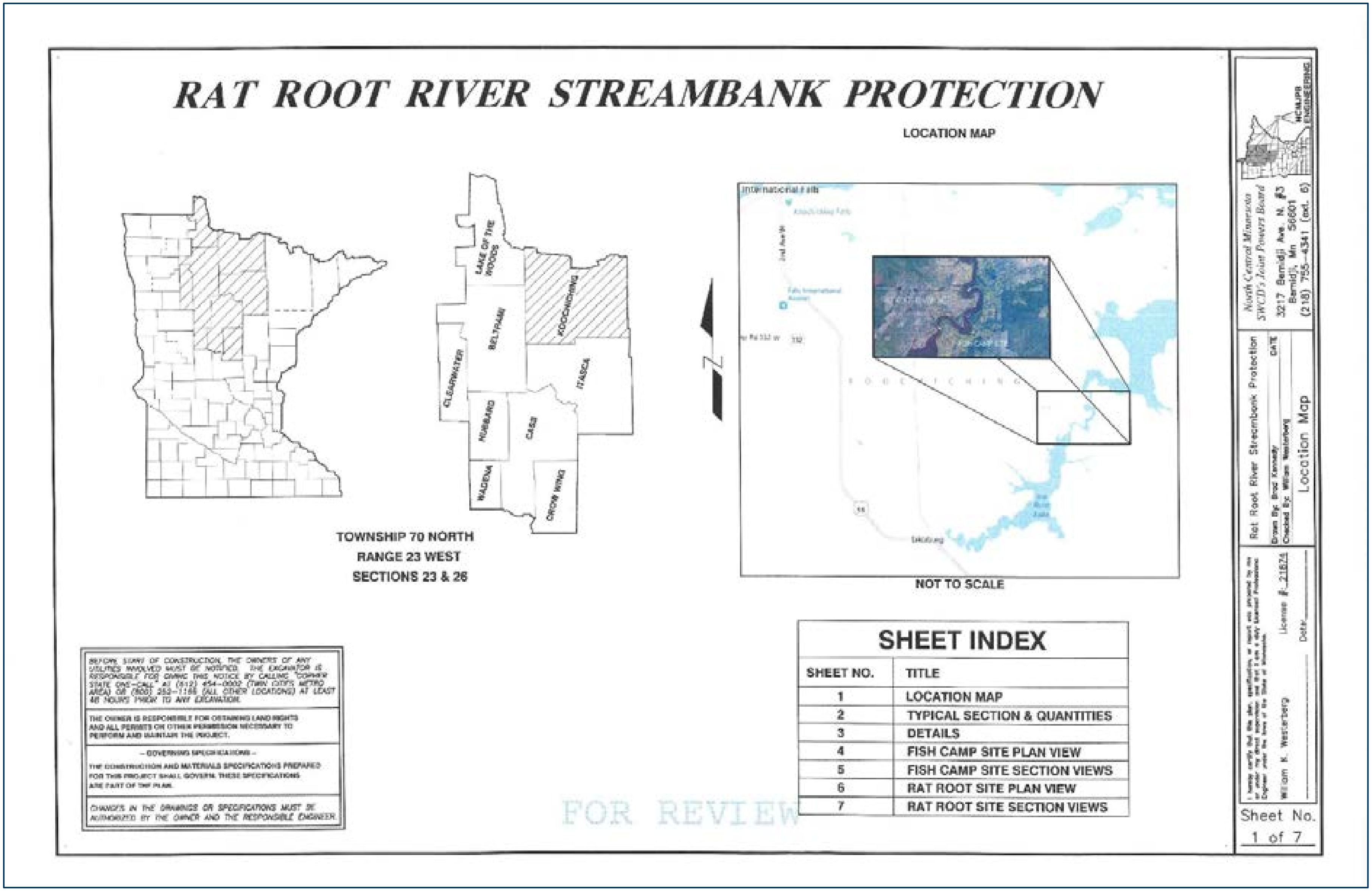


Figure 25-2. Sheet 1 of the construction plan set showing the project location of the two bank stabilization sites (Fish Camp and Picnic Site) on the Rat Root River.

EARTHWORK SUMMARY

		FISH CAMP SITE	RAT ROOT SITE	TOTAL
EXCAVATION	TOPSOIL	20 CY	10 CY	30 CY
	SUITABLE MATERIAL	90 CY	150 CY	240 CY
EMBANKMENT (EARTHFILL)	TOPSOIL	60 CY	55 CY	115 CY
	SUITABLE MATERIAL	85 CY	130 CY	215 CY
EMBANKMENT (EARTHFILL)	TOPSOIL BORROW (CV)	40 CY	45 CY	85 CY
	SUITABLE MATERIAL BORROW	0 CY	0 CY	0 CY

CY = CUBIC YARD
(CV) = COMPACTED VOLUME

ESTIMATED QUANTITIES

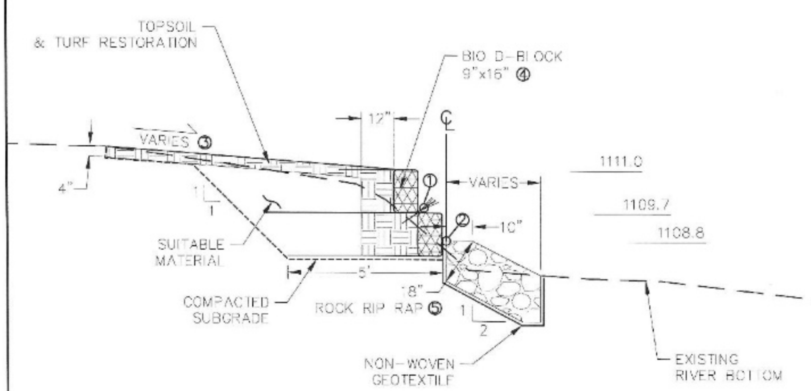
ITEM	UNIT	QUANTITY FISH CAMP SITE	QUANTITY RAT ROOT SITE	TOTAL
Mobilization	Lump Sum	0.5	0.5	1
Clearing	Acre	0.1	0.5	0.6
Grubbing	Acre	0.1	0.5	0.6
Seeding	Sq. Yd.	205	150	355
Excavation	Cu. Yd. (P)	110	160	270
Topsoil Borrow (CV)	Cu. Yd.	40	45	85
Rock Rip Rap	Cu. Yd.	70	70	140
Bio D-Block	Lin. Ft.	400	502	902
Steps System 1	Unit	1	0	1
Steps System 2	Unit	0	1	1
Steps System 3	Unit	0	1	1

(P) – Planned Quantity

ROCK RIP RAP GRADATION

% PASSING BY WEIGHT	ROCK SIZE (IN.)
100	18
75	12
50	9
10	3

TYPICAL SECTION



① WILLOWS TO BE FURNISHED AND INSTALLED BY OWNER AFTER COMPLETION OF PROJECT.
② TOP OF ROCK ELEVATION 1108.8 AT CENTERLINE LOCATION.
③ SEE PLAN VIEW AND SECTION VIEWS FOR LIMIT OF TURF RESTORATION
④ SEE INSTALLATION PROCEDURE AND MATERIALS DETAIL ON SHEET 3
⑤ SEE ROCK RIP RAP GRADATION

TYPICAL SECTION DETAILS & ELEVATIONS APPLY TO BOTH SITES

North Central Minnesota SWCD's Joint Powers Board
3217 Bemidji Ave. N. #3
Bemidji, Mn 56601
(218) 755-4341 (ext. 6)
NCMJPB ENGINEERING

Rat Root River Streambank Protection
Drawn By: Brad Kennedy
Checked By: William Westerberg
Typical Section & Quantities

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.
William K. Westerberg License #: 21874 Date:

Sheet No. 2 of 7

Figure 25-3. Sheet 2 of the construction plan set showing estimated material quantities and construction details for stone toe and coir log installation at bank stabilization sites on the Rat Root River.

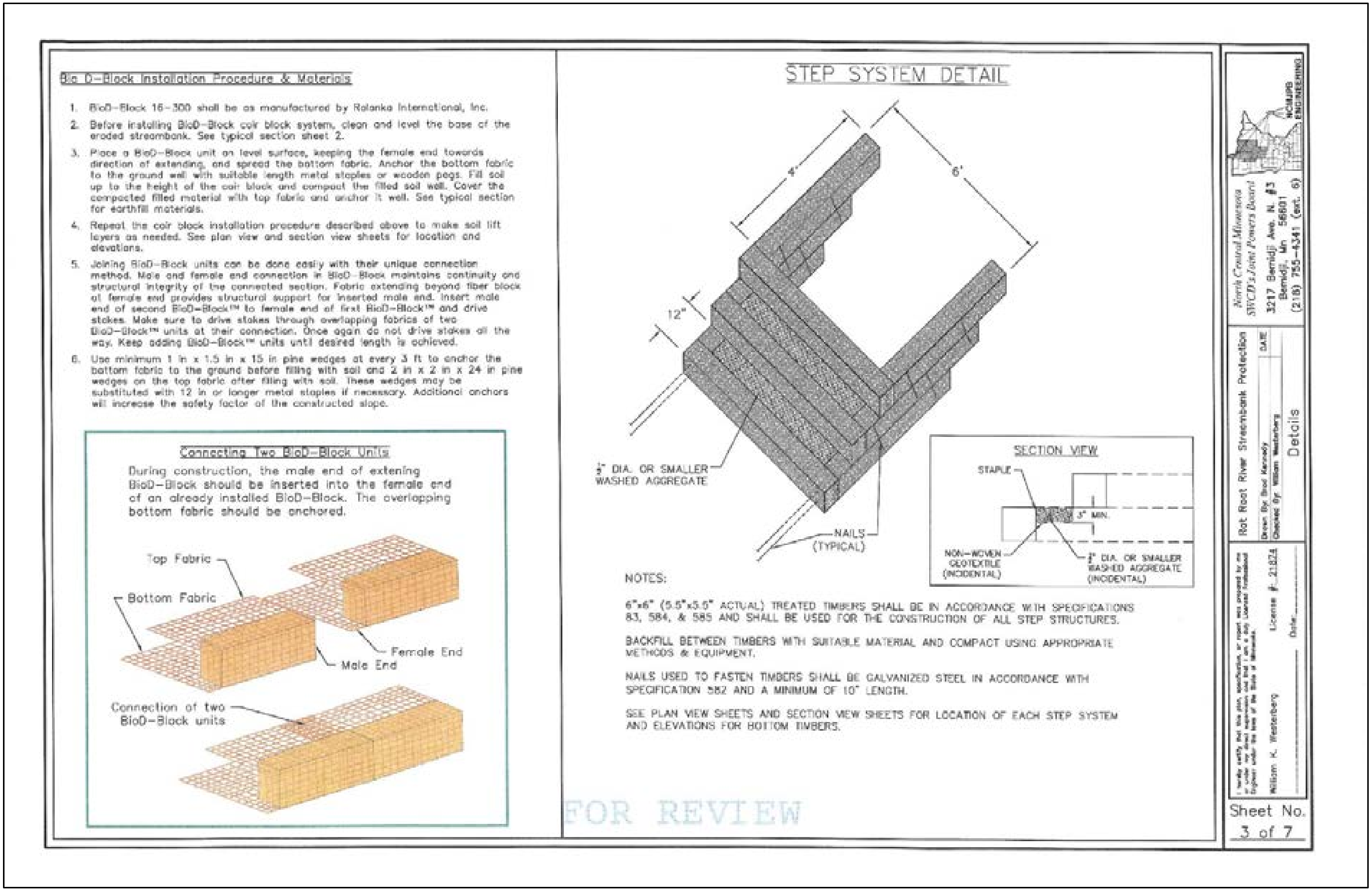


Figure 25-4. Sheet 3 of the construction plan set showing construction details for steps and the coir log installation at bank stabilization sites on the Rat Root River.

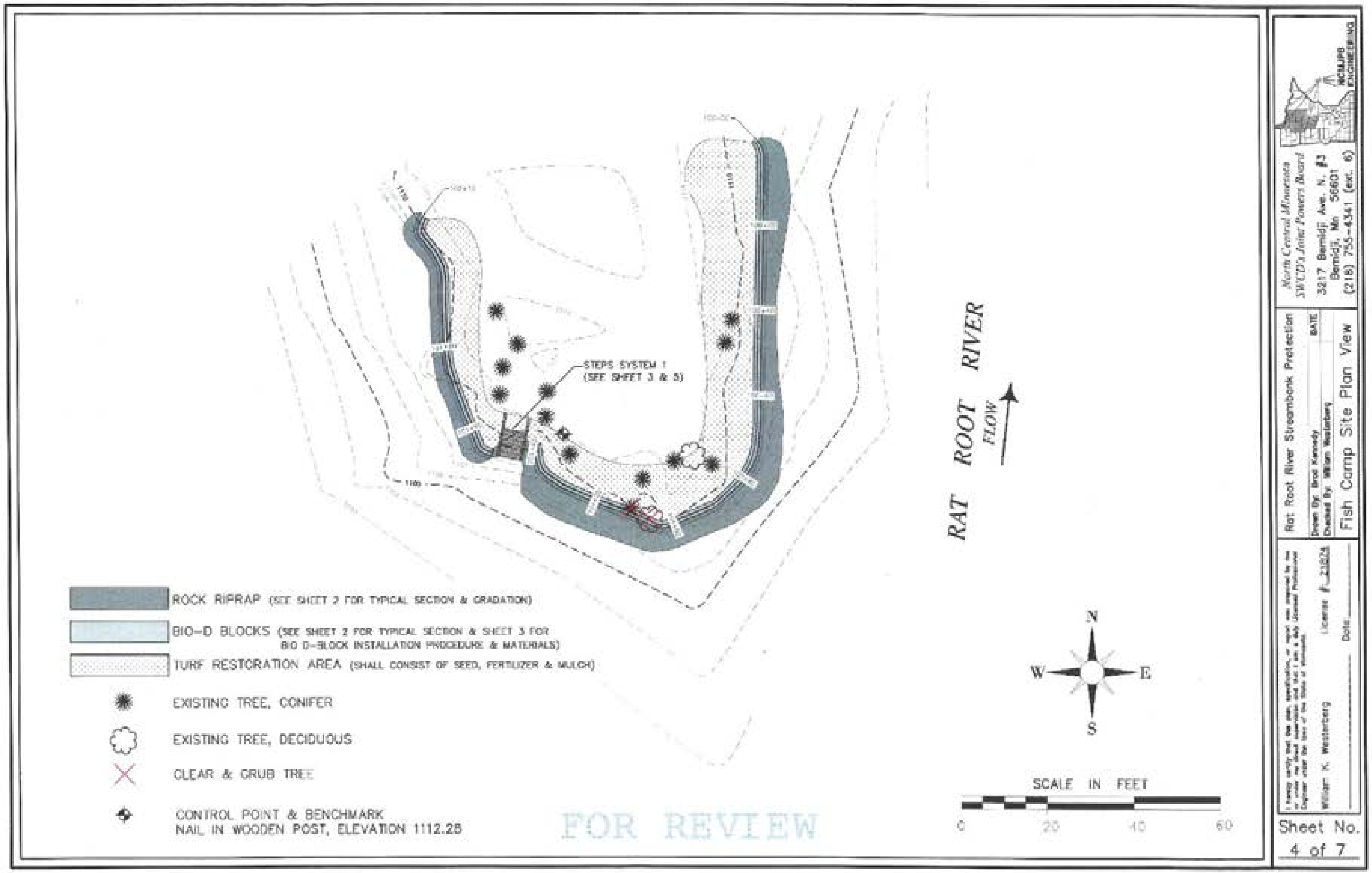


Figure 25-5. Sheet 4 of the construction plan set showing the plan view and treatment layout of the Fish Camp bank stabilization area on the Rat Root River.

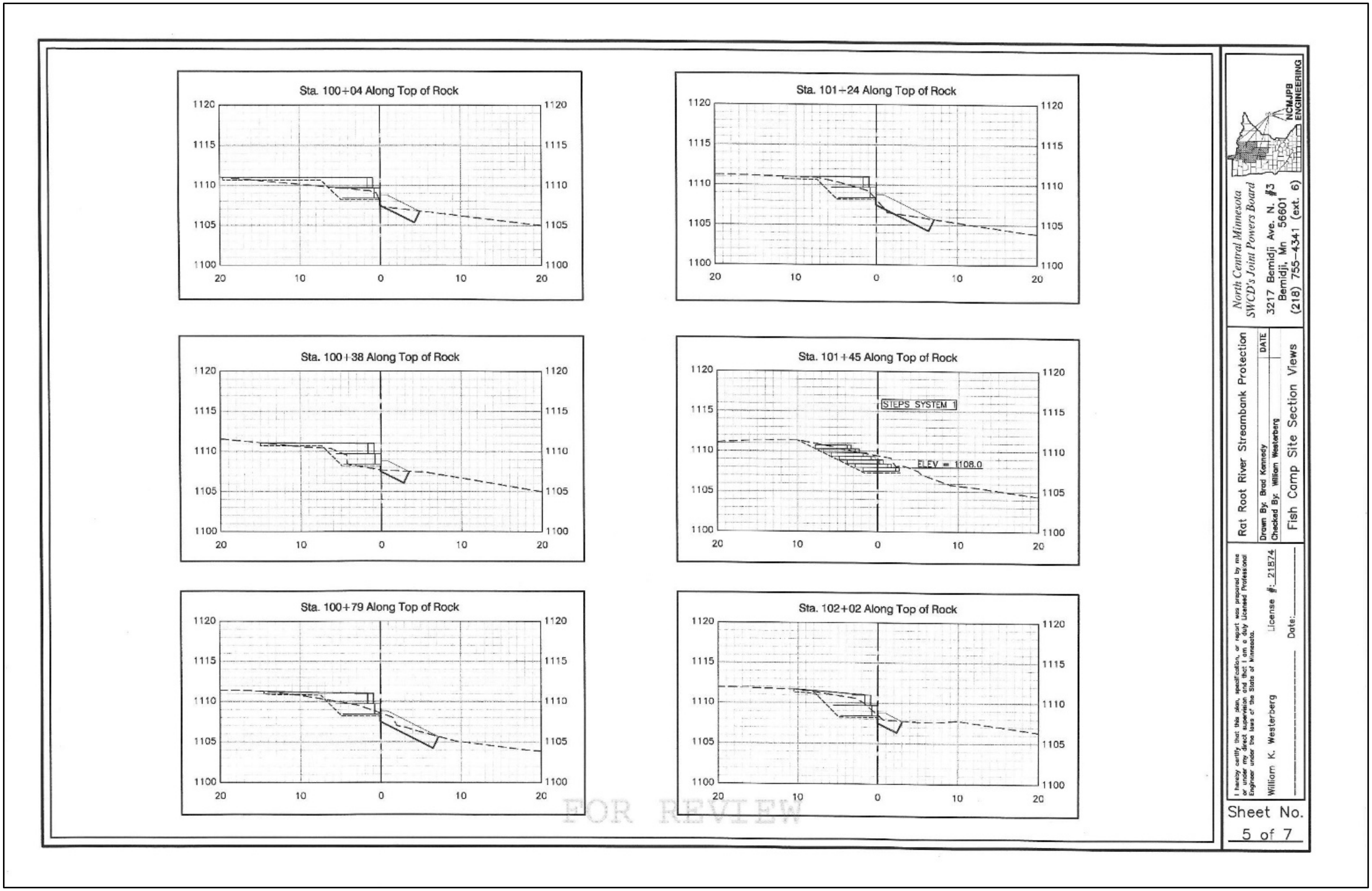


Figure 25-6. Sheet 5 of the construction plan set showing existing and proposed cross sections for the Fish Camp bank stabilization area on the Rat Root River

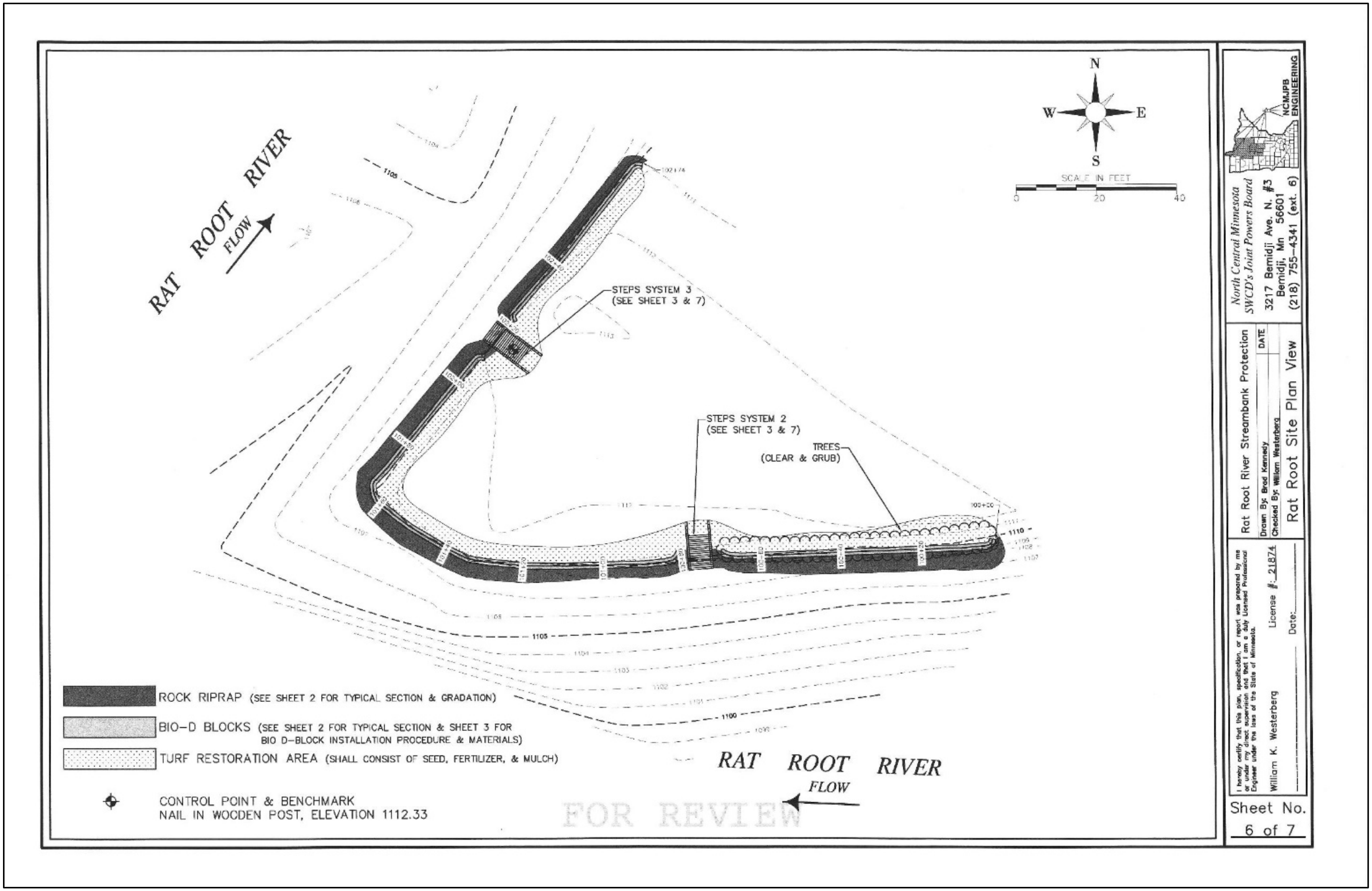


Figure 25-7. Sheet 6 of the construction plan set showing the plan view and treatment layout of the Picnic Site bank stabilization area on the Rat Root River.

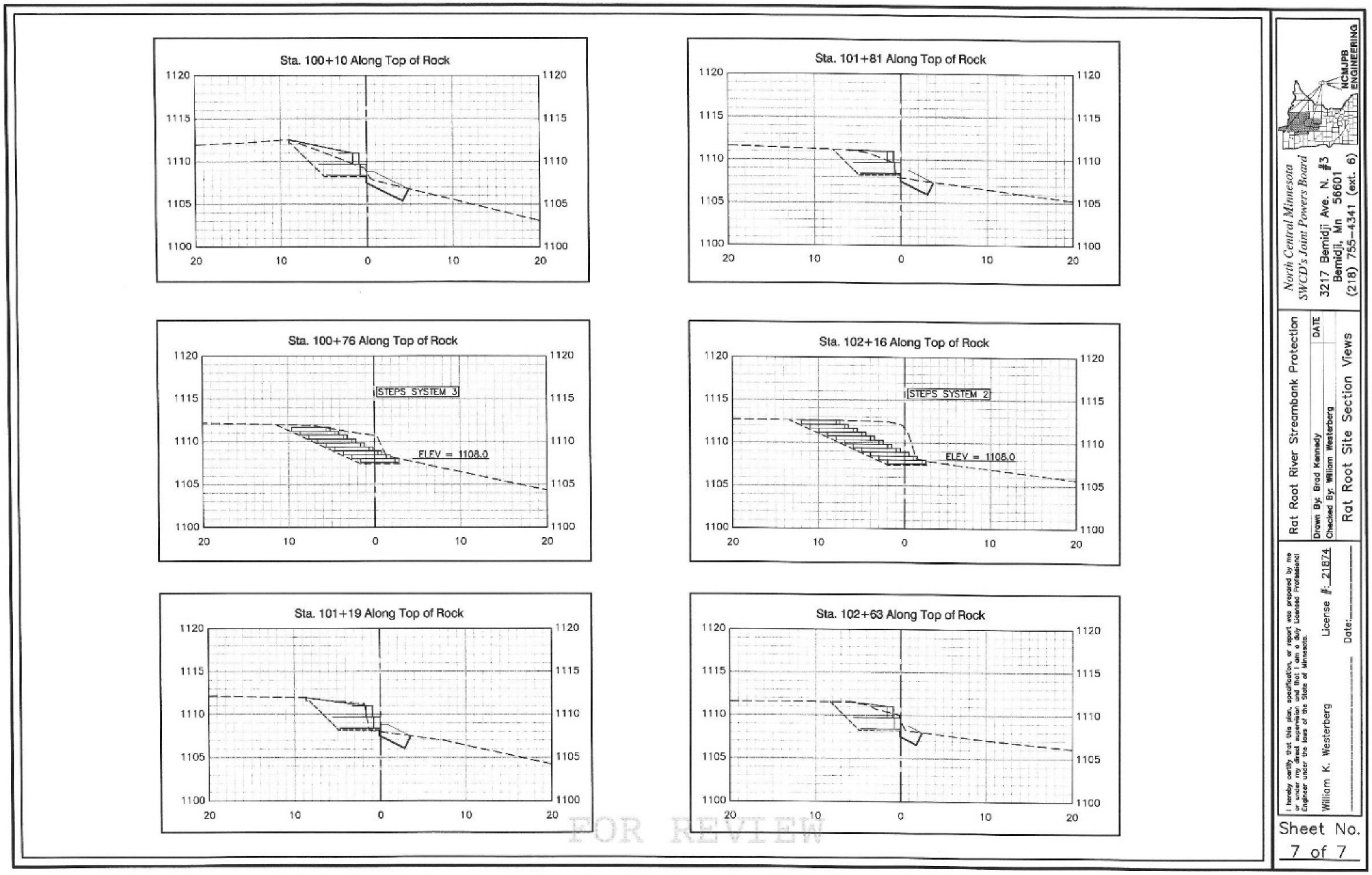


Figure 25-8. Sheet 7 of the construction plan set showing existing and proposed cross sections for the Picnic Site bank stabilization area on the Rat Root River.

Table 25-1. Results of meander survey through project area. Cover ranges were estimated visually. Meander survey occurred 9/17/19 by Mark Pranckus, Cardno. Meander times were 10:45 – 11:45.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Salix bebbii	Hybrid Willow	50-75%	Yes	Native
Populus deltoides	Eastern Cottonwood	1-5%	No	Native
Rosa blanda	Smooth Rose	1-5%	No	Native
Cornus sericea	Redosier Dogwood	10-25%	Yes	Native
Rubus strigosus	Wild Red Raspberry	5-10%	No	Native
Solidago gigantea	Giant Goldenrod	5-10%	Yes	Native
Melilotus officinalis	Sweet Clover	5-10%	No	Non-Native
Phalaris arundinacea	Reed Canary Grass	25-50%	No	Non-Native
Trifolium pratense	Red Clover	25-50%	No	Non-Native
Poa pratensis	Kentucky Bluegrass	10-25%	No	Non-Native
Cirsium arvense	Canada Thistle	1-5%	No	Non-Native
Amorpha fruticose	False Indigo Bush	10-25%	No	Native
Trifolium repens	White Clover	5-10%	No	Non-Native
Symphyotrichum firmum	Purplestem Aster	5-10%	Yes	Native
Phleum pratense	Timothy	1-5%	No	Non-Native
Geum aleppicum	Yellow Avens	5-10%	No	Native
Taraxacum officinale	Common Dandelion	1-5%	No	Native
Calamagrostis canadensis	Bluejoint	5-10%	Yes	Native
Oenothera biennis	Common Evening Primrose	0-1%	No	Native
Hypericum spp.	St. John's Wort	0-1%	No	Native/Non-Native
Persicaria lapathifolia	Curlytop Knotweed	1-5%	No	Native
Ranunculus acris	Tall Buttercup	5-10%	No	Native
Carex vulpinoidea	Fox Sedge	10-25%	Yes	Native
Typha angustifolia	Narrowleaf Cattail	5-10%	No	Native/Non-Native
Apocynum cannabinum	Indianhemp	5-10%	No	Native
Carex stricta	Tussock Sedge	10-25%	Yes	Native
Persicaria amphibia	Water Knotweed	1-5%	No	Native
Euthamia graminifolia	Flat-Top Goldentop	0-1%	Yes	Native
Achillea millefolium	Common Yarrow	0-1%	No	Native/Non-Native
Trifolium campestre	Field Clover	1-5%	No	Non-Native

Appendix B: Site Photographs

Photo 25-1. Example of the Fish Camp bank stabilization site on the Rat Root River in 2011 prior to construction. Photo provided by Koochiching County SWCD.

Photo 25-2. Example of the Fish Camp bank stabilization site in spring 2014 following construction in fall 2013. Photo provided by Ed Lombard, Rat Root River Enterprises, LLC.

Photo 25-3. Example of the Fish Camp bank stabilization site in summer 2019 following construction in fall 2013. Photo provided by Ed Lombard, Rat Root River Enterprises, LLC.

Photo 25-4. Example of the Picnic Site bank stabilization site in 2013 prior to construction. Photo provided by Ed Lombard, Rat Root River Enterprises, LLC.

Photo 25-5. Example of the Picnic Site bank stabilization site following construction in fall 2013. Photo provided by Ed Lombard, Rat Root River Enterprises, LLC.

Photo 25-6. Example of the Picnic Site bank stabilization site in summer 2019 following construction in fall 2013. Photo provided by Ed Lombard, Rat Root River Enterprises, LLC.

Photo 25-7. Example of rock toe and vegetated bank at the Fish Camp Site. Photo taken during site visit 9/18/2019.

Photo 25-8. Example of rock toe and vegetated bank at the Picnic Site. Photo taken during site visit 9/18/2019.

26) Rat Root River Spawning Riffles

Project Background

Project Name: Rat Root River Spawning Riffle Enhancement

Project Site: Rat Root River

Township/Range Section: Township 69N Range 24W Section 10, 11, 12

Project Manager / Affiliated Organization: Pam Tomevi, Koochiching County SWCD

Fund: OHF - CPL ***Fiscal Year Funds:*** FY 12, FY 16

Project Start Date: June 2012

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase

County: Koochiching

Primary Activity: Stream/River Enhancement

Project Size: 18.5 miles

Project Completed: June 2019

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Install modified Newberry riffles at six locations on the Rat Root River to enhance walleye spawning habitat.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   For each riffle, MNDNR provided a brief design memo that included the following information:
   - Background information on site selection
   - Typical drawing on modified Newberry Riffle
   - Site maps
   - Existing and proposed longitudinal profile and stream channel cross sections
   - A brief narrative on design rationale
   - Stone material quantities and specifications
3. ***What are the stated goals of the project?***
   The stated goal of the project improve riffle habitat and substrate quality for walleye spawning on the Rat Root River in areas that have been impacted due to sedimentation resulting from large, channel-spanning log jams.

4. ***What are the desired outcomes of achieving the stated goals of the project?***
The desired outcome is to increase the walleye spawning run abundance and success on the Rat Root River, which has declined since the 1930s. Walleye fry production in the Rat Root River will support a sustainable walleye fishery in downstream Rainy Lake.
5. ***Were measures of restoration success identified in plans?*** No
If yes, list specific measurements.
Click here to enter text.
6. ***Are plan Sets available?*** No ***Have project maps been created?*** No
If yes, provide in Appendix A and list Maps provided:
Riffle Designs for West Branch of the Rat Root River, Koochiching County, Minnesota. 2013 seven-page design document developed by Ellen River Partners that includes information on the location, longitudinal profile, cross section, and material quantities for Riffle No. 1 on the Rat Root River.

Riffle Designs for West Branch of the Rat Root River, Koochiching County, Minnesota. 2013 ten-page design document developed by Ellen River Partners that includes information on the location, longitudinal profile, cross section, and material quantities for Riffle No. 2 on the Rat Root River.

Riffle Designs for West Branch of the Rat Root River, Koochiching County, Minnesota. 2013 nine-page design document that developed by Ellen River Partners includes information on the location, longitudinal profile, cross section, and material quantities for Riffle No. 3 on the Rat Root River.

Riffle Designs for the Rat Root River, Koochiching County, Minnesota. 2018 nine-page design document developed by MNDNR Stream Habitat Specialist that includes information on the location, longitudinal profile, cross section, design narrative, and material quantities for riffles at the Galvin Line and County Rd. 98 locations on the Rat Root River.

Riffle Designs for the Rat Root River, Koochiching County, Minnesota. 2018 nine-page design document developed by MNDNR Stream Habitat Specialist that includes information on the location, longitudinal profile, cross section, design narrative, and material quantities for Riffle No. 6 on the Rat Root River.

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
Riffles were placed in straight sections of the Rat Root River typically downstream from a pool or outside bend feature that would promote deposition of the material and maintain the riffle feature. Riffles were constructed to a bankfull width. Riffle height and dimensions considered individual site and channel dimensions. Stone material sizing changed over the course of implementation to reflect substrates found naturally in the section of the Rat Root River and considered stream power and the ability to transport substrate material.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***

Yes

Boulders at the crest of each riffle stopped being used in the later riffle installations (Galvin Line, County Rd 98, and Riffle No. 6) due to a lack of stream power to transport smaller, more context-appropriate material.

A secondary location to Riffle No. 6 was added at the project access point because warm weather at the end of winter and the loss of ice limited the ability of the contractor to complete the work at the original location.

9. ***In what ways did alterations change the proposed project outcome?***
   The alterations had limited changes to the proposed outcome. Using smaller rock that matches the existing material found on-site likely enhances the aesthetics of the project because the riffle will appear more natural and less like an actual project occurred there.

   Creating a secondary riffle upstream of the original location for Riffle No. 6 adds more spawning habitat and was placed in an appropriate location within the stream pattern for a riffle. However, the additional location is more of an enhancement than an alteration that significantly changes the project outcome in a positive or negative manner.

Site Assessment

Field Review Date: 9/17/2019

Field Visit Attendees: Eric Olson, Koochiching County SWCD; Jeff Tillma, MNDNR; Gina Quiram, MNDNR, Jason Ellman, Rainy Lake Sportfishing Club; Mark Pranckus, Cardno

10. ***Surrounding Landscape Characteristics:***
    Primarily forested with minimal road crossings. A few scattered shallow lakes and open marshes.
11. ***Site Characteristics:***
    a. ***Soil Series:***

       Bowstring and Fluvaquents, loamy, 0 to 2 percent slopes, frequently flooded

       Morcom-Thistledew complex, 0 to 6 percent slopes

       Haystore-Kooch complex, 1 to 8 percent slopes

       Ratroot-Dora complex, 0 to 1 percent slopes

       Kooch-Kab-Ratroot complex, 0 to 4 percent slopes

       Kab-Ratroot complex, 0 to 2 percent slopes

       Kab-Kooch complex, 0 to 4 percent slopes

       Dora and Terric Haplohemist soils, kab catena, 0 to 1 percent slopes

       Rifle-Rifle, ponded, complex, 0 to 1 percent slopes

       Greenwood-Greenwood, ponded, complex, 0 to 1 percent slopes

       Greenwood-Lobo complex, 0 to 1 percent slopes

Quetico, bouldery-Insula, bouldery-Rock outcrop complex, 3 to 18 percent slopes

b. ***Topography:***

Generally flat.

c. ***Hydrology:***

Perennial stream with relatively low gradient.

d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***

Not applicable

e. ***Vegetation B: Meander Search Species List (as appropriate for site)***

Not applicable.

12. ***Is the plan based on current science?*** Yes

The project considered a combination of factors: river geomorphology, equipment access, and historical fish use in identifying locations for the riffle installations. Riffle dimensions were based on bankfull channel dimensions. Material sizing was modified throughout the project to match the existing conditions and maximize material stability.

13. List indicators of project goals at this stage of project:

During the assessment, we floated several miles of the project area in a canoe. The Rat Root River was at or near bankfull stage. It was difficult to identify and observe the riffles. However, at most locations we were able to confirm that stone substrate was still in place by probing with a canoe paddle. Additionally, there were no indications that bank erosion or any other negative impact to the project were was occurring at each riffle location.

The local fisheries manager reported that walleye eggs have been found in egg baskets placed at the riffles prior to spawn and walleyes have been observed during electrofishing on the riffles. It's unclear if walleyes are using the specific constructed riffles because spawning hasn't been visually observed yet due to water conditions. There is a thought that walleyes may be spawning elsewhere and the eggs may be rolling down river with the current and the riffles are catching the rolling eggs. MN DNR has observed walleye fry in tow nets, but it too difficult to determine the level of success based on the constructed riffles.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes. The riffle project combined with the previous and on-going log jam removal project will allow for walleye to access this portion of the Rat Root River and to find potentially available spawning habitat. Due to the low gradient nature of the Rat Root River, water level management on Rainy Lake, and sediment inputs due to land use, riffles will need to be monitored to ensure they do not become covered by sediment.

15. Are corrections or modifications needed to achieving proposed goals?

None at this point. Koochiching County SWCD and their local partner, the Rainy Lake Sportfishing Club appear to be engaged in monitoring the sites and potentially pursuing opportunities to do similar type of projects if these riffles indicate an improvement in the walleye spawning abundance and subsequent fry production.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

Future and long term management seem practical and reasonable. The desired project goal is fairly straightforward: to improve walleye spawning habitat. The MN DNR plans to continue to monitor the sites to determine if adult walleye using the riffles and whether fry are hatching from the riffles. Collecting this information can help refine the project goals and outcomes such as determining where in the Rat Root River system walleye spawning habitat or success is limited.

Potential challenges or limitations include the influence of water levels on Rainy Lake limiting the availability of riffle habitat, especially on the more downstream riffles. For example, it was noted that in typical years, Rainy Lake water levels will be low in the spring and discharge and water elevations at the County Rd 98 riffle will be determined by snow melt and precipitation. If there's a wet spring that results in elevated water levels on Rainy Lake, there's the potential for the County Rd 98 riffle to be backwatered and the available substrate maybe temporarily covered with sediment during a critical time for walleye use. A second challenge or limitation is continued sedimentation due to land use. Koochiching County and Rainy Lake Sportfishing Club should consider pursuing opportunities within the watershed that reduce sedimentation to the Rat Root River.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***

    No. No current or planned activity likely detracts from the existing or potential habitat of the Rat Root River.

18. ***Are follow-up assessments needed? Explain.***

    No.

19. ***Additional comments on the restoration project.***

    Reviewing the project documentation and conducting interviews with the project partners during the assessment, it appears that partnership between Koochiching County SWCD, MNDNR, and Rainy Lake Sportfishing Club is extremely productive and valuable. The Rainy Lake Sportfishing Club seems to be extremely engaged and willing to take ownership in improving walleye populations in the Rat Root River and Rainy Lake system and want technical assistance from MNDNR and the SWCD.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***

    achieved the stated goals.

21. ***The project will:***

    Minimally meet proposed outcomes

    Confidence of outcome determination:

    Medium

22. ***Provide explanation of reason(s) for determination.***

    The goal was to increase the amount of walleye spawning habitat in the Rat Root River. At this point, the project has met that goal because there is now at least six locations with riffles that walleyes can use during the spawning run. Whether the project meets the desired outcomes of increasing the number of walleye spawning in the Rat Root River and whether walleye spawning translates to both increased walleye fry production and walleye abundance in Rainy Lake are yet to be seen. The project has specific project goals and desired outcomes that could be measured by targeted, periodic monitoring during and after the spawning season. Continuing to collect this information would help to determine the success of the project and potentially indicate other factors that may be limiting walleye abundance in Rainy Lake.

23. ***Site Assessor(s) Conducting Review:***

    Mark Pranckus, Cardno

Appendix A: Site maps, Project plans or Vegetation tables

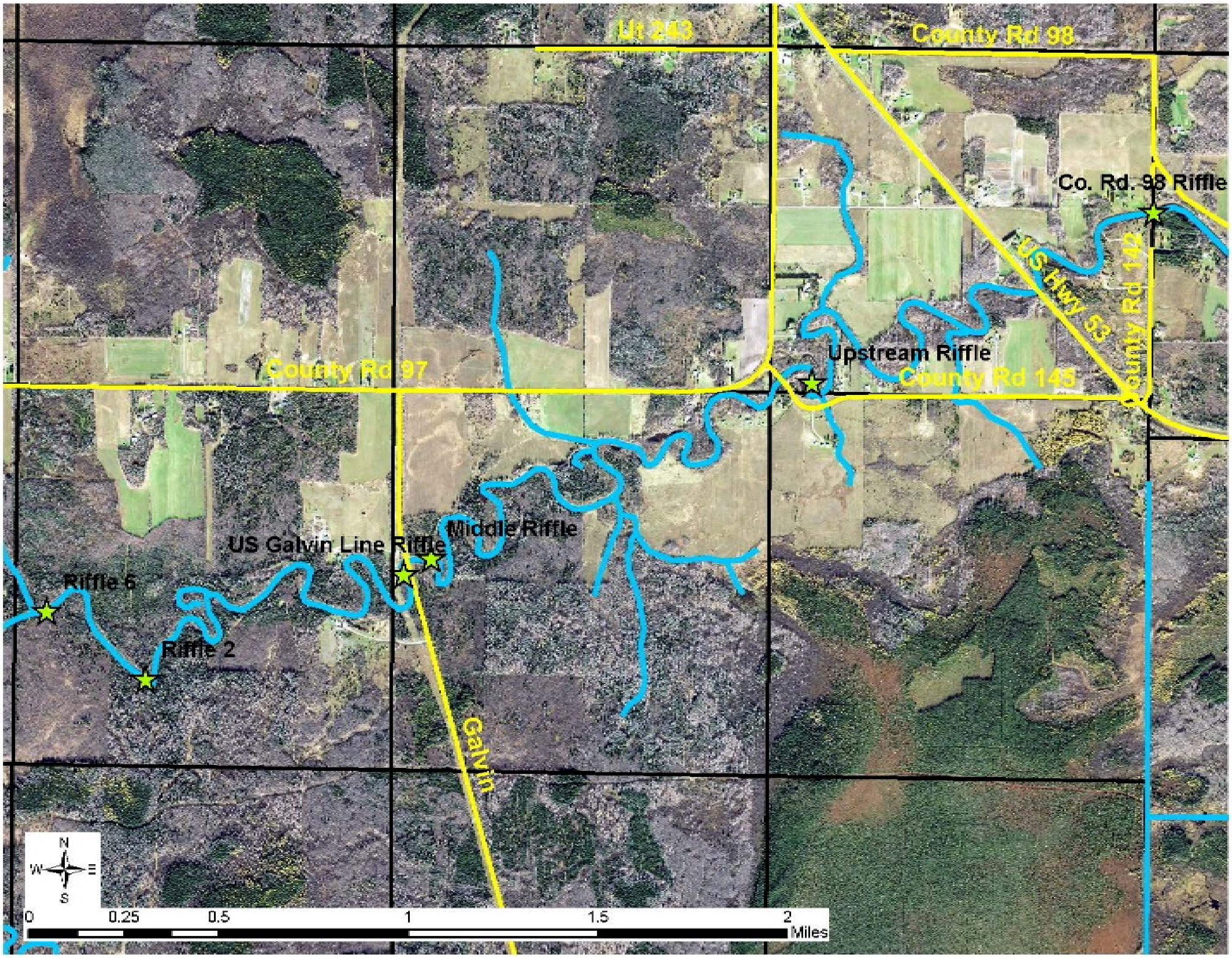


Figure 26-1 Project map of approximately 5 miles of the Rat Root River indicating the location of six constructed riffles for walleye spawning habitat. Map provided by Koochiching County SWCD.

Appendix B: Site Photographs

Photo 26-1. Example of riffle construction of Riffle No. 1 during winter 2013. Excavator and skid steer are operating on a frozen Rat Root River. Photo provided by Koochiching County SWCD.

Photo 26-2. Example of the stone material installed at the County Rd 98 riffle location in 2018. Material is similar to what is naturally found in the adjacent areas of the Rat Root River. Photo provided by Koochiching County SWCD.

Photo 26-3. Example of installation of the riffle material at the County Rd 98 riffle in 2018. Stone material is installed to the bankfull elevation and throughout the channel width. Photo provided by Koochiching County SWCD.

Photo 26-4. Example of a completed constructed riffle. The stone extends to the bankfull width and is throughout the entire channel. Photo provided by Koochiching County SWCD.

Appendix C: Project documents provided by MN DNR

Design report developed by MNDNR for the three riffle locations (Riffle No. 6, Galvin Line riffle, County Rd 98 riffle). Similar material was developed for the first three riffles designed in 2013 by Ellen River Partners.

Riffle Designs for the Rat Root River

Jeff Tillma MNDNR

1/8/2018

The Rainy Lake Sportfishing Club is partnering with the Koochiching County SWCD to construct two walleye spawning riffles in the Rat Root River, International Falls, MN. Three riffles have previously been constructed between 2013 and 2016 and the current proposal incorporates design and material improvements. Site selection was based on existing river geomorphology, equipment access, public accessibility and a desire to locate a site farther downstream than previous sites. The first site is off Galvin Line Bridge and has good public access. The second site is off CR 98, downstream of Hwy 53 and utilizes an old road bed. Walleye are known to spawn on this site and has good access for the public and equipment (Figure 1). Riffles will be constructed following using previous designs which used a modified Newberry design (Figure 2).

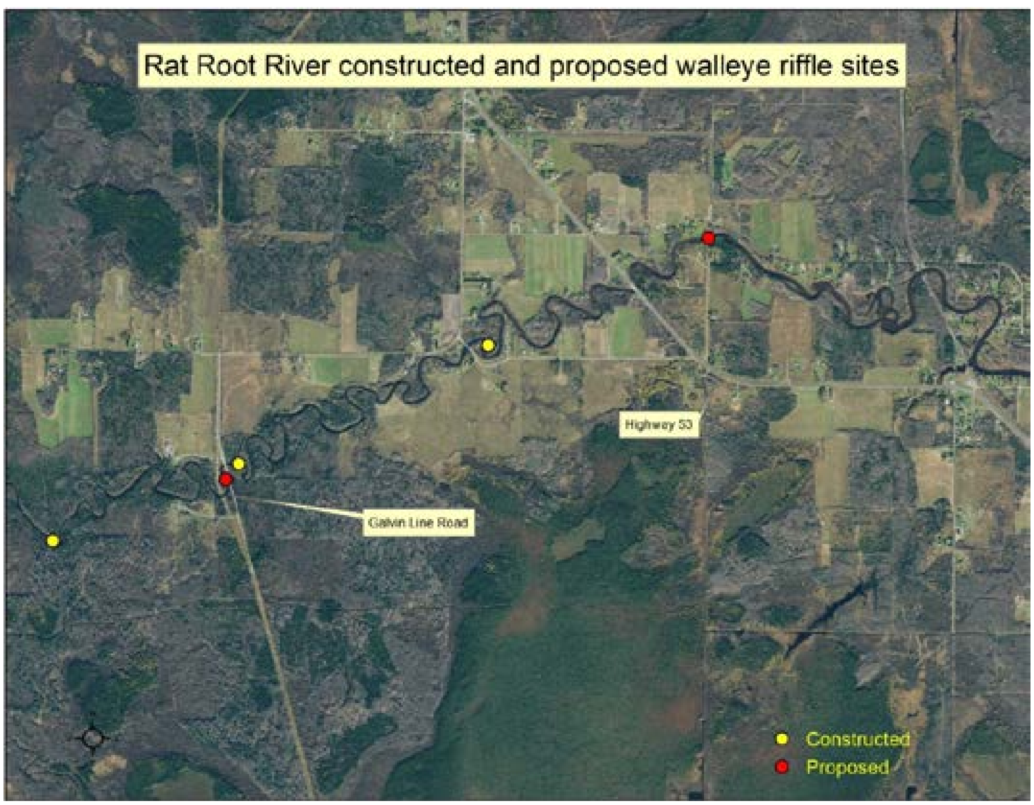


Figure 1. Location of proposed and constructed walleye spawning riffles on the Rat Root River in Koochiching County, MN.

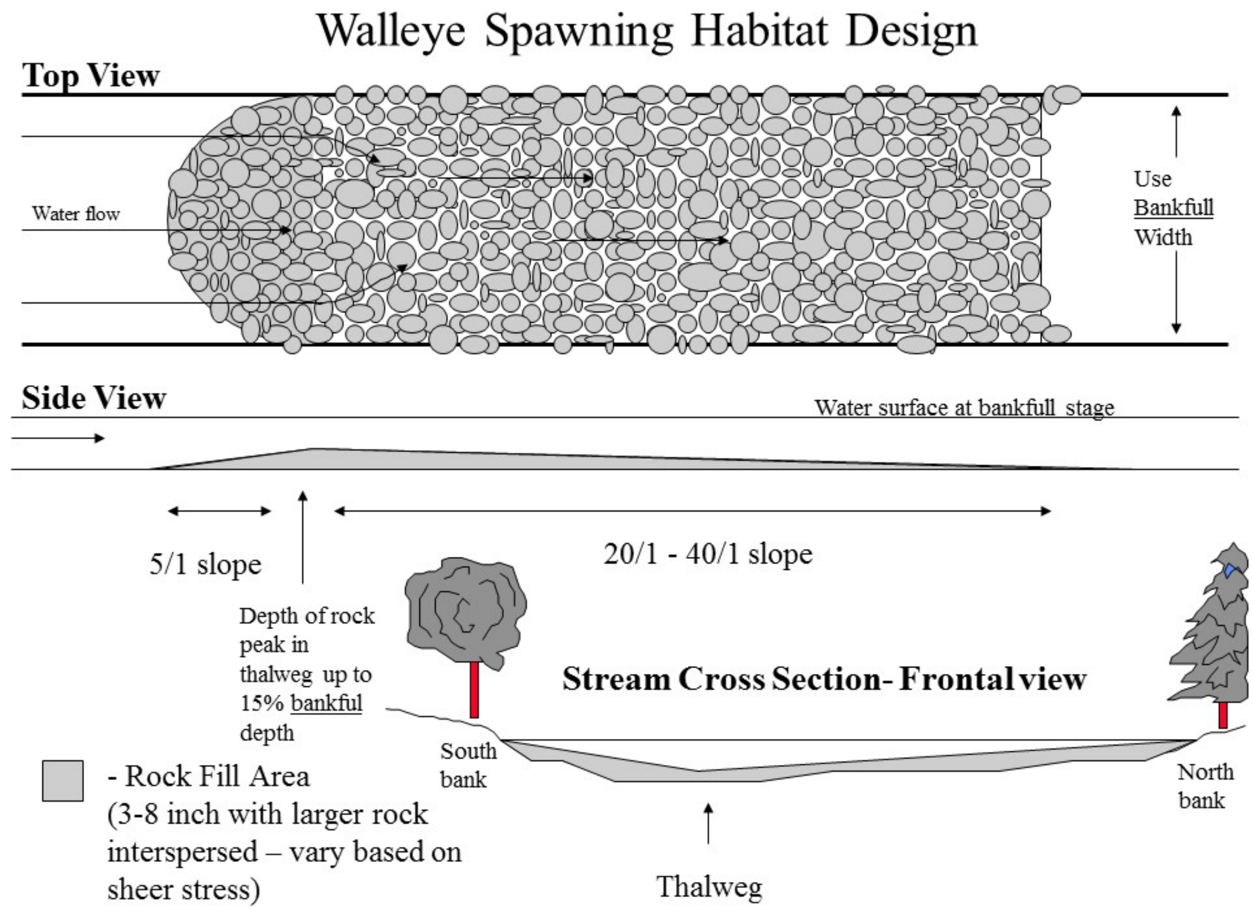


Figure 2. Modified Newberry Weir design.

Galvin Line Site

A longitudinal profile and two cross sections were surveyed in the fall and winter of 2017 (Figures 3, 4 & 5).

Figure 3. Longitudinal profile and cross section survey points of Galvin Line site on the Rat Root River.

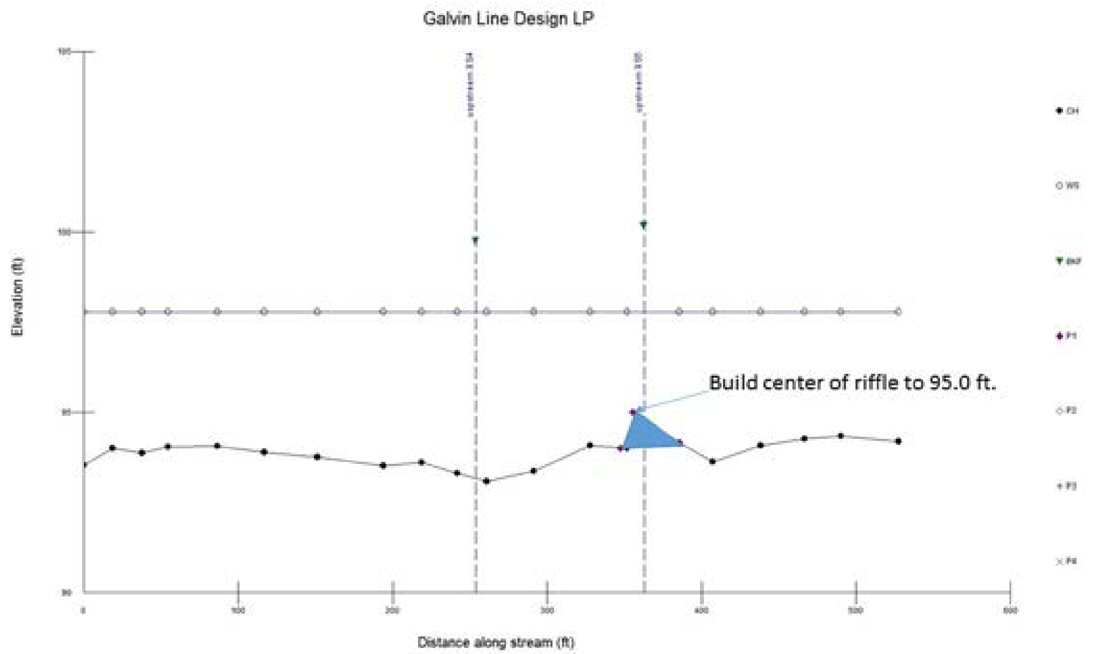


Figure 4. Longitudinal profile of the Galvin Line riffle site on the Rat Root River.

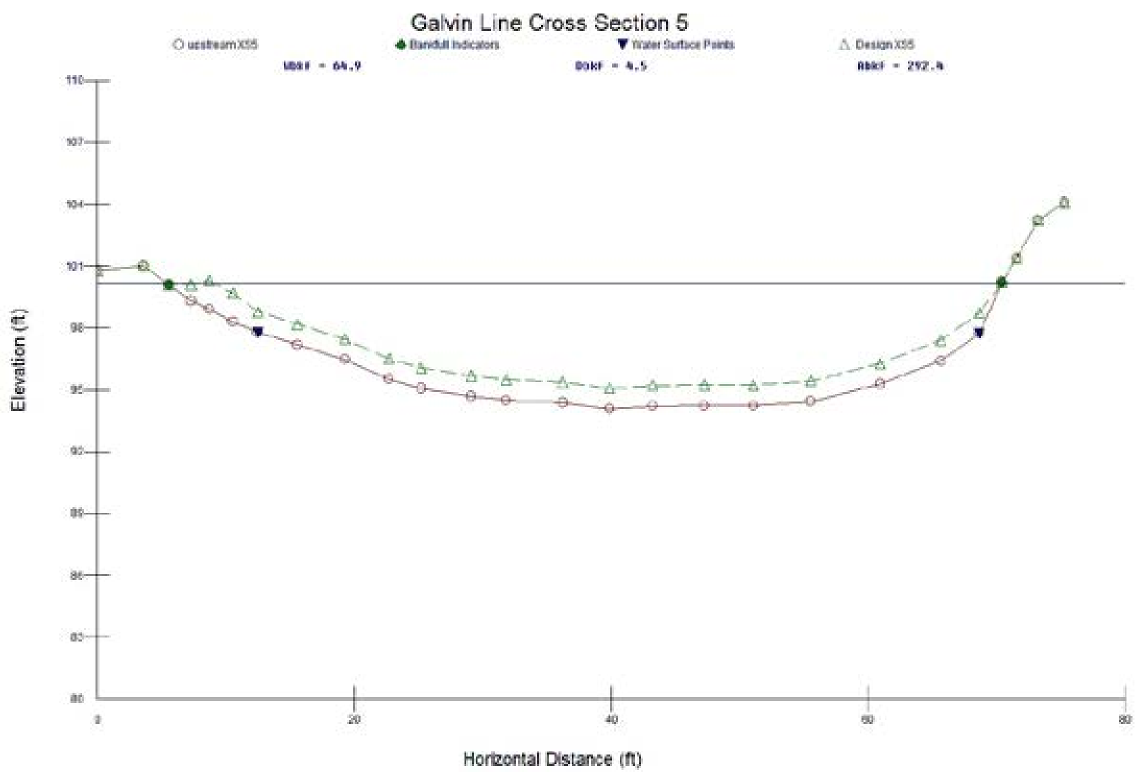


Figure 5. Overlay of existing cross section 5 and riffle design cross section for the Galvin Line site on the Rat Root River.

The Galvin Line site is relatively shallow ranging from 3 to 3.5 ft. deep which reduces the amount of rock needed and makes construction easier. The site has a lower bank height on the left bank than previous projects which limits the height of the riffle to prevent the river from cutting around the riffle at high flows. The design is conservative for this reason with a riffle height of 1.0 ft. higher than the stream bed and occupies 20% of the cross sectional area. The design dimensions closely follow previous designs which used the Newberry Weir design (Figures 2, 4 & 5).

Previous designs incorporated 2-3 ft. boulders in the crest of the weir and as a guide for placing the smaller fill material. These stones are much larger than the river is capable of moving, are difficult to place in deep turbid water, required streambed excavation to place correctly, and are out of place relative to native substrates. For these reasons, we will use MNDOT class III rip rap for the crest of the weir and smaller material for the downslope and spawning substrate (Appendix 1 & Table 1).

The river comes close to road prism at this site and it was initially thought that we could work cooperatively with Koochiching County Highway Department to add rock to the toe of the bank to protect the road prism as well as enhance the walleye spawning riffle. However, the best site for the spawning riffle is further downstream and adding rock to protect the road prism would not benefit this project. The county may wish to pursue using the same contractor to place rip rap along the road embankment to reduce construction costs.

County Road 98 Site

This site is further downstream than previous sites and utilizes stream bed fill from old road bed and/or bridge site. The road prism leading down to the river creates higher banks allowing a higher riffle design than could be constructed at previous sites (Figures 6, 7 & 8). This site was deeper than the Galvin Line site varying from 5 to 6.5 ft. deep at the time of the survey in October. The top of the weir is 1.5 ft. above the streambed and occupies 30% of the cross-sectional area. The river is much wider (98 ft.) compared to the Galvin Line site (65 ft.) and will use more material (Table 1).

Construction at this site will require the operator to build a higher weir than designed to provide a working platform. Once built, the operator will reduce the height of the weir to the designed elevation and work back across the river to the bank. Some rock will likely need to be excavated and removed from the river at the exit point. Material estimate for this site is somewhat uncertain and the bid should state additional materials may be needed and include a per/yd^3 estimate for additional material placed.

The DNR operates a gage at the Highway 53 bridge and water levels should be monitored prior to construction (Figure 9). Water level in December has dropped considerably and would make construction much easier if water levels stayed low.

Figure 6. Longitudinal profile and cross section survey points of County Road 98 site on the Rat Root River.

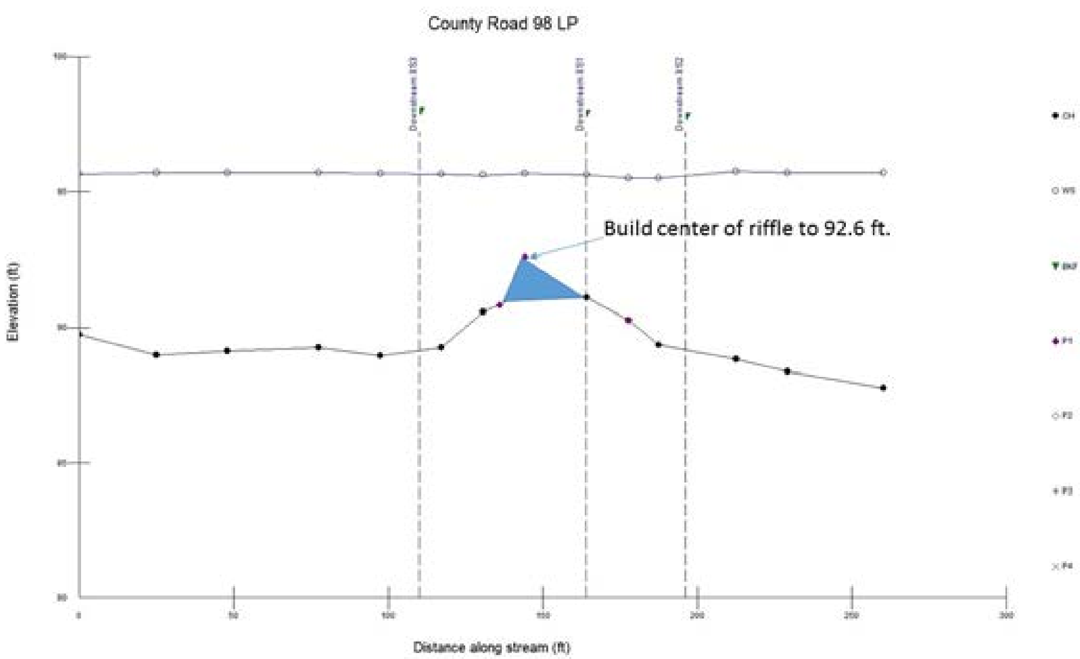


Figure 7. Longitudinal profile of the County Road 98 site on the Rat Root River.

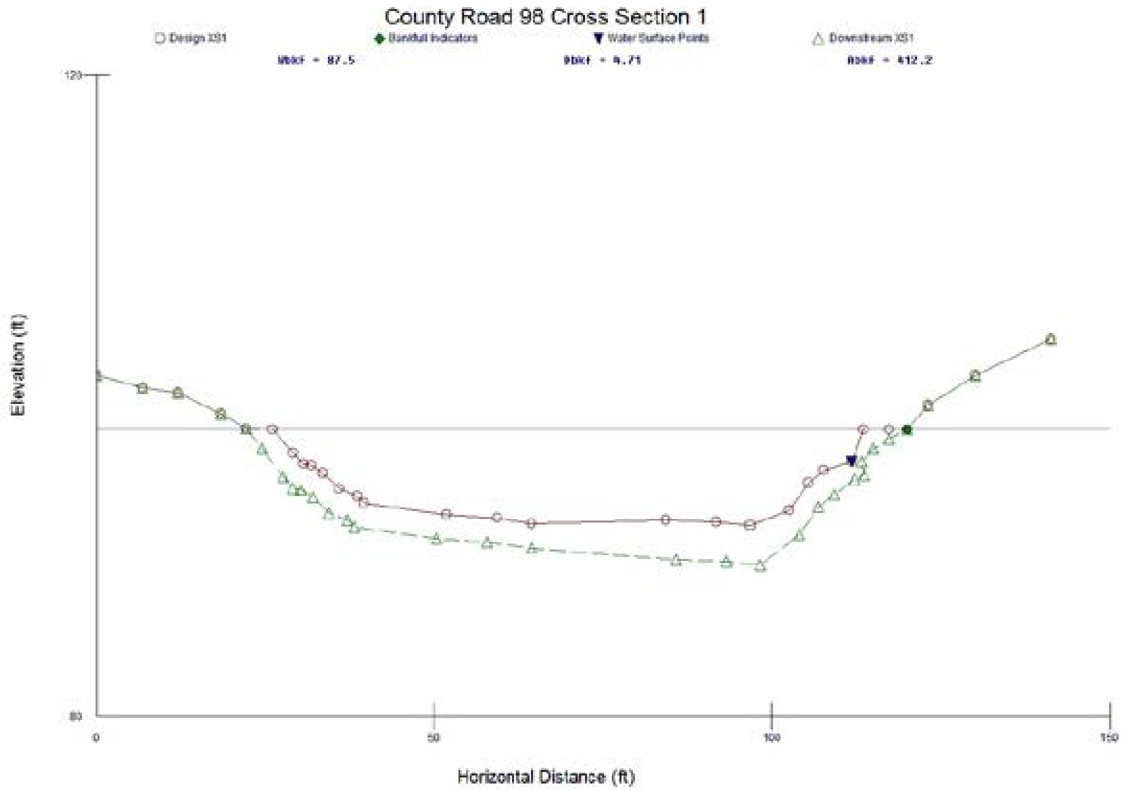


Figure 8. Overlay of existing cross section 1 and riffle design cross section for the County Road 98 site on the Rat Root River.

Rainy Lake water levels heavily influence water levels at the County Road 98 site and the constructed spawning riffle will be backwatered when Rainy Lake is at full pool during summer months. In early spring Rainy Lake is generally low and river levels are influenced by snowmelt and precipitation (Figure 9). The net effect is that if Rainy Lake is unusually high in the spring the riffle may not stay clear of sediment thus attracting fewer fish. If Rainy Lake is low to normal and runoff is high, the riffle will function well, however, if runoff is also low the riffle may be difficult for boats to pass over.

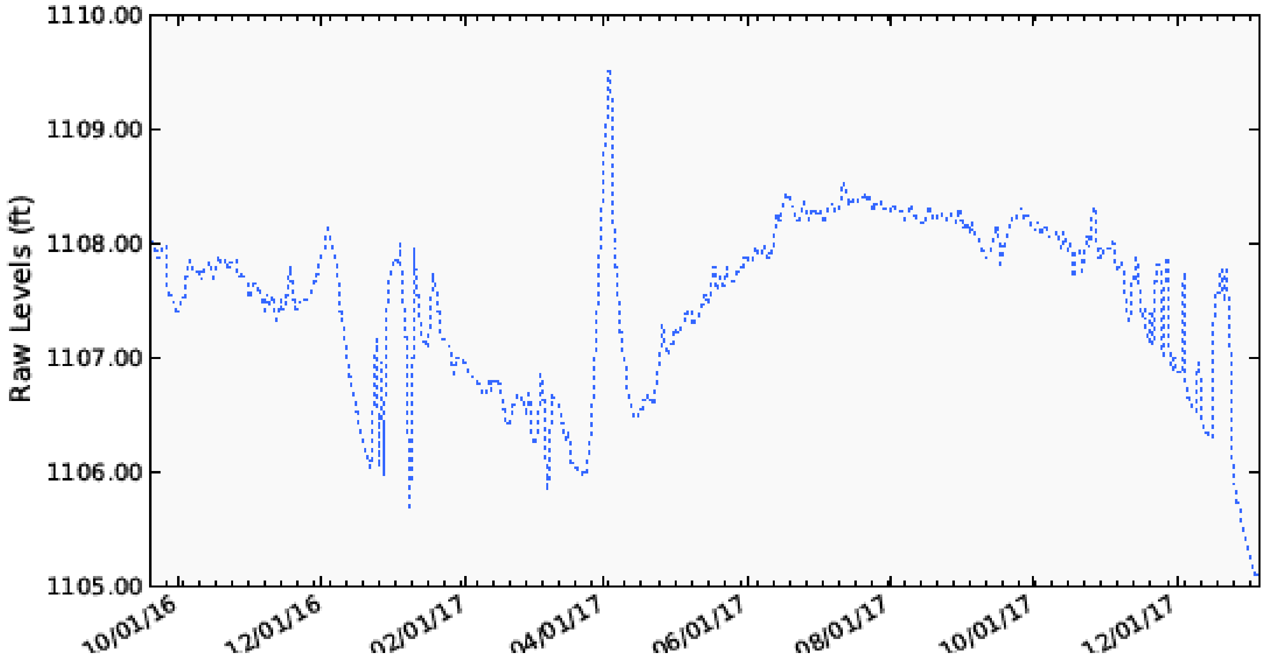


Figure 9. Hydrograph of Rat Root River water levels at the Hwy 53 Bridge.

Table 1. Estimated quantities and dimensions for walleye spawning riffles at two sites on the Rat Root River. Volumes (cubic yards) and Dimensions (ft.)

Material/dimensions	Galvin Line Site	County Road 98 Site
MNDOT Class III	30	60
MNDOT Class I	50	75
1.5 inch minus	15	25
Riffle width	65 ft.	100 ft.
Riffle length	45 ft.	45 ft.
Riffle area	2,925 ft^2	4,500 ft^2

27) Rock River Boelman Streambank Restoration

Project Background

Project Name: Larry Boelman Streambank Habitat and Restoration

Project Site: Boelman Property, Rock County

Township/Range Section: Township 101 Range 45W Section 13

Project Manager / Affiliated Organization: Douglas Bos, Rock County SWCD

Fund: OHF - CPL ***Fiscal Year Funds:*** FY 2014

Project Start Date: September 2014

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Prairie / Savana / Grassland , Choose an item.

Project Status: Establishment Phase

County: Rock

Primary Activity: Stream/River Enhancement

Project Size: 600 linear feet

Project Completed: December 2016

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Stabilize two eroding banks using toewood and sod mats and install a native grass buffer along the streambank to provide upland habitat.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Final (pre-construction) and as-built construction plan sets.
   Annual and final accomplishment reports to the CPL program.
3. ***What are the stated goals of the project?***
   Stabilize the eroding banks to reduce turbidity to the Rock River, designated critical habitat for the federally-listed endangered Topeka shiner.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Stable banks with a native grass buffer to protect against further erosion.
5. ***Were measures of restoration success identified in plans?*** *No*
   If yes, list specific measurements.
   Click here to enter text.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No

If yes, provide in Appendix A and list Maps provided:
Southwest Prairie Technical Service Area – Larry Boelman Streambank Stabilization, Rock County, Minnesota. Three-sheet 2014 construction plan set outline the location of the project, stationing of toewood treatments across two banks, proposed cross sections, and typical construction details.

Southwest Prairie Technical Service Area – Larry Boelman Streambank Stabilization As-built Plans, Rock County, Minnesota. 2016 as-built plans showing "red-line" mark-ups of constructed design for two sections of toewood.

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Large, coarse wood and woody debris (rootwads, branches and tree tops) were used to stabilize the toe of two eroding meander bends. Bank grading created a narrow bench on top of the toewood wood at the bankfull elevation. The banks were hydroseeded with a native plant species mix to provide long-term stabilization.

   The use of toewood to stabilize eroding meander bends is a commonly used practice as an alternative to methods such as riprap. The toewood reduces shear stress and water velocities against the bank and creates microhabitat for a variety of aquatic organisms. Creating a bankfull bench in conjunction with the toewood is a common practice because the bench functions to relieve shear stress during flood events greater than bankfull by increasing the floodplain width. The bench also provides a flat surface for the accumulation of sediment during flood events. Incorporating native vegetation into the re-vegetation design provides long-term stabilization because many native species have root depths that exceed 3 feet and form dense root mats. Tall native vegetation along the bank also provides overhead cover for aquatic organisms and pollinator habitat for terrestrial invertebrates.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   The initial scope of the project was to install a series of J-hook vanes to stabilize the eroding banks. The vanes direct the thalweg of the channel away from the bank and toward the center of the channel. In June 2014, the project area received 18 to 22 inches of rain over an eight day period causing additional bank erosion including eroding a 40 feet wide by 275 feet long section of the project area. Following the rain event, Southwest Prairie Technical Service Area staff consulted with MNDNR to re-design the project using toewood as the preferred method for stabilization.

   During construction, as-built drawings indicate that constructed cross sections were required to be adjusted because of eroding banks. In other words, toewood was installed along the eroding banks instead of filling and building the banks back out to the previous location.
9. ***In what ways did alterations change the proposed project outcome?***
   Using toewood not only stabilized the eroding banks, but provided habitat for aquatic organisms.

Site Assessment

Field Review Date: **8/22/2019**

Field Visit Attendees: Doug Bos, Rock County SWCD; Scott Ralston, USFWS; Russ Hoogendoorn Rock County SWCD; Brooke Hacker, MNDNR; Jon Lore, MNDNR; Kristin Hall MNDNR; Gina Quiram, MNDNR; Mark Pranckus, Cardno (Site Assessor)

10. ***Surrounding Landscape Characteristics:***
    The project site is located on the Rock River. The surrounding landscape is dominated by row-crop agricultural practices with limited pasture/grassland. The riparian corridor upstream, adjacent and downstream of the project area is a mixture of floodplain forest and grass-forb dominated uplands and wetlands. Riparian width varies between 500 and 900 feet adjacent to the project area.
11. ***Site Characteristics:***
    a. ***Soil Series:***
       Pits, gravel-Udipsamments complex (along lower half of downstream bank)
       Spillco silt loam 0 – 1 percent slopes, frequently flooded (the entirety of the upstream bank and upper half of the downstream bank.
    b. ***Topography:***
       The surrounding upland area is relatively flat up to the streambanks. Through the project area, streambanks ranged from 10 to 15 feet high.
    c. ***Hydrology:***
       Well-drained, but the potential for the area to inundated seasonally and for an extending period of time due to flooding.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
       The project is a combination of grasses, forbs, and early successional woody vegetation. Willow species (sandbar willow) was observed along the bank toe of slope and lower banks. Native grasses and forbs like from the original seeding were present in the understory of the willow. Higher on the banks seeding was conducted by the landowner as a part of the CRP program and cool-season grasses such as smooth brome became more dominant along with scattered native forbs. In general, the plant community was typical of a native seeding within a primarily agricultural landscape (mix of native and non-native species). For the purpose of this site, invasive species such as reed canarygrass, purple loosestrife, Canada thistle were limited to less 10% of the total cover.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
       See Table 27-1 in Appendix A for list of species observed during site visit.
12. ***Is the plan based on current science?*** Yes
    Toewood with a sod mat bench is a standard bank stabilization practice used as an alternative to hard armoring banks on the outside bend of streams.
13. ***List indicators of project goals at this stage of project:***
    Greater than 50 percent of the total bank length had a stable toe and vegetation established above the toewood. Based on an interview with the farmer who rents the property, the toewood was in place and working prior to spring 2019. A flood event in spring 2019 damaged and blew out the downstream sections of toewood on each bank.

14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Barring any unforeseen major flood events, the portion of streambank where toewood remains in place and woody vegetation is becoming established on the bank, the banks should remain stable and significantly reduce erosion and sedimentation.
15. ***Are corrections or modifications needed to achieving proposed goals?***
    No immediate corrections are required. It is recommended that the two banks that started eroding following the 2019 spring flood be monitored to determine if they continue to erode at a high rate and/or get worse (i.e. aerial map or bank pin monitoring).
16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    During our assessment and discussion with the project team, it appears that no long term management of the site beyond the continued establishment of the native grass buffer is planned. The project team has changed their focus since this project was completed to work on areas in the headwaters of the Rock River watershed where projects have a higher probability of long term success to support recovery of the Topeka shiner such as oxbow channel restoration.

    There is an opportunity to improve the project by repairing the eroding sections of toewood and potentially extending them in either an upstream or downstream direction, if additional funding and resources were available.

    The Rock River watershed is undergoing hydrologic change due to a combination of land use practices (intensive row-crop agriculture and pattern tile drainage) delivering more stormwater to the storm over a shorter time period and a climatic cycle that is producing larger, more frequent storm events. These two factors make developing a design and constructing a project with a high degree of certainty of success difficult. Additionally, based on observations while traveling throughout the watershed, addressing erosion at the project site provides minimal benefits compared to the significant amount of eroding banks within the Rock River.
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    Based on our understanding, the long-term management of the site will be left to the landowner or the farmer that rents (manages) the adjacent row-crop areas. Maintaining the native grass buffer will be important. Prior to the assessment, he mowed the buffer to manage for weeds. This is an excepted practice to establish a native seeding during the first several years. A representative from Rock County SWCD or NRCS should work with the farmer on appropriate management techniques post-establishment to avoid either overmowing, spraying that results in loss of forb diversity, or overgrazing.

    An unintended outcome of the project is the establishment of a willows along the toe of the slope along both banks and the extensive establishment along the bank on the downstream treatment bank. The willows will provide long-term bank stabilization and are typically planted in many toewood applications. Based on our discussion during the assessment, the willows naturally colonized the banks following construction. A representative from Rock County SWCD or NRCS should work with the farmer to make sure he understands the value and function of those willows and that he doesn't herbicide or remove them.

18. ***Are follow-up assessments needed? Explain.***
    A follow up assessment in two to three years may be valuable to determine how much erosion has occurred or if vegetation became established on the banks in the eroded areas, allowing them to heal.
19. ***Additional comments on the restoration project.***
    This project is a typical example of how toewood can be used as an alternative to hard armoring techniques to reduce bank erosion on outside bends. Logs and woody material for the project were collected on-site and provided an adequate source for material.

    Sandbar willow (or other woody species) were not planned to be planted on the site to stabilize the banks; however, it naturally colonized the toe and lower banks of both treatment areas providing high quality long-term bank protection. Every effort should be made to maintain the existing woody vegetation.

    The project could have been improved by extending the upstream toewood downstream by 70 to 90 feet or installing a rock grade control structure at the downstream end of both toewood sections to hold the pool elevation and take pressure off the lower third of each meander bend. Reviewing aerials from 2009 to 2019, it appears that erosion is occurring in relatively the same locations, indicating the existing toewood did not fully address the issues causing the local bank erosion.

    The design and construction of toewood is an evolving topic in streambank stabilization and stream restoration in Minnesota and other parts of the country. Where to start and stop toewood treatments along an outside bend, the elevation of the top of the toewood, and how the rootwads and coarse woody material should be installed can vary among projects and regions of the State. This is a project where additional specifications, and/or lessons learned from others that have installed toewood would have benefitted the project and potentially helped avoid the eroding banks that were observed. From our understanding, this was the project team's first application of toewood and they haven't completed any additional toewood projects since. Experience from similar previous projects is extremely valuable to implement a successful project because lessons learned through observations on what worked and didn't work and how the stream reacted over time can be applied.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    minimally achieved the stated goals.
21. ***The project will:***
    Minimally meet proposed outcomes
    Confidence of outcome determination:
    Medium

22. ***Provide explanation of reason(s) for determination.***

    Where still present, the toewood appears to be stabilizing the toe of the bank from eroding and further supported by dense woody vegetation. Assuming no significant change in riparian vegetation management to remove woody vegetation and no catastrophic floods, the stable banks should likely remain stable. The eroding banks, based on pattern geometry (lower third of tight outside meander bends), high, steep banks, and minimal woody vegetation will likely continue to erode.

23. ***Site Assessor(s) Conducting Review:***

    Mark Pranckus, Cardno

Appendix A: Site maps, Project plans or Vegetation tables

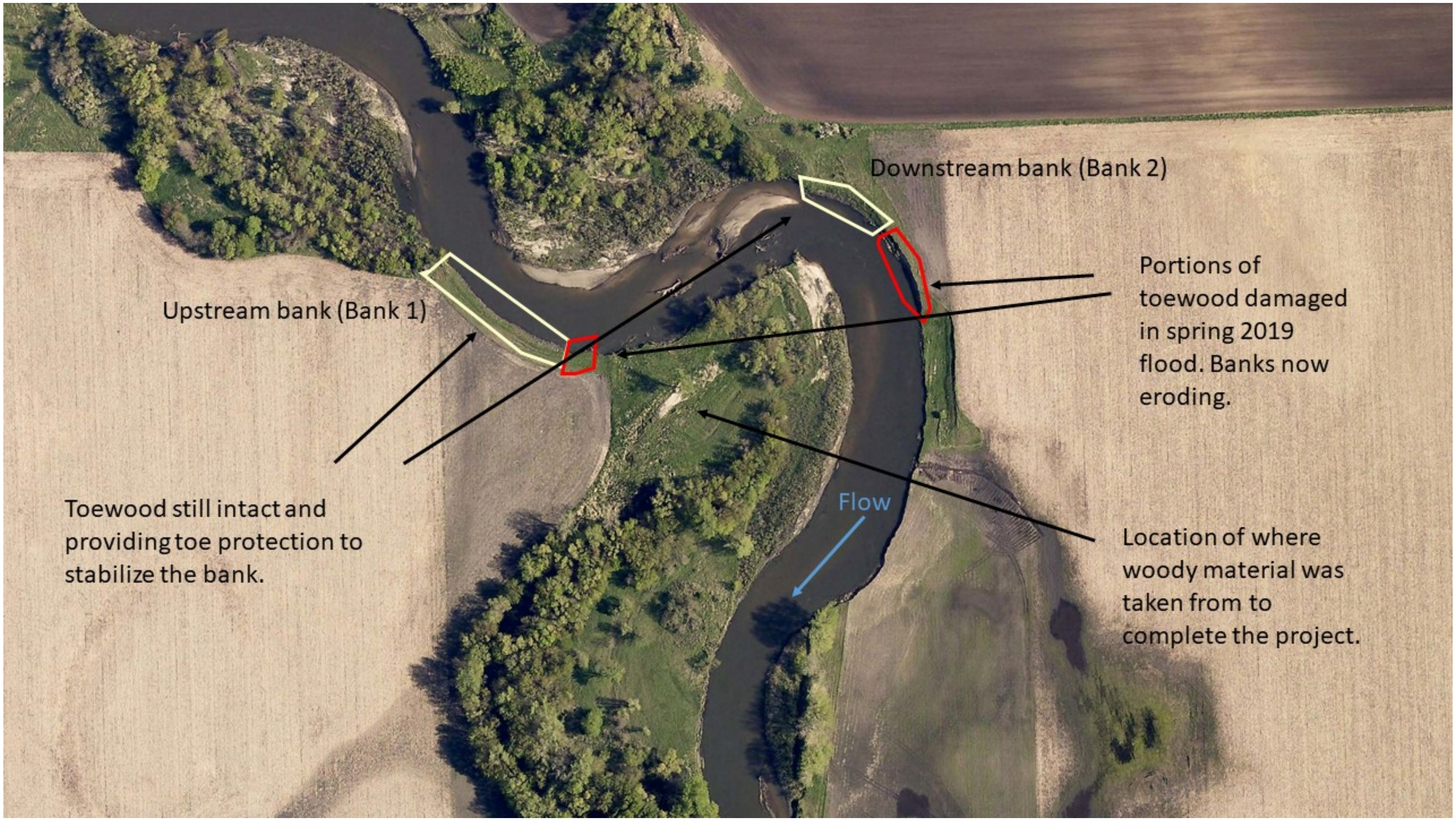


Figure 27-1. Aerial from spring 2019 following flooding. Areas where the toewood remains intact are highlight along with areas where erosion occurred, blowing out the toewood. Aerial image provided by Rock County (http://rock.houstoneng.com/).

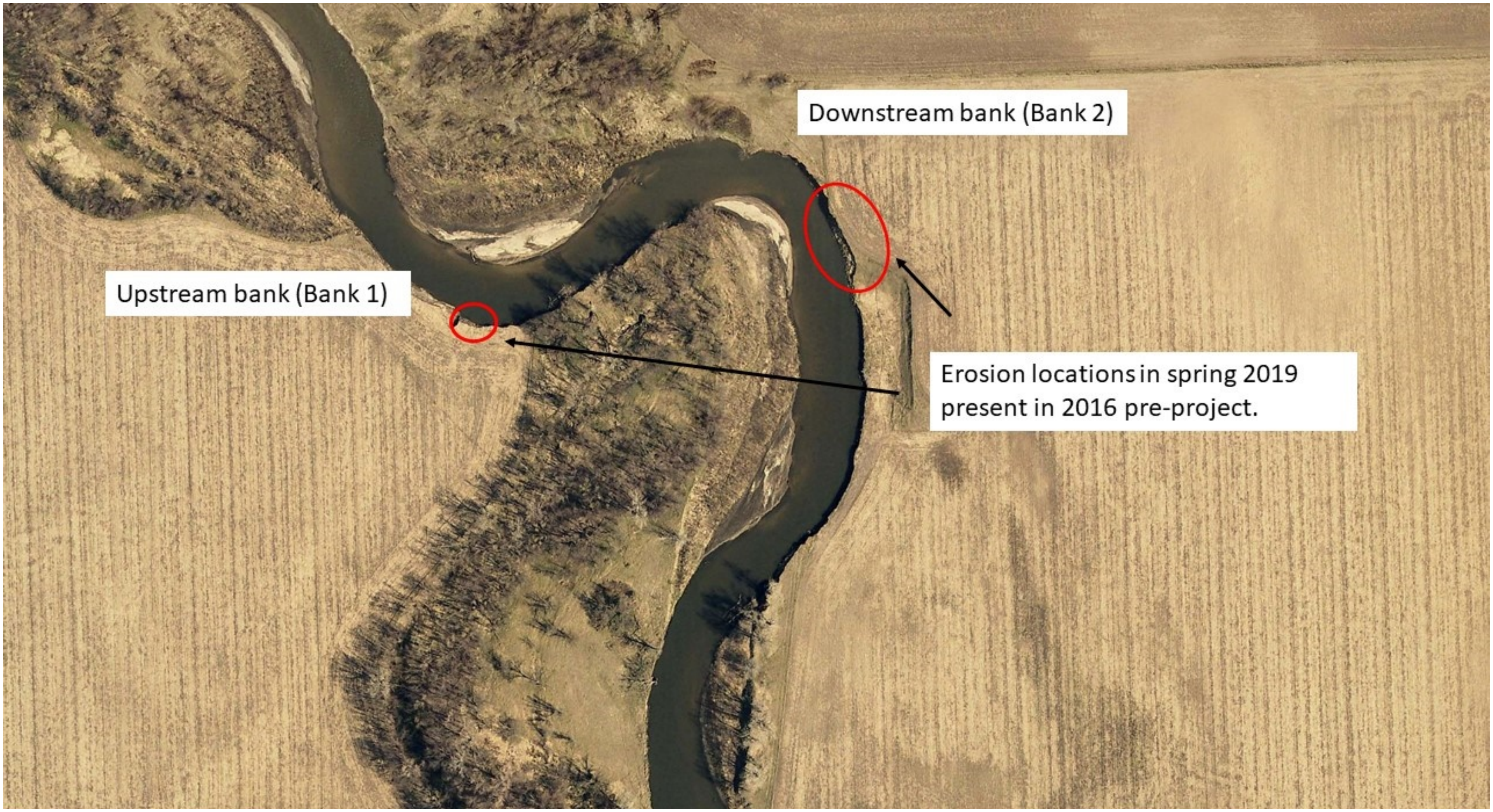


Figure 27-2. 2016 aerial of the project prior to construction. Areas highlighted show where erosion occurred in spring 2019. Aerial image provided by Rock County (http://rock.houstoneng.com/).

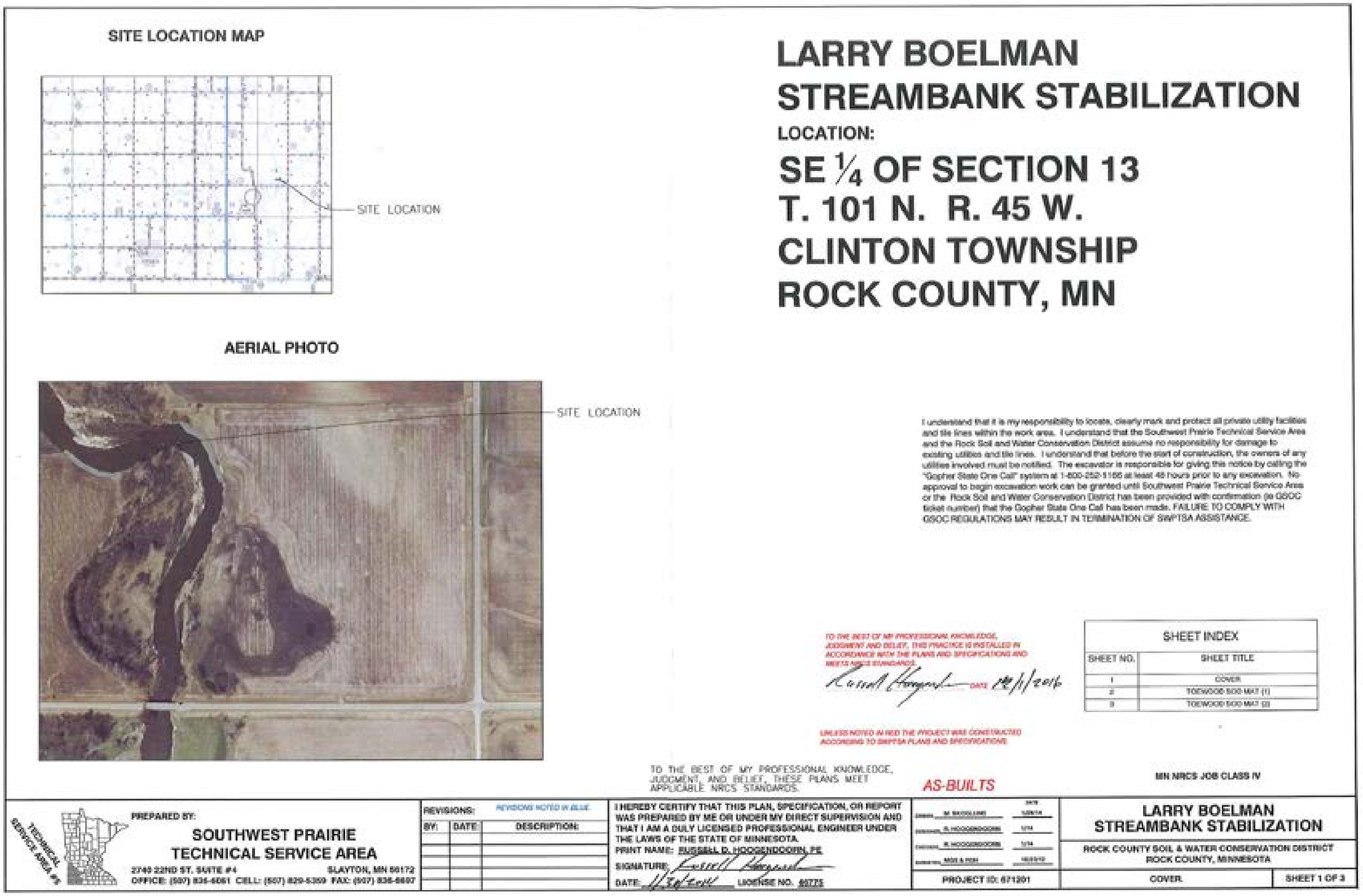


Figure 27-3. Sheet 1 of as-built construction plan set for toewood installation.

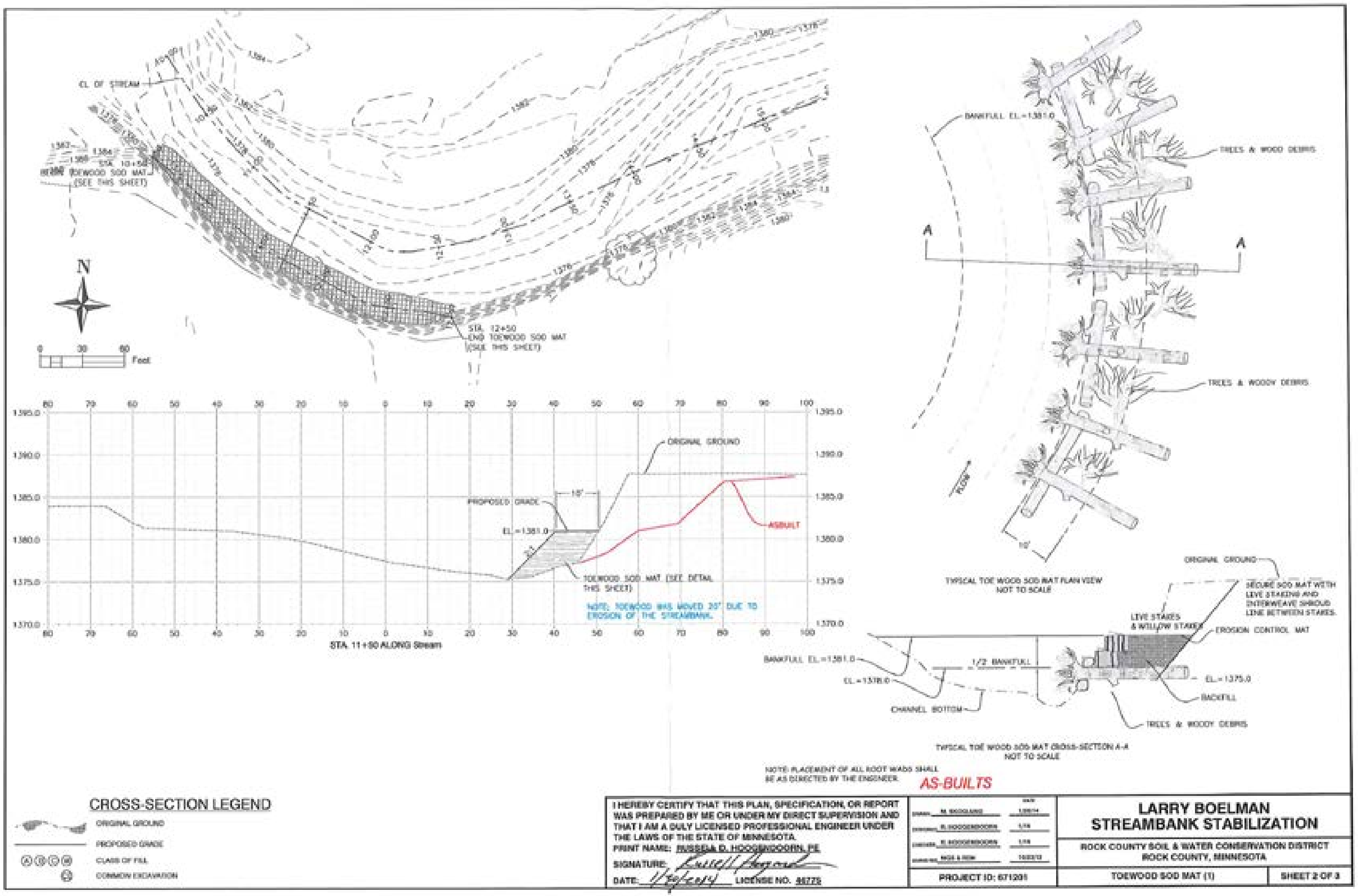


Figure 27-4. Sheet 2 of the as-built construction plan set detailing the layout for the upstream bank treatment.

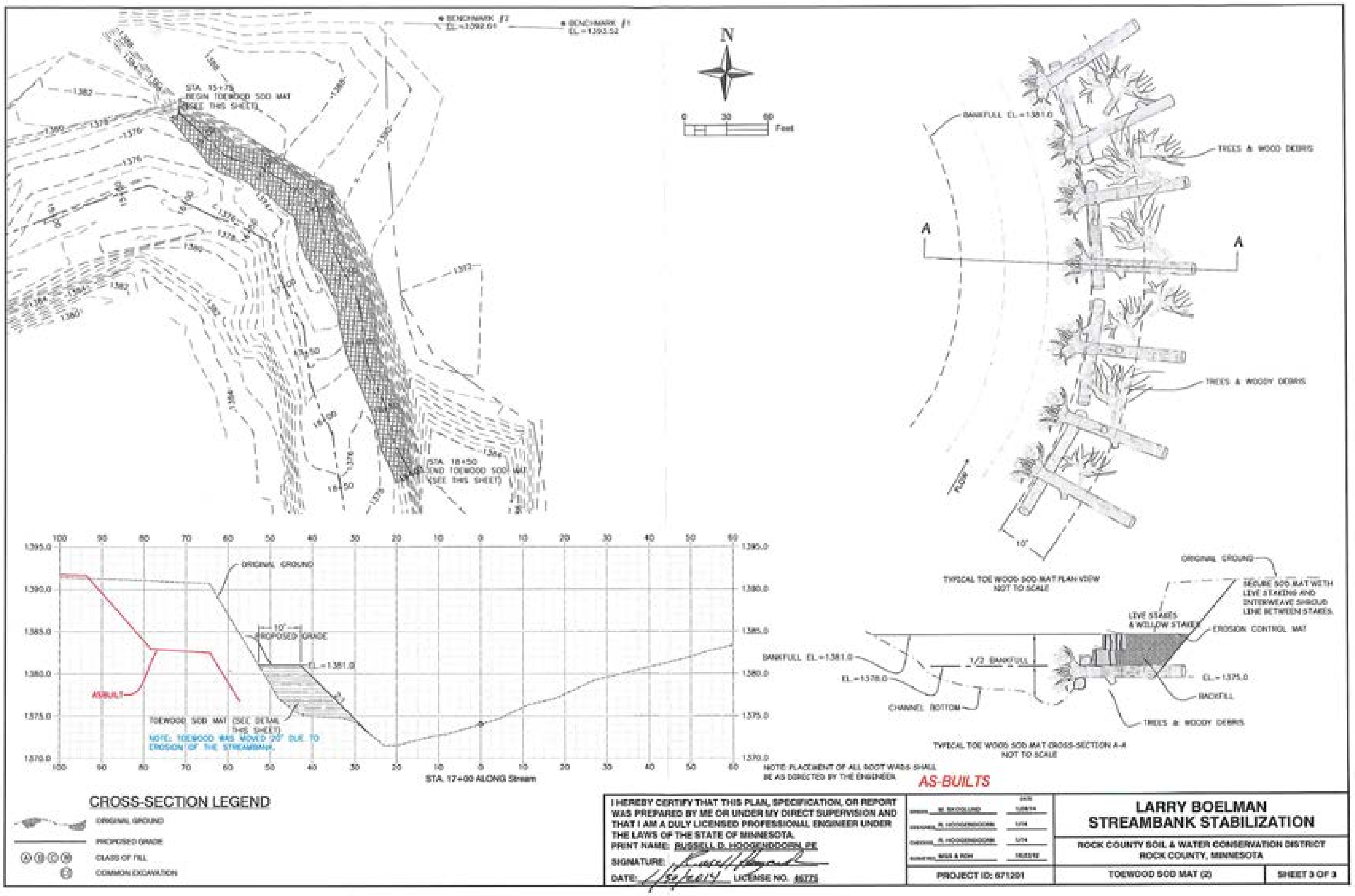


Figure 27-5. Sheet 3 of the as-built construction plan set detailing the layout for the downstream bank treatment.

Table 27-1. Results of meander survey through project area. Meander survey occurred 8/22/19 by Mark Pranckus, Cardno. Meander times were 10:30 – 11:15.

Scientific Name	**Common Name**	**Species Status**
Echinochloa crus-galli	Barnyard Grass	Non-native
Bromus inermis	Smooth Brome	Non-native
Bidens connate	Purple-stem Beggarstick	Native
Oenothera biennis	Common Evening Primrose	Native
Monarda fistulosa	Wild Bergamot	Native
Bouteloua curtipendula	Side-oats Grama	Native
Solidago rigida	Stiff Goldenrod	Native
Trifolium pretense	Red Clover	Non-native
Ambrosia trifidum	Giant Ragweed	Native
Sorghastrum nutans	Indian Grass	Native
Setaria pumila	Yellow Foxtail	Non-native
Helianthus giganteus	Giant Sunflower	Native
Elymus canadensis	Canada Rye	Native
Andropogon gerardii	Big Bluestem	Native
Ambrosia artemisiifolia	Common Ragweed	Native
Verbena stricta	Hoary Vervain	Native
Senna hebecarpa	Wild Senna	Native
Asclepias syriaca	Common Milkweed	Native
Phalaris arundinacea	Reed Canary Grass	Non-native
Solidago canadensis	Canada Goldenrod	Native
Salix interior	Sandbar Willow	Native
Phleum pretense	Wild Timothy	Non-native
Melilotus officinalis	Sweet Clover	Non-native
Cirsium arvense	Canada thistle	Non-native
Solidago gigantean	Giant Goldenrod	Native
Xanthium strumarium	Cocklebur	Non-native
Poa pratensis	Kentucky Bluegrass	Non-native
Achillea millefolium	Yarrow	Native
Elymus repens	Quackgrass	Non-native
Rumex crispus	Curly Dock	Non-native
Ratibida pinnata	Yellow Coneflower	Native

Appendix B: Site Photographs

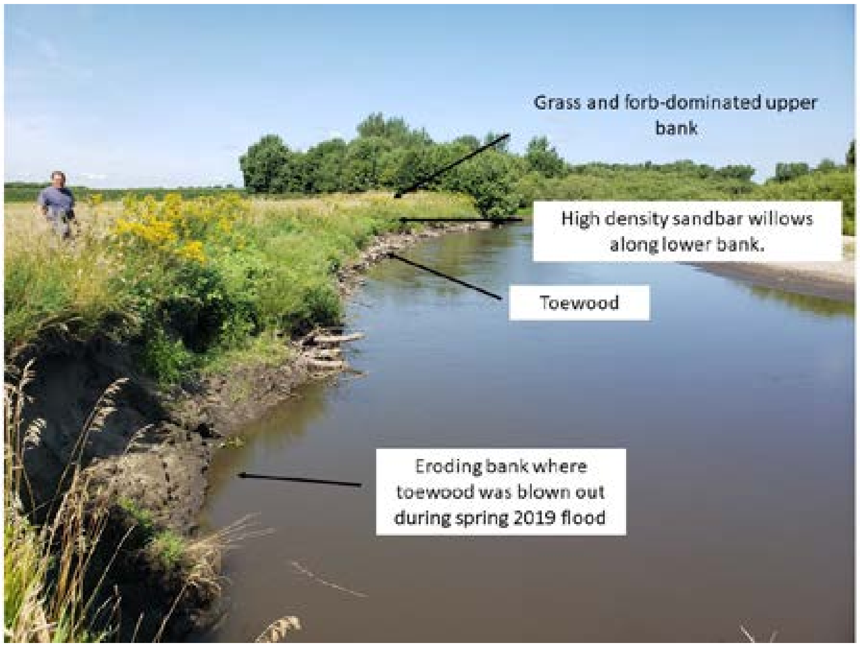


Photo 27-1. Looking upstream at the Upstream Bank (Bank 1). The upstream portion of the bank demonstrates the existing toewood used to stabilize the bank. Above the toewood, sandbar willow have colonized the lower bank. At the top of the bank, grasses and forbs compromise the majority of the cover. Approximately the last 50 feet of toewood blew out during spring 2019 flooding. (Photo taken 8/22/19 by Mark Pranckus, Cardno).

Photo 27-2. Looking upstream at the Upstream Bank (Bank 1) in 2012. In 2014, a significant flood event caused additional bank erosion prior to construction of the project (Photo provided by Scott Ralston, USFWS).

Photo 27-3. Looking upstream at the Downstream Bank (Bank 3). The upstream portion of the bank demonstrates the existing toewood used to stabilize the bank. Above the toewood, sandbar will have colonized the lower and upper banks. At the top of the bank, primarily smooth brome and other compromise the majority of the cover. Approximately the last 150 feet of toewood blew out during spring 2019 flooding. (Photo taken 8/22/19 by Mark Pranckus, Cardno).

Photo 27-4. Looking upstream at the Downstream Bank (Bank 2) in 2012. In 2014, a significant flood event caused additional bank erosion prior to construction of the project (Photo provided by Scott Ralston, USFWS).

Photo 27-5. Looking at the area adjacent to the Upstream Bank where trees for the toewood were harvested. The site was re-seeded with a combination of native grasses and forbs. (Photo taken 8/22/19 by Mark Pranckus, Cardno).

28) Rock River Knutson Streambank Restoration

Project Background

Project Name: Russel Knutson Streambank Stabilization

Project Site: Knutson Property, Rock County

Township/Range Section: Township 101 Range 44W Section 25

Project Manager / Affiliated Organization: Douglas Bos, Rock County SWCD

Fund: OHF - CPL ***Fiscal Year Funds:*** FY 2013

Project Start Date: January 2014

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Prairie / Savana / Grassland , Choose an item.

Project Status: Establishment Phase

County: Rock

Primary Activity: Stream/River Enhancement

Project Size: 1000 linear feet

Project Completed: September 2014

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Stabilize two eroding banks using a series of rock J-hooks and bank grading and install a native grass buffer along the streambank to provide upland habitat.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Final (pre-construction) and as-built construction plan sets.
   Final accomplishment reports to the CPL program.
3. ***What are the stated goals of the project?***
   Stabilize the eroding banks to reduce turbidity to Kanaranzi Creek, a tributary of the Rock River, and a designated critical habitat for the federally-listed endangered Topeka shiner.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Stable banks with a native grass buffer to protect against further erosion.
5. ***Were measures of restoration success identified in plans?*** *No*
   If yes, list specific measurements.
   Click here to enter text.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No

If yes, provide in Appendix A and list Maps provided:
Southwest Prairie Technical Service Area – Russell Knutson Streambank Stabilization, Rock County, Minnesota. Nine-sheet 2014 construction plan set outlines the location of the project, stationing of rock J-hook treatments across two banks, proposed cross sections, and typical construction details.

Southwest Prairie Technical Service Area – Russell Knutson Streambank Stabilization As-built Plans, Rock County, Minnesota. 2014 as-built plans showing "red-line" mark-ups of constructed design for eight rock J-hooks.

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
Rock J-hooks are a common practice used to reduce streambank erosion. A rock vane is installed in an upstream direction from the bank that is to be protected. The "hook" of the vane forms an upstream facing "J" shape. The vane slopes up as it goes downstream and ties into the bank at or near a designated bankfull elevation. The slope on the vane directs water flow into the center of the channel and away from the banks. The inside of the upstream vane slows water and promotes deposition and bank building. The downstream side of the vane promotes scour, creating a pool and reducing stream energy. Typically, rock J-hook vanes are used in a series along meander bends and curves to manipulate flow through high energy/highly erosive areas. Bank grading that reduces bank slope is often done in conjunction with the installation of rock J-hooks. Hydroseeding the banks with a native plant species mix provides long-term stabilization.

Rock J-hook vanes are often used as an alternative to installing rock along an entire meander bend because the J-hooks distribute stream energy, create a series of short riffles and pools, and minimizes negative impacts to downstream banks. A typical rock-lined bank provides local bank stabilization while speeding up stream velocities and increasing stream energy to downstream sections. Incorporating native vegetation into the re-vegetation design provides long-term stabilization because many native species have root depths that exceed 3 feet and form dense root mats. Tall native vegetation along the bank also provides overhead cover for aquatic organisms and pollinator habitat for terrestrial invertebrates.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
No
As-built plans and a discussion with the project team indicate that minimal alterations were made to the plan during implementation.

9. ***In what ways did alterations change the proposed project outcome?***
No significant alterations were made to the project during construction that altered the proposed project outcome.

Site Assessment

Field Review Date: **8/22/2019**

Field Visit Attendees: Doug Bos, Rock County SWCD; Scott Ralston, USFWS; Russ Hoogendoorn Rock County SWCD; Brooke Hacker, MNDNR; Jon Lore, MNDNR; Kristin Hall MNDNR; Gina Quiram, MNDNR; Mark Pranckus, Cardno (Site Assessor)

10. ***Surrounding Landscape Characteristics:***
    The project site is located on Kanaranzi Creek. The surrounding landscape is dominated by row-crop agricultural practices with limited pasture/grassland. The riparian corridor upstream, adjacent and downstream of the project area are primarily grass-forb dominated uplands and wetlands that are extensively pastured. Riparian width varies between 50 and over 1,000 feet adjacent to the project area.
11. ***Site Characteristics:***
    a. ***Soil Series:***
       Spillco silt loam 0 – 2 percent slopes, occasionally flooded (the entirety of the upstream bank)
       Spillco silt loam 0 – 2 percent slopes, frequently flooded (the entirety of the downstream bank)
    b. ***Topography:***
       The surround upland area is relatively flat up to the streambanks. Through the project area, streambanks ranged from 5 to 10 feet high.
    c. ***Hydrology:***
       Well-drained, but the potential for the area to inundated seasonally and for an extending period of time due to flooding.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
       The upstream project area is a combination of native and non-native grasses and forbs with a limited number of woody tree and shrub seedlings and saplings. Smooth brome was the dominant grass at the top of the bank. Reed canarygrass was more common along the lower bank.

       The downstream project area was primarily overgrazed pasture. Based on a discussion with the USFWS, the Windom Wetland Management District considered purchasing an easement along the stream because records indicate that it is remnant prairie (no evidence of every being plowed). The quality of the native vegetation was extremely difficult to discern given the overgrazed nature of the site, but is likely a mix of both native and non-native vegetation if it were allowed to grow to a state of more easily being identified. The vegetation along the two J-hooks was primarily grazed native and non-native grasses with limited forbs.

    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
       See Table 28-1 in Appendix A for list of species observed during site visit.
12. ***Is the plan based on current science?*** Yes
    Rock J-hook vanes with bank grading are a standard bank stabilization practice used as an alternative to hard armoring banks on the outside bend of streams.
13. ***List indicators of project goals at this stage of project:***

Greater than 75 percent of the total bank length had a stable toe and vegetation was established above the rock vanes and along the bank on nearly the entire project length. There was observed sediment deposition in along the edge of the channel and behind vanes.

14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***

    Barring any unforeseen major flood event, the portion of streambanks where the rock J-hook vanes are in place should remain stable and significantly reduce erosion and sedimentation. Livestock appear to be overgrazing the vegetation along the downstream site. Continued overgrazing can limit the ability of vegetation to help prevent bank erosion during high flows due to reduced root depth and decreased in bank roughness, which reduces the ability of vegetation to decrease stream velocities and shear stress.

15. ***Are corrections or modifications needed to achieving proposed goals?***

    No immediate corrections are required. Because the Rock River and its tributaries appear to be very dynamic, it is recommended that the two banks be visually inspected on an annual basis to make sure that the J-hooks remain in place and are functioning properly. Photo inspections would be an effective and simple way to create an annual record for review.

16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

    During our assessment and discussion with the project team, no long term management of the site beyond the continued establishment of the native grass buffer is planned. The project team has changed their focus since this project was completed to work on areas in the headwaters of the Rock River watershed where projects have a higher probability of long term success to support recovery of the Topeka shiner such as oxbow channel restoration.

    Overall, the project has accomplished the goal of stabilizing the banks relative to the conditions prior to the project. The amount of sediment loading to Kanaranzi Creek has been reduced. However, there is some bank erosion that is occurring along the toe of the slope between structures. The erosion will likely not lead to catastrophic failure of the project in the near term; however, installing woody vegetation along the toe of the slope either during construction or under current conditions would be a relatively easy action to support continued project success while providing additional aquatic habitat enhancement through overhead cover.

    Based on our observations, there were two potential opportunities to improve project goals and outcomes. The first opportunity is with the construction of the rock J-hook vanes. The vane arm of Vane No. 7, the first vane on the downstream bank, could have been installed so that the arm angled into the stream channel more. Based on the 2016 aerial photo review, it was installed parallel and adjacent to the existing bank. A greater angle would likely encourage more scour on the downstream side of the vane creating a pool and adding habitat to the stream. Currently, a large sediment bar has formed. The sediment deposit is building the bank and preventing erosion, but overtime, it may force the flow into the opposite bank. The second opportunity was to incorporate some inside meander bend (point bar) channel grading to reduce shear stress on the outside meander bend. Given the open nature of the point bar (pastured and tree-less), lowering the point bar to at or below bankfull would have provided more floodplain area to convey higher flows and further reduce the potential for bank erosion against the outside bank. Not considering the point bar grading and elevations during design and construction is a common theme in many streambank stabilization projects because most of the project time and resources are focused on the eroding banks. Future projects should consider how overall channel geometry. It is very understandable in a system like Kanaranzi Creek there is not a clear start and stop to addressing local issues because most of the streambanks need some level of stabilization.

The Kanaranzi Creek and Rock River watersheds are undergoing hydrologic change due to a combination of land use practices (intensive row-crop agriculture and pattern tile drainage) delivering more stormwater to the storm over a short time period and a climatic cycle that is producing larger, more frequent storm events. These two factors make developing a design and constructing a project with a high degree of certainty of success difficult. Additionally, based on observations while traveling throughout the watershed, addressing erosion at the project site provides minimal benefits compared to the significant amount of eroding banks within Kanaranzi Creek.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***

    Based on our understanding, the long-term management of the site will be left to the landowners or their renters who manage either the adjacent row-crop areas or the livestock grazing the pastures. Maintaining a well-vegetated buffer will be important for continued success in reducing bank erosion and sedimentation. The upstream project area had a well-developed buffer compromised up a combination of native species likely seeded during construction and non-native species such as smooth brome and alfalfa likely overseeded by the landowner post-construction. The downstream project area appeared to be heavily and continuously grazed by livestock. A representative from Rock County SWCD or NRCS should work with the farmers on management techniques post-establishment to avoid either overmowing, spraying that results in loss of forb diversity, or overgrazing.

18. ***Are follow-up assessments needed? Explain.***

    A follow up assessment in two to three years may be valuable to determine if the J-hooks are still in place and functioning and is the erosion between structures increasing. The assessment could be as simple as establishing several photo points and cataloging any change.

19. ***Additional comments on the restoration project.***

    This project is a typical example of how rock J-hook vanes can be used as an alternative to hard armoring techniques to reduce bank erosion on outside bends.

    The majority of the rock used to create J-hook vanes has remained in place. It appears that some of it moved during high flow events. Larger stone size may not have moved, but would have cost more per ton.

    There is erosion occurring between the Vanes 4 to 6 in the upstream area. In a system like Kanaranzi Creek, it’s very difficult to eliminate all bank erosion due to high flows and the amount of shear stress against the banks. Future projects of similar style should consider, in addition to bank grading, creating a narrow bankfull bench between structures. Additionally, the establishment of woody vegetation along the toe between structures would further help to reduce erosion and maintain a stable bank. Adjusting the location of the structures or the vane arm angles during construction to capture the thalweg off the upstream structures during construction is one potential field fit to consider; however, this is often not predictable until the stream has had time to adjust.

There is a lot of sediment deposition between Vanes 7 and 8. If the vane arm of Vane 7 was extended further into the stream, potentially some of that sediment would get scoured out to create a pool. Excessive sediment deposition can be an indicator that there's a large amount of sediment moving through the system and that the structures are preventing the stream from transporting the necessary amount to balance erosional and depositional processes. In terms of sediment reduction, the structures are doing a good job of protecting the banks from further erosion and storing sediment along the edge of the channel. At some point, sediment accumulation may force the flow into the opposite bank creating additional erosion.

Limiting overgrazing of cattle along the slopes of the stream where the project occurred and elsewhere will be important to support continued success.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***

    achieved the stated goals.
21. ***The project will:***

    Meet proposed outcomes

    Confidence of outcome determination:

    Medium
22. ***Provide explanation of reason(s) for determination.***

    The J-hooks were installed in 2014 and remain in place in 2019 after undergoing at least one major flood event. Sediment is depositing on the upstream end of several structures and the banks are well-vegetated with only minor areas of erosion. Given the absence of a catastrophic flood and a significant change in riparian management, the project should continue to meet the project goal of reducing sedimentation to Kanaranzi Creek and the Rock River watershed.
23. ***Site Assessor(s) Conducting Review:***

    Mark Pranckus, Cardno

Appendix A: Site maps, Project plans or Vegetation tables

Figure 28-1. Aerial from spring 2019 showing the project extent and the location of the two project areas. Aerial image provided by Rock County (http://rock.houstoneng.com/).

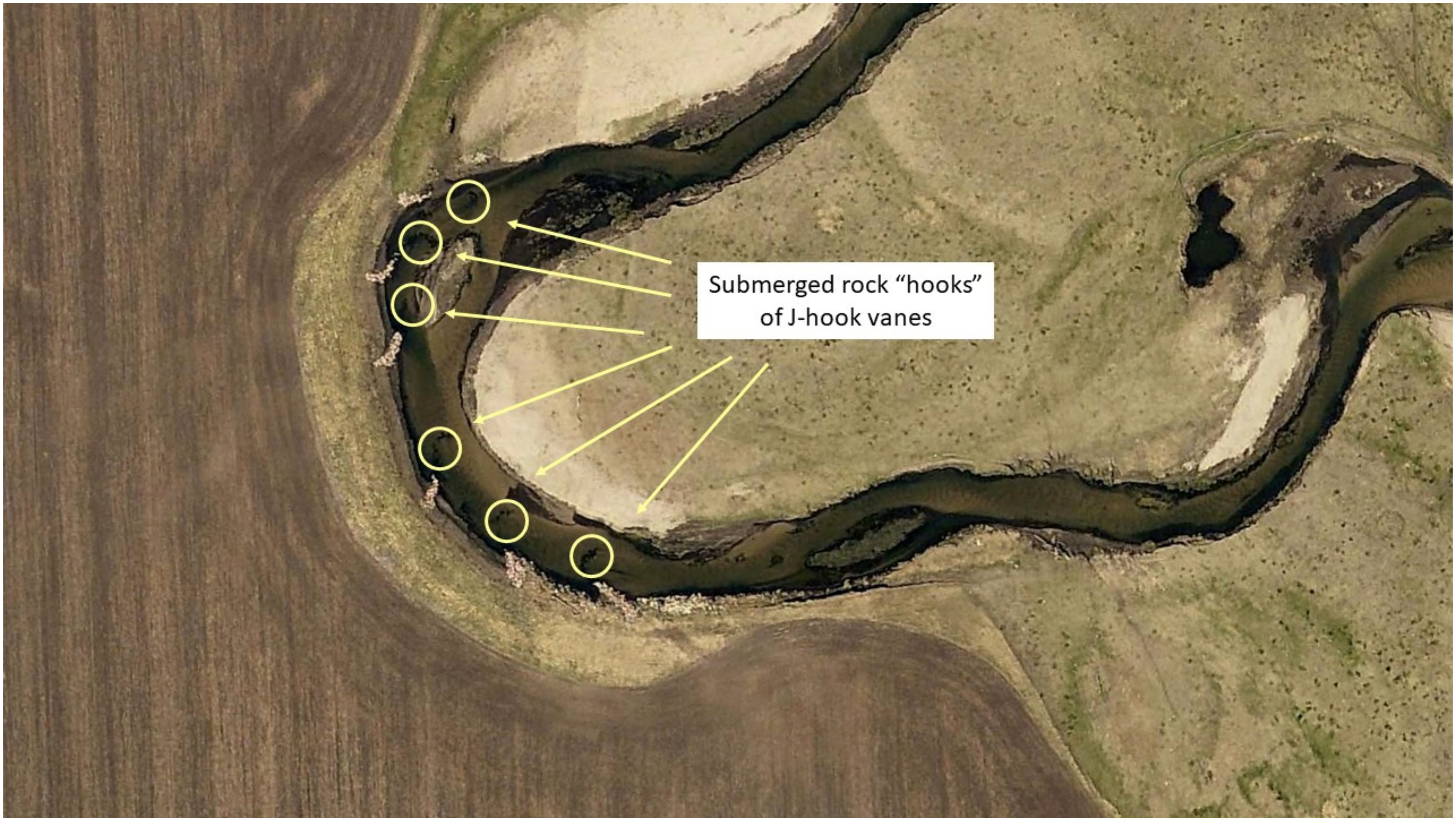


Figure 28-2. 2016 aerial of the upstream project area following construction. The six rock J-hook vanes are clearly visible including the submerged "hooks" highlighted with the circles. Aerial image provided by Rock County (http://rock.houstoneng.com/).

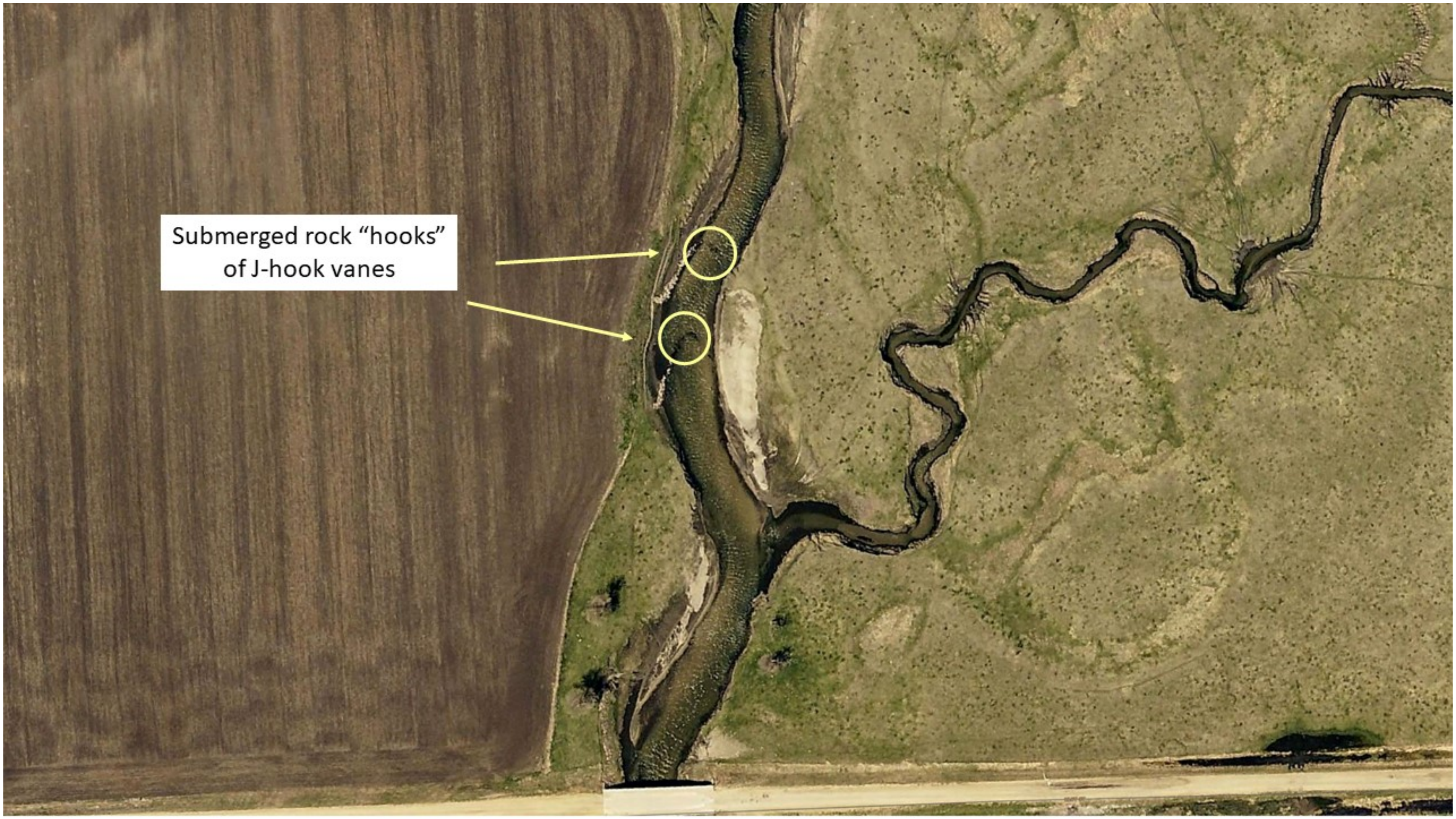


Figure 28-3. 2016 aerial of the downstream project area following construction. The two rock J-hook vanes are clearly visible including the submerged “hooks” highlighted with the circles. Aerial image provided by Rock County (http://rock.houstoneng.com/).

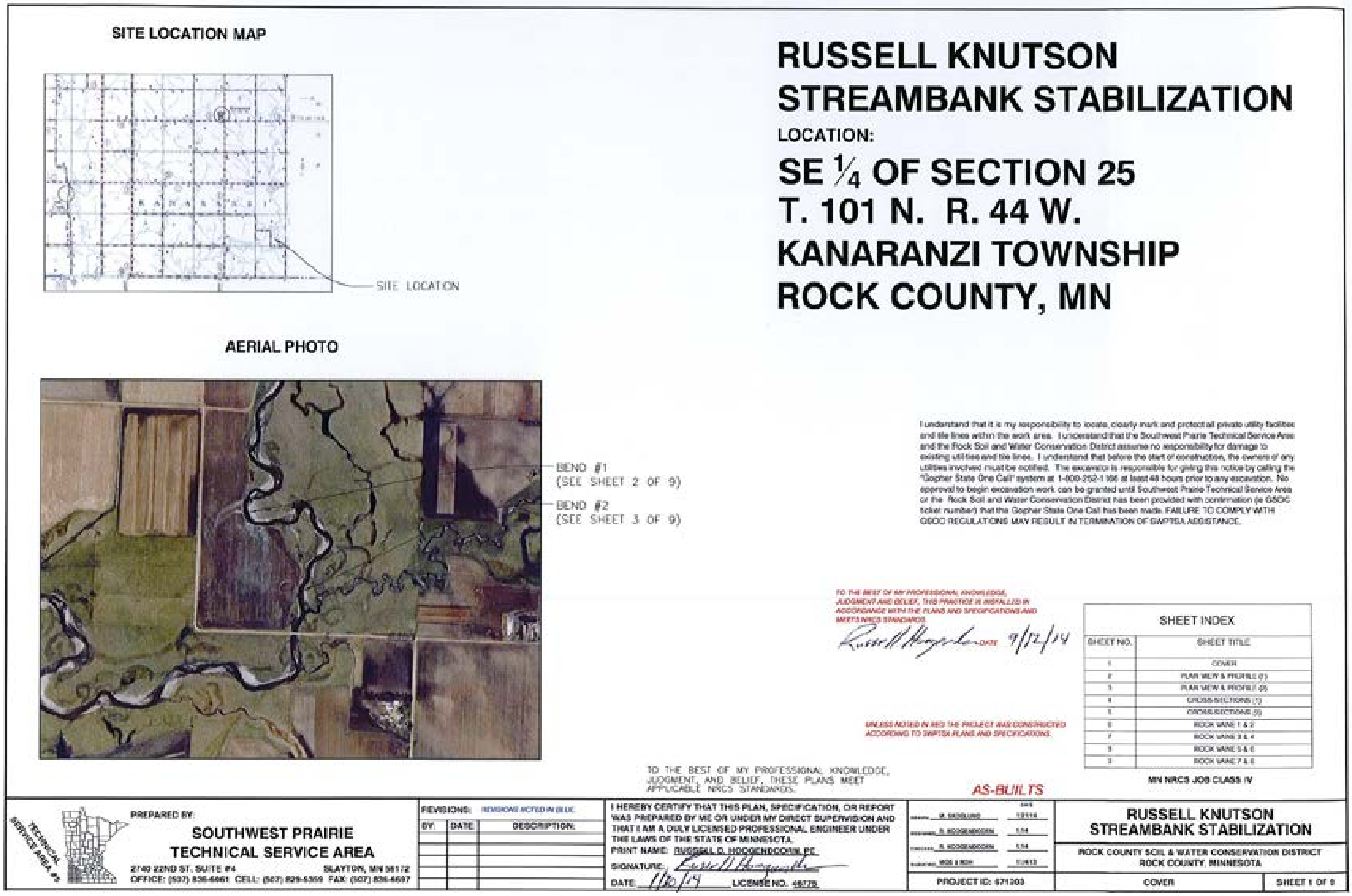


Figure 28-4. Sheet 1 of as-built construction plan set for J-hook installation.

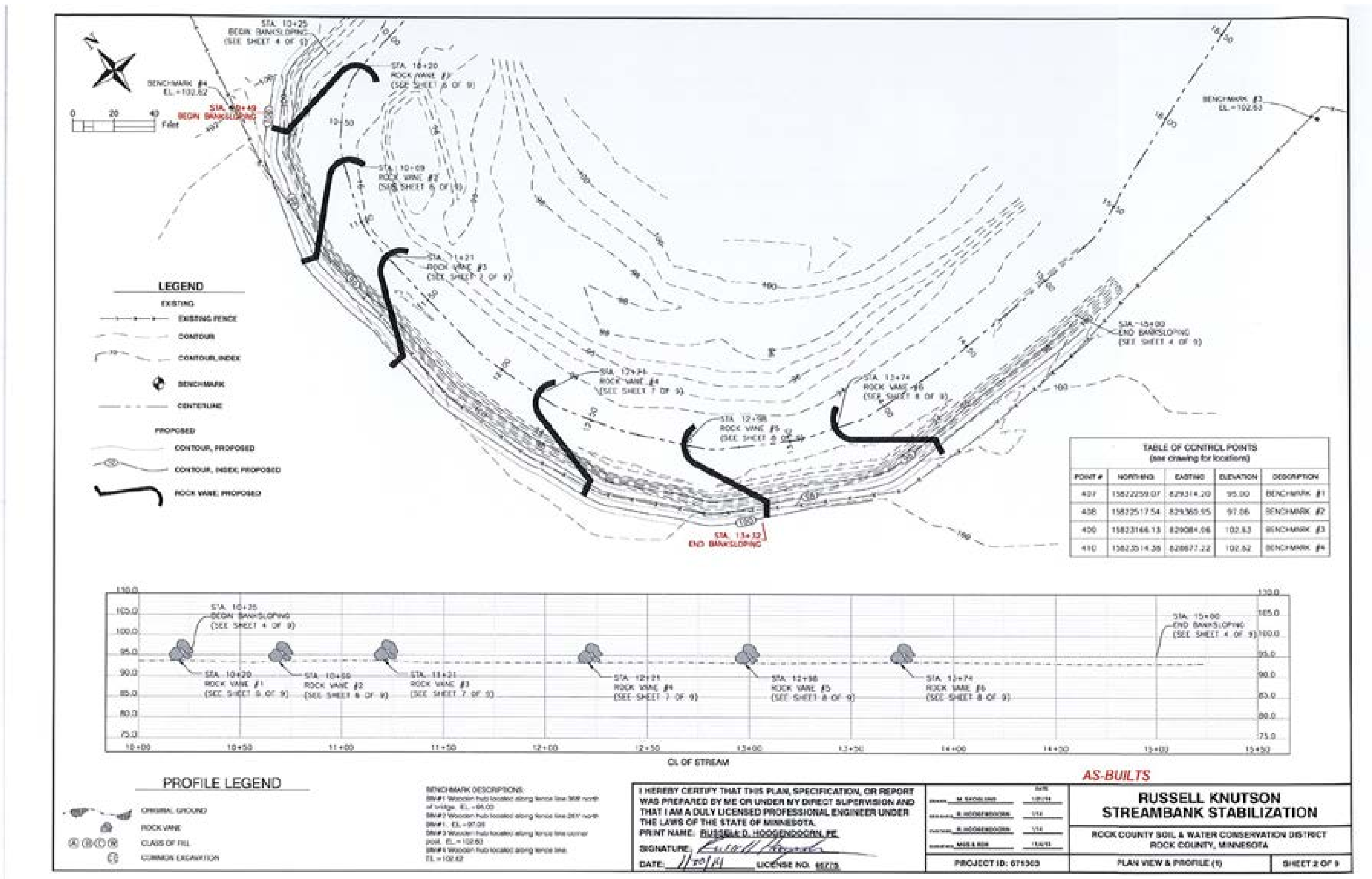


Figure 28-5. Sheet 2 of the as-built construction plan set detailing the layout for the upstream bank treatment.

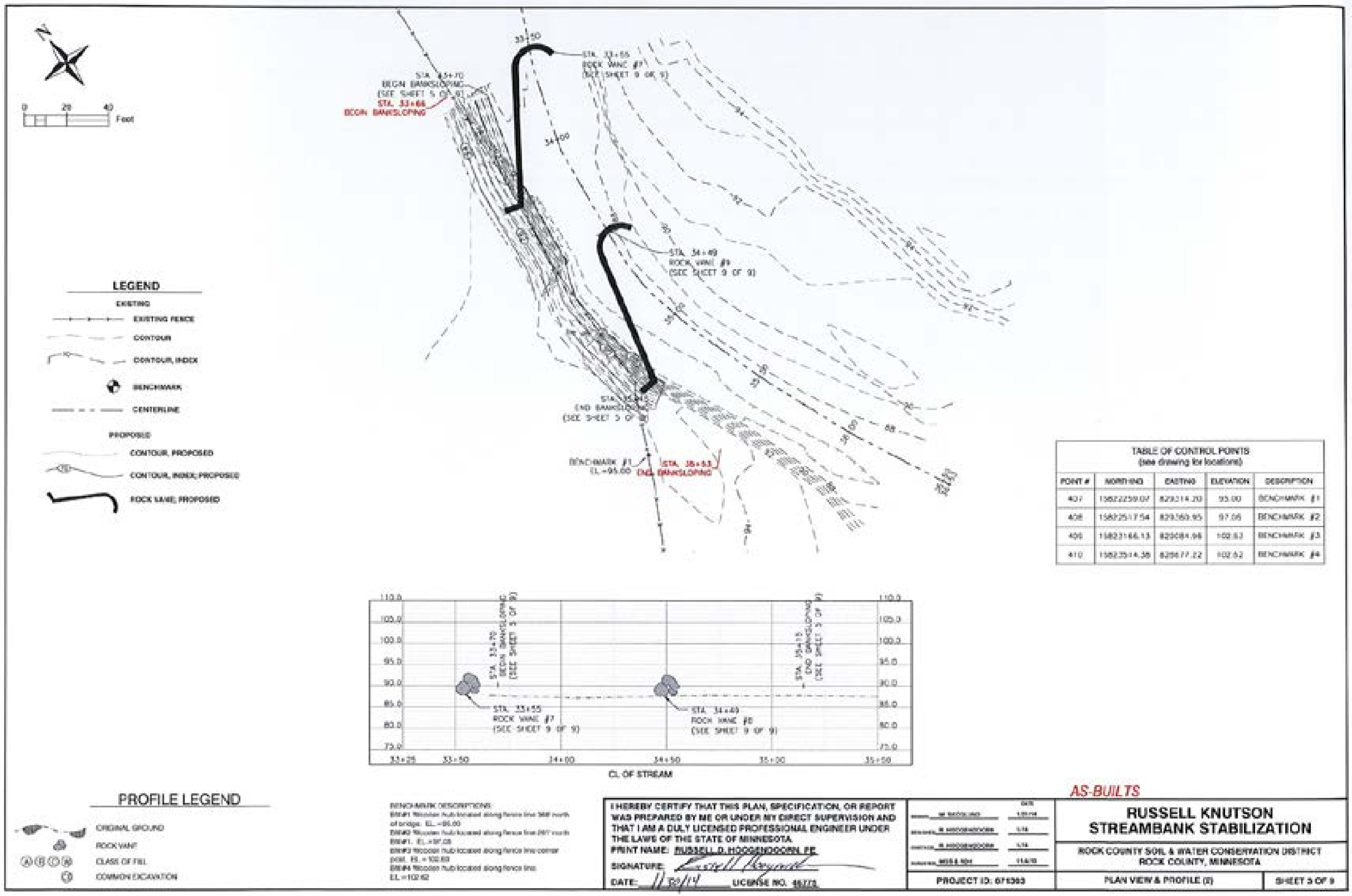


Figure 28-6. Sheet 3 of the as-built construction plan set detailing the layout for the downstream bank treatment.

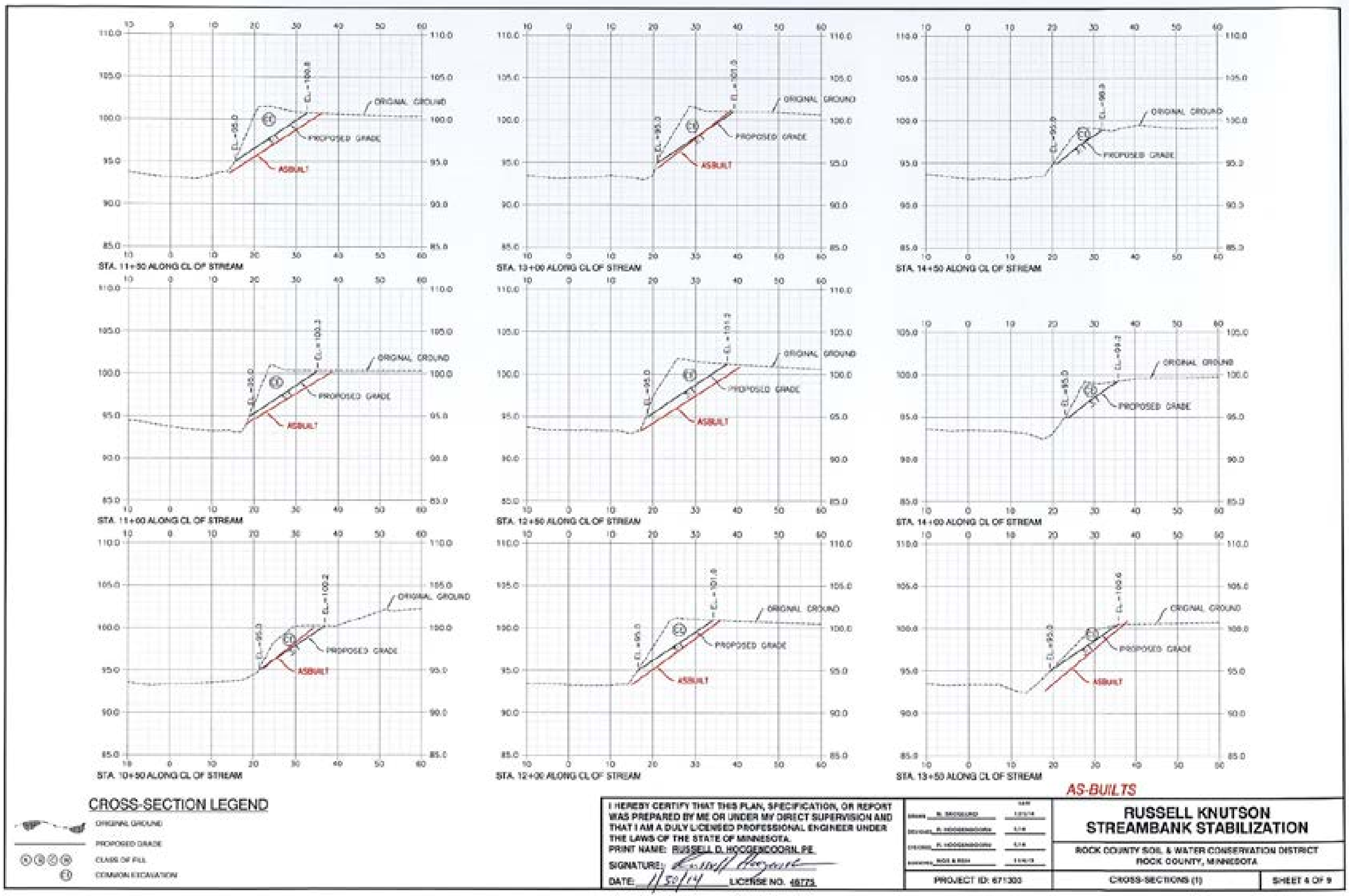


Figure 28-7. Sheet 4 of the as-built construction plan set as an example of proposed cross sections and bank grading.

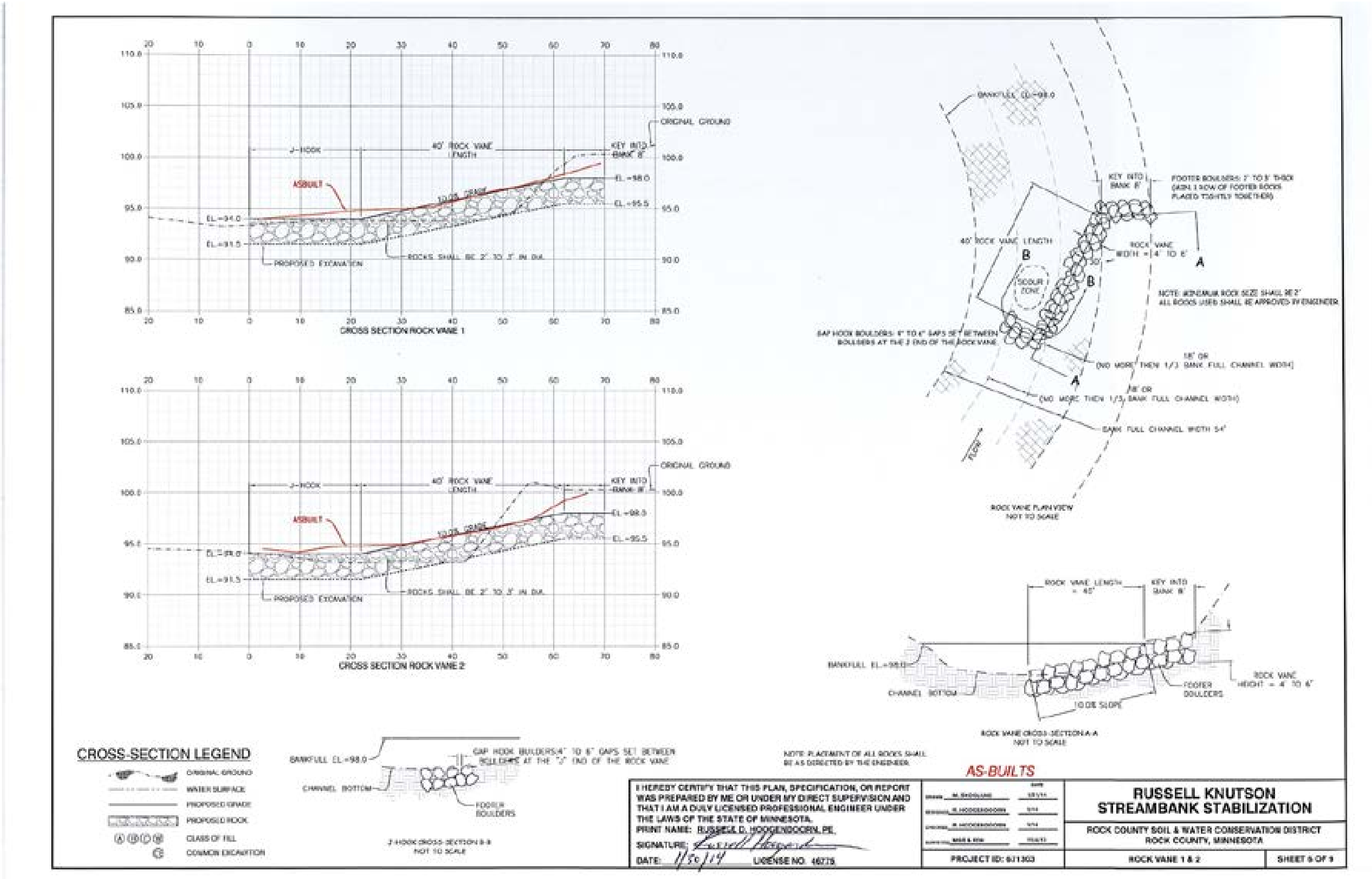


Figure 28-8. Sheet 6 of the as-built construction plan set as an example of proposed J-hook profiles and construction details.

Table 28-1. Results of meander survey through project area. Meander survey occurred 8/22/19 by Mark Pranckus, Cardno. Meander times were 11:45 – 12:15.

Scientific Name	Common Name	Species Status
Phalaris arundinacea	Reed Canary Grass	Non-native
Xanthium strumarium	Cocklebur	Native
Poa pratensis	Kentucky Bluegrass	Non-native
Festuca rubra	Creeping Fescue	Non-native
Elymus repens	Quackgrass	Non-native
Bidens connata	Purple-stem Beggarticks	Native
Populus deltoides	Eastern Cottonwood	Native
Persicaria pensylvanica	Pennsylvania Smartweed	native
Solidago canadensis	Canada Goldenrod	Native
Rumex crispus	Curly Dock	Native
Bromus inermis	Smooth Brome	Non-native
Acer Negundo	Box Elder	Native
Solidago gigantea	Giant Goldenrod	Native
Equisetum hyemale	Tall Scouring Rush	Native
Urtica dioica	Stinging Nettle	Native
Verbena hastata	Blue Vervain	Native
Salix interior	Sandbar Willow	Native
Echinochloa crus-galli	Barnyard Grass	Non-native
Securigera varia	Crown Vetch	Non-native
Helianthus annus	Common Sunflower	Native
Panicum virgatum	Switchgrass	Native
Phleum pratense	Wild Timothy	Non-native
Sagittaria latifolia	Broad-leaf Arrowhead	Native
Echinocystis lobata	Wild Cucumber	Native
Scutellaria lateriflora	Mad-dog Skullcap	Native
Poa palustris	Fowl Meadow Grass	Native
Taraxacum officinale	Dandelion	Non-native
Mimulus ringens	Monkeyflower	Native
Cyperus odorata	Rusty Flatsedge	Native
Salix nigra	Black Willow	Native
Eragrostis hypnoides	Creeping Lovegrass	Native
Equisetum arvense	Field horsetail	Native
Penthorum sedoides	Ditch Stonecrop	Native
Mentha arvensis	Wild Mint	Native
Verbena hastata	Hoary Vervain	Native
Setaria pumila	Yellow Foxtail	Non-native
Persicaria hydropiper	Marsh Waterpepper	Non-native
Lactuca biennis	Wild Lettuce	Native
Panicum capillare	Hairy Witchgrass	Native
Solanum rostratum	Buffalo-bur	Native
Asclepias syriaca	Common Milkweed	Native
Bull Thistle	Cirsium vulgare	Non-native
Conyza canadensis	Canadian Horseweed	Native
Centaurea stoebe	Spotted Knapweed	Non-native
Helianthus strumosus	Woodland Sunflower	Native

Appendix B: Site Photographs

Photo 28-1. Looking upstream at the upstream project area. Locations of four of the six rock J-hook vanes are identified. Vegetation along the bank is 3 to 4 feet tall and well-established. (Photo taken 8/22/19 by Mark Pranckus, Cardno).

Photo 28-2. Looking upstream at the upstream project area following construction in 2014 showing five of the six rock J-hook vanes. The areas between the vanes were graded to a 3:1 slope hydroseeded with native seed mix. Notice when compared to Photo 28-1, the elevation of rock on several structures have decreased, potentially due to rock moving during high flows. Photo provided by Scott Ralston (USFWS)

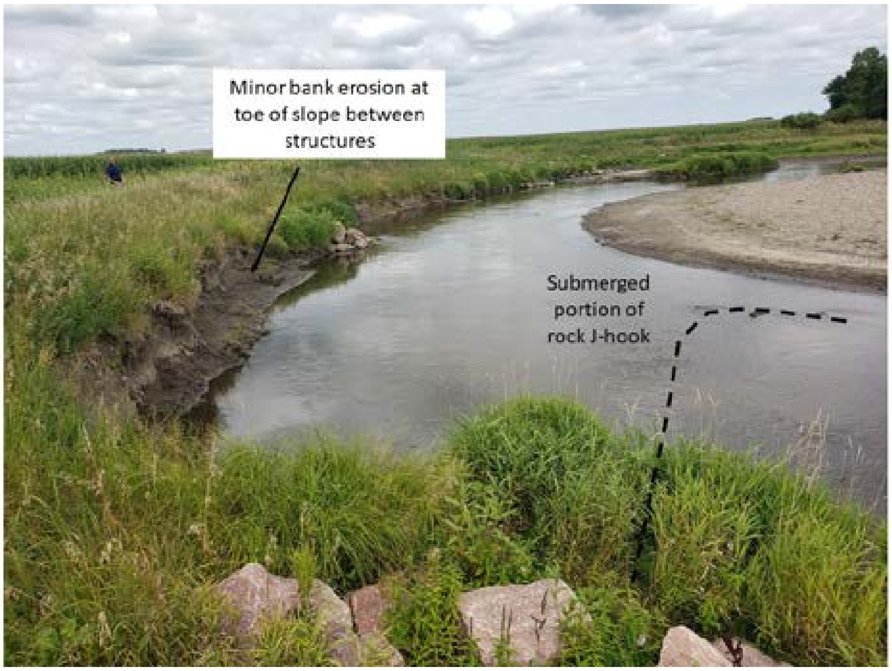


Photo 28-3. Looking upstream at the upstream project area. Minor bank erosion is occurring along the toe between J-hook vanes No. 4 and 5. (Photo taken 8/22/19 by Mark Pranckus, Cardno).

Photo 28-4. Looking downstream near the upstream end of the upstream project area prior to construction in 2014. Note the nearly vertical, severely eroding banks. Rocks used to create the J-hook vanes can be observed along the top of the bank. Photo provided by Scott Ralston (USFWS).

Photo 28-5. Looking upstream at the downstream project area. The two rock J-hook vanes installed in the project area can be seen. A large amount of sediment has accumulated between the structures, which helps to build the bank and protect against erosion. If the upstream vane angle was greater and extended into the channel more, the sediment in the hook of the vane would likely be scoured out, creating pool habitat. (Photo taken 8/22/19 by Mark Pranckus, Cardno).

29) Rush Creek Restoration/Enhancement

Project Background

Project Name: Rush Creek Restoration

Project Site: Rush Creek, Winona County

Township/Range Section: Township 105N Range 8W Section 33

Project Manager / Affiliated Organization: John Lenczewski, Minnesota Trout Unlimited

Fund: OHF ***Fiscal Year Funds:*** FY 10

Project Start Date: 2011

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Prairie / Savana / Grassland , Choose an item.

Project Status: Post Establishment Phase

County: Winona

Primary Activity: Stream/River Enhancement

Project Size: 2,400 linear feet

Project Completed: 2011

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Bank grading and rip rap installation to stabilize eroding banks.
   Installation of several instream structures including cross vanes, boulder J-hook vanes, and random boulder clusters.
   Installation of rootwads to increase habitat complexity.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   There is a 12 page report that includes a narrative on the history of the project, the goals, and the planned activities. A construction plan set was also included in the report.
3. ***What are the stated goals of the project?***
   Reduce streambank erosion and associated sedimentation.
   Reconnect the stream to its floodplain to reduce the negative impacts from severe flooding.
   Increase natural reproduction of trout and other aquatic organisms.
   Maintain or increase adult trout abundance.
   Increase biodiversity for both in-stream and non-game species.
   Be long-lasting with minimal maintenance required.
   Improve angler access.

4. ***What are the desired outcomes of achieving the stated goals of the project?***
   This stretch of Rush Creek will have stable banks, improved adult trout habitat, and anglers will have increased access and opportunities to pursue trout.
5. ***Were measures of restoration success identified in plans?*** Yes
   If yes, list specific measurements.
   Stable banks
   Improved trout fishing
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   2012 Rush Creek Stream Restoration Project, Winona County, MN. Winona County. WHKS. A 10-sheet construction plan set that includes location, plan view, cross sections, and construction detail information.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Eroding streambanks were graded from nearly vertical to a less steep slope (ranging from 2(H):1(V) to 3:1). A stone toe was added along the bank at all outside bends. Point bar and inside bank grading occurred at most meander bends. In-stream structures were installed to direct flows into or out of three of the five meander bends through the project area. In-stream habitat was enhanced by installing random boulder clusters throughout the project reach and install rootwads along the lower third of the project.
   NRCS provided approximately two-thirds of the funding for this project. The design followed NRCS specifications for streambank stabilization. The design was based on the best science available at the time given the limitations of needing to meet NRCS specifications to qualify for funding.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Random boulder clusters were added throughout the project area.
9. ***In what ways did alterations change the proposed project outcome?***
   The boulder clusters added habitat value to the overall stream reach. The bank grading and stone toe installations addressed the eroding bank issues. The addition of the boulder clusters provided the habitat enhancement that other elements of the project didn’t necessarily address. The boulder clusters also enhance the habitat value of the rootwads and the vane structures by providing a different habitat element.

Site Assessment

Field Review Date: 10/17/2019

Field Visit Attendees: Melissa Wagner, MN DNR; Wade Johnson, MN DNR; John Lenczewski, MNTU; Mark Pranckus, Cardno (Contracted Assessor)

10. ***Surrounding Landscape Characteristics:***

Mix of forested, steep bluffs with row crop agriculture and hayland/pastures on flat to gentle slopes.

11. ***Site Characteristics:***

   a. ***Soil Series:***

      Chaseburg silt loam - Moderately well drained, 0 to 2 percent slopes
      Minneiska fine sandy loam - Channeled
      Plainfield sand - River valley, 12 to 25 percent slopes
      Festina silt loam, 1 to 6 percent slopes
      Chaseburg silt loam - Channeled
      Volney channery silt loam – Occasionally flooded, 2 to 12 percent slopes

   b. ***Topography:***

      Part of the Driftless portion of Minnesota. Characterized by narrow to wide valleys bounded by steep bluffs. The project site was located where the valley was generally 1,000 feet wide. Relatively flat floodplain. Stream is likely both incised and entrenched.

   c. ***Hydrology:***

      Perennial stream with flashy hydrology during storm events. Groundwater-driven enough to support a coldwater fishery.

   d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***

      The plant community is a combination of non-native, cool-season grazed pasture and native, warm season grasses on slopes where grazing has been limited. There are isolated patches of willows on the bank and within the floodplain. Forbs are relatively limited.

   e. ***Vegetation B: Meander Search Species List (as appropriate for site)***

      See Table 29-1 in Appendix A for species observed during the site visit.

12. ***Is the plan based on current science?*** Yes

The project design was based on NRCS specifications that were current at the time the project was implemented. If the project were designed and constructed today with the same sideboard of having to meet NRCS specifications for funding purposes, the majority of the design elements would be very similar. There would likely be less emphasis on using stone to protect the toe through the entire project area, but seek to minimize either rock height or be strategic in where it is placed.

13. ***List indicators of project goals at this stage of project:***

The project had seven goals. Observed indicators for all seven include:

- Significantly less streambank erosion through the project area. Banks are well-vegetated.
- The upper two-thirds of the project has better connection to the floodplain; however, the overall project area is still somewhat disconnected from the floodplain, especially at less than severe floods.
- Trout were observed on a spawning bed during the assessment where gravel had deposited due to the influence of a cross vane and random boulder clusters.
- Several adult trout were observed using the structures and swimming into the bank where overhanging vegetation was present. Based on interviews at the site, fish abundance has increased.
- A spoils pile created during construction was deliberately left to have a steep face to provide bank swallow habitat. The steep, bare-soil embankment is still present.
- It has been approximately 8 years since the project was complete. MNTU and MN DNR have not reported significant maintenance being done to the project area. The landowner has grazed the

banks, indicating the importance of periodic grazing to minimize woody vegetation establishment.
- Anecdotal evidence indicates anglers are fishing this stream reach more than prior to when the project was completed.

14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Yes. It has been 8 years since the project was complete. It is meeting at least some portion of each of the seven goals identified.
15. ***Are corrections or modifications needed to achieving proposed goals?***
    None at this time.
16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    Future management should continue to consider periodic grazing by cattle or goats to keep woody vegetation such as boxelders from developing on the streambanks. If possible, a prescribed burn or periodic mowing would suffice in lieu of a burn.
    The floodplain connection goal is probably the weakest under the current design. In the upper two-thirds of the project area there was at least some bank grading on the point bars and inside bank. On the lower third, there was none and that's where the most current erosion and bank slumping is occurring. It's currently nothing like previous conditions. A missed opportunity, likely driven by NRCS specifications and funding at the time, would have been to lower at least one bank to provide greater flood conveyance and floodplain connection for higher frequency floods. The obstacle likely was, and still is, the cost associated with moving a large amount of soil to accomplish the desired outcome.
    Increased duration, intensity, and frequency of flooding will present future changes and limitations to maintaining project success. The project received a significant flood event in the summer 2019 and had limited negative impacts. If the project area were to receive several more similar type events in consecutive years, some of the vegetative bank protection may be impacted causing the potential for bank erosion. Currently, a portion of the project area is grazed and a portion has been grazed in the past, but it was not currently grazed at the time of the assessment. Continuous, unmanaged grazing through the project would represent a potential challenge to the stability of the site
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No.
18. ***Are follow-up assessments needed? Explain.***
    None at this time.
19. ***Additional comments on the restoration project.***
    Rush Creek has a high sediment load. Most of the stream was dominated by a sand bottom. The random boulder clusters weren't included on the initial plan, but their addition helps significantly to provide in-stream habitat that isn't currently available.
    NRCS's involvement in the project was beneficial because they were a financial partner and able to bring technical expertise; however, the portfolio of acceptable practices during the design was fairly limited. Since that time period, it is reported by project managers and area fisheries staff that a similar type of project would have more practices that qualify for funding under NRCS guidelines.

Overall, for the time and context that this project was designed and constructed, it appears to maximize the benefits of being a bank stabilization project.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium
22. ***Provide explanation of reason(s) for determination.***
    Currently the project is meeting at least some portion of all seven goals outlined in the project plan. It has been 8 years since the project was completed, so in all likelihood it should continue to meet those goals and outcomes. A combination of climate change and a change in local land management could impact how long this continues. Overgrazing could weaken the vegetation or no grazing/vegetation management could allow for boxelders and other low quality trees to become established, reducing the understory vegetation. In both situations, reduced vegetation makes the banks more susceptible to erosion during floods, especially if floods are larger and more frequent.
23. ***Site Assessor(s) Conducting Review:***
    Mark Pranckus, Cardno

Appendix A: Site maps, Project plans or Vegetation tables

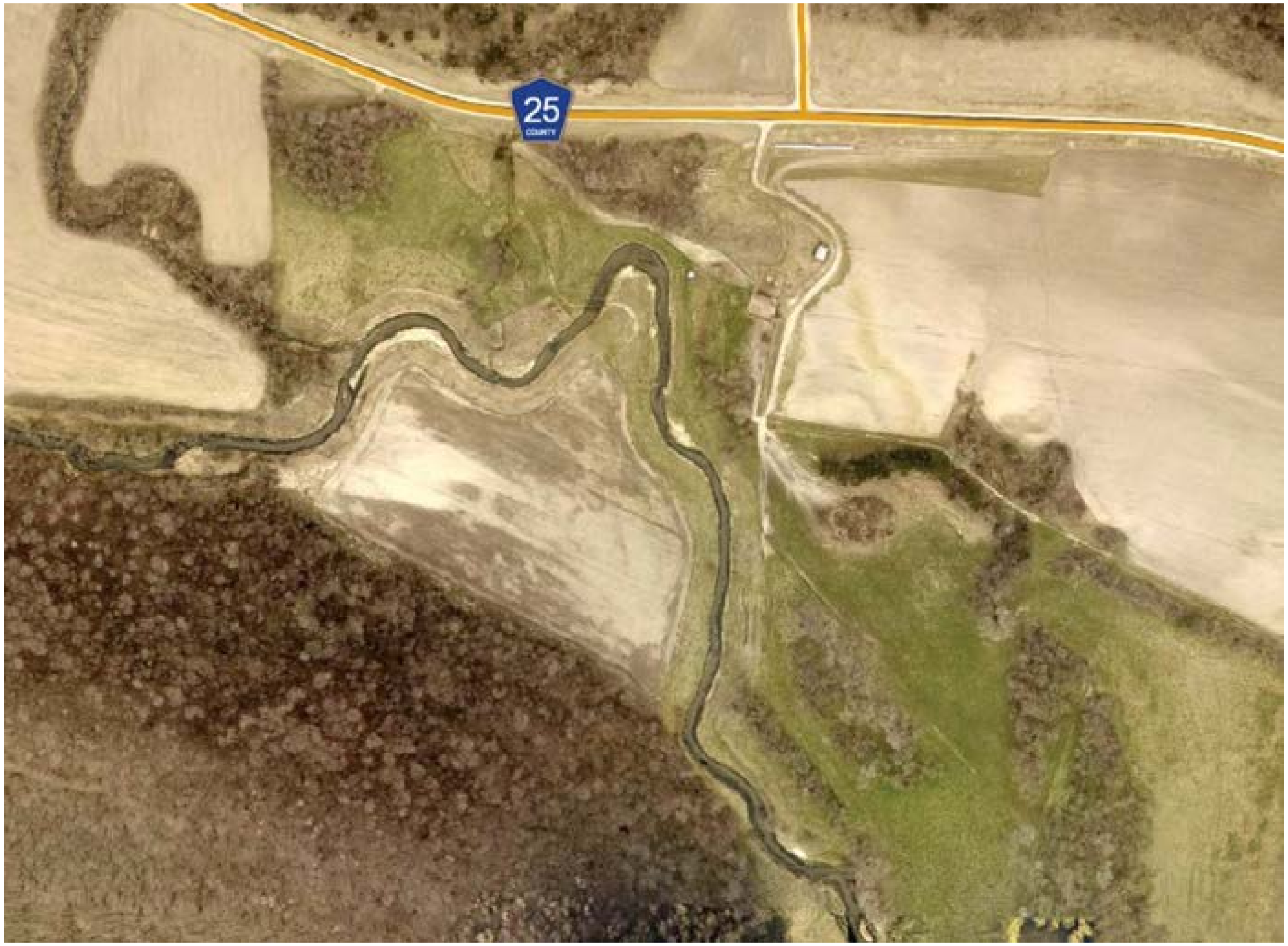


Photo 29-1 Aerial of the project site from 2016, 5 years after construction. Aerial imagery provided by Winona County, Minnesota.

Photo 29-2 Aerial image of the project site from 2008, prior to construction in 2011. Areas highlighted in red indicate severely eroding banks. Aerial photography is from April 2008 and provided by Google Earth.

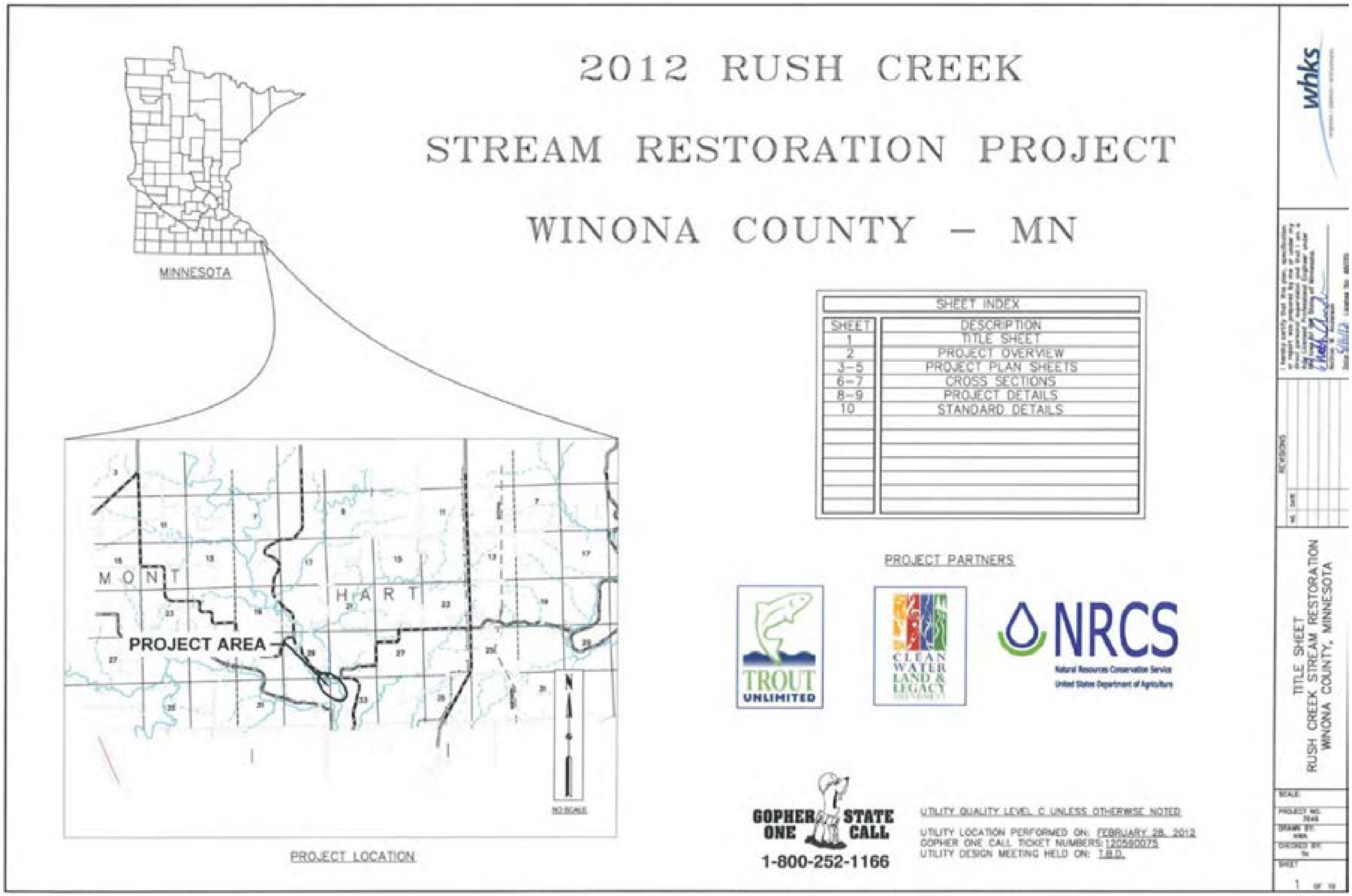


Figure 29-1 Sheet 1 of the construction plan set showing project location and sponsor information.

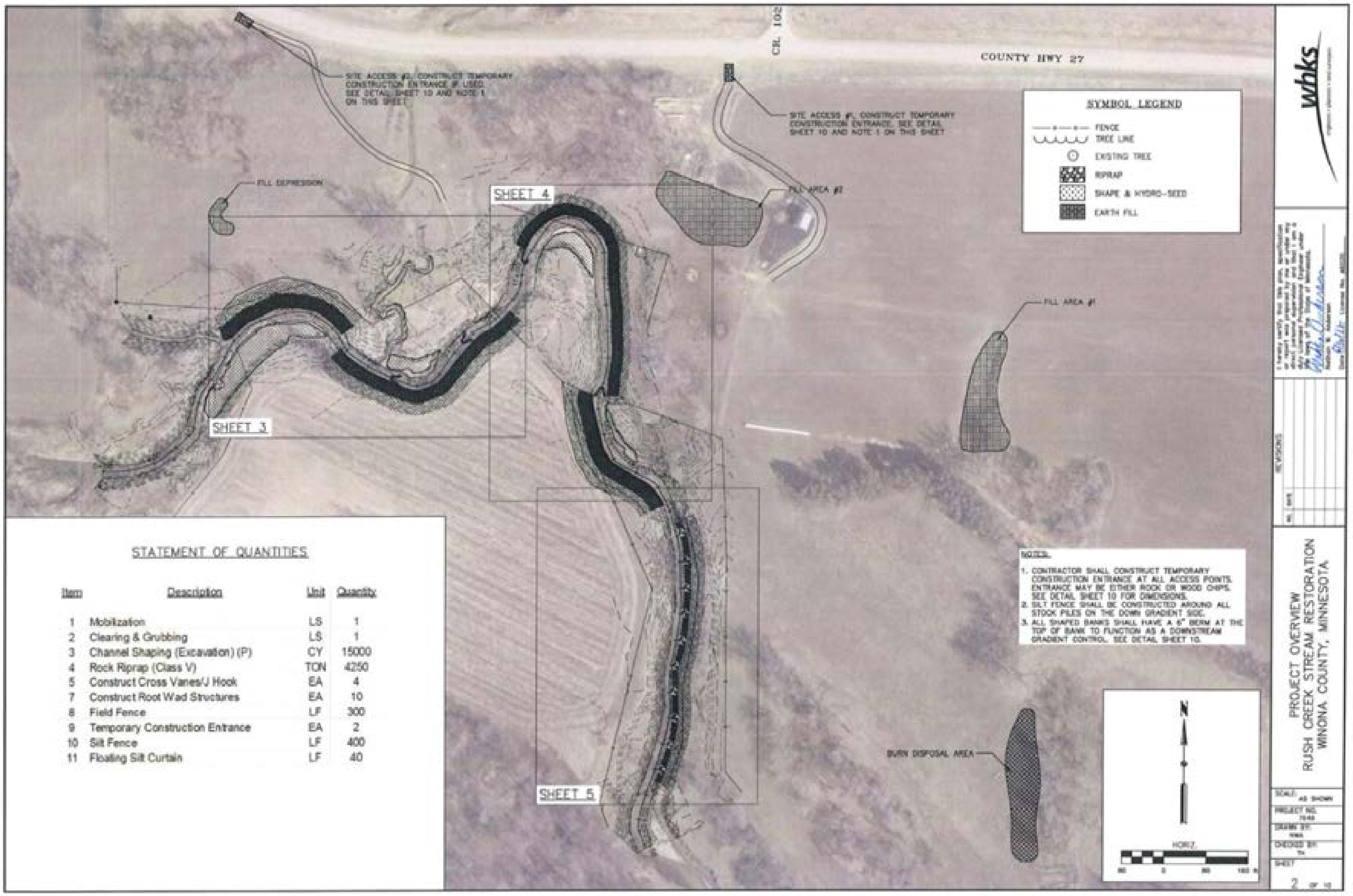


Figure 29-2 Sheet 2 of the construction plan set showing overview of the project, construction sheet extents, and material quantities.

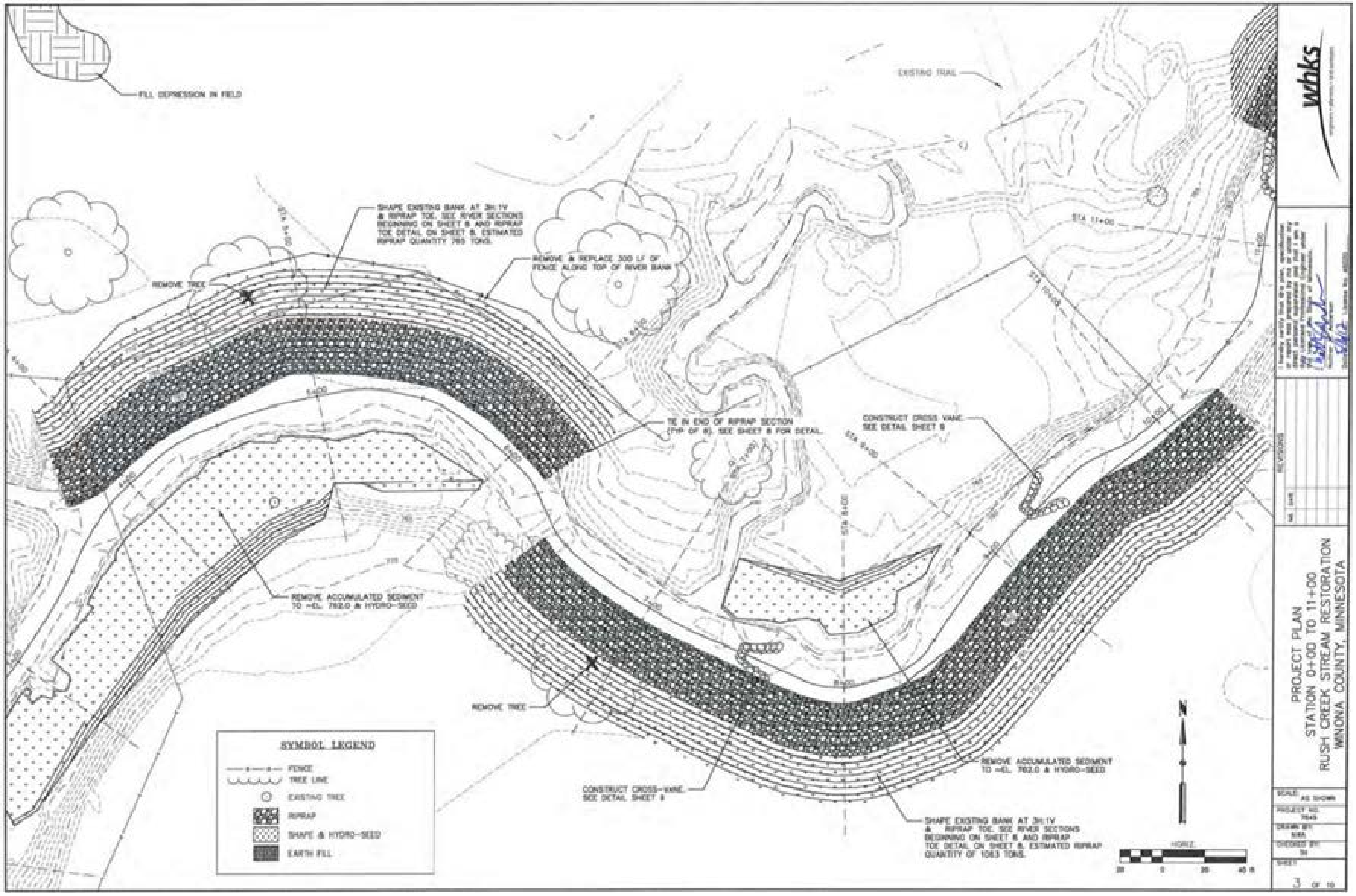


Figure 29-3 Sheet 3 of the construction plan set showing treatments from Station 0+00 through Station 10+00.

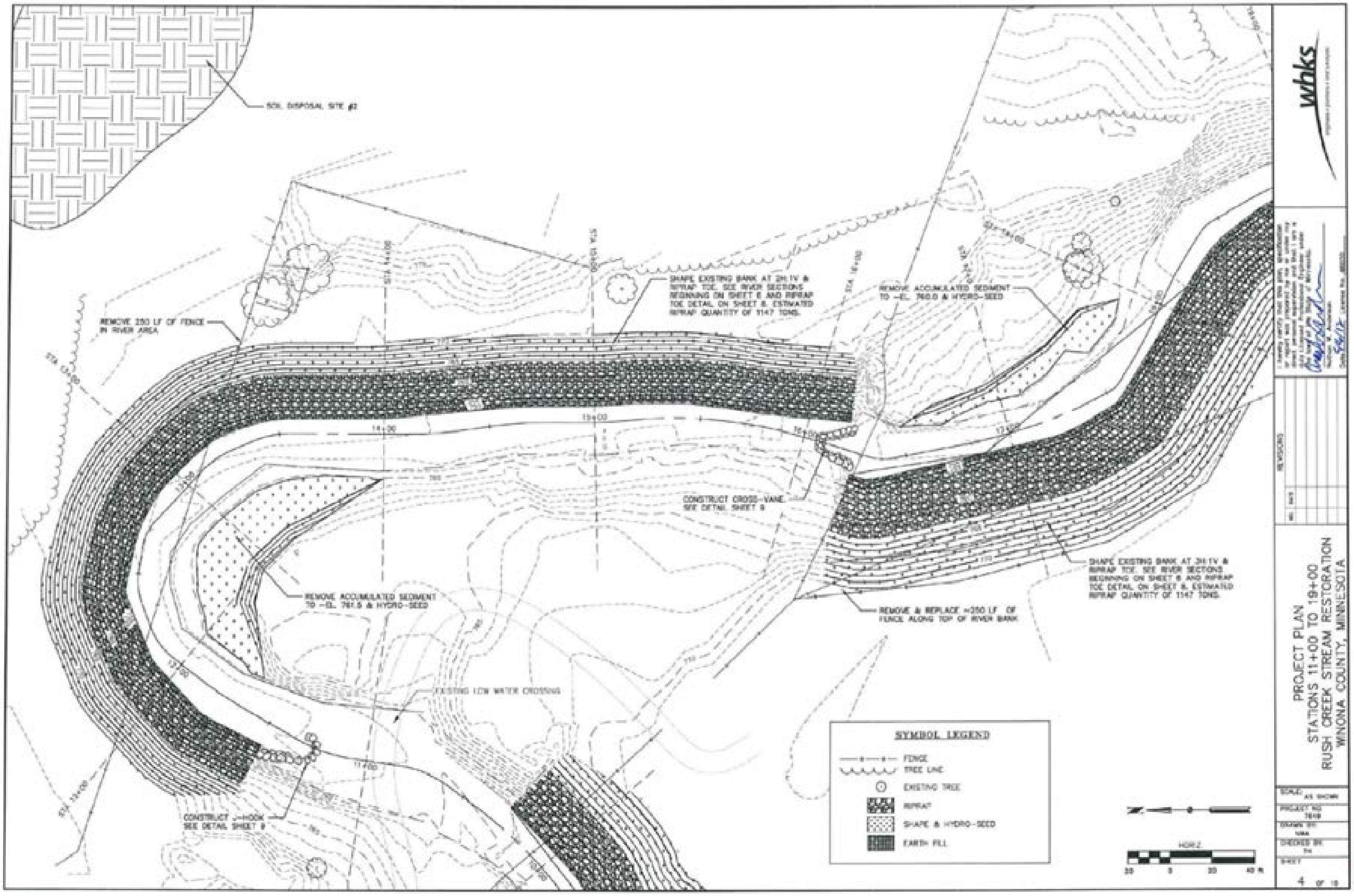


Figure 29-4 Sheet 4 of the construction plan set showing treatments from Station 10+00 through Station 18+00.

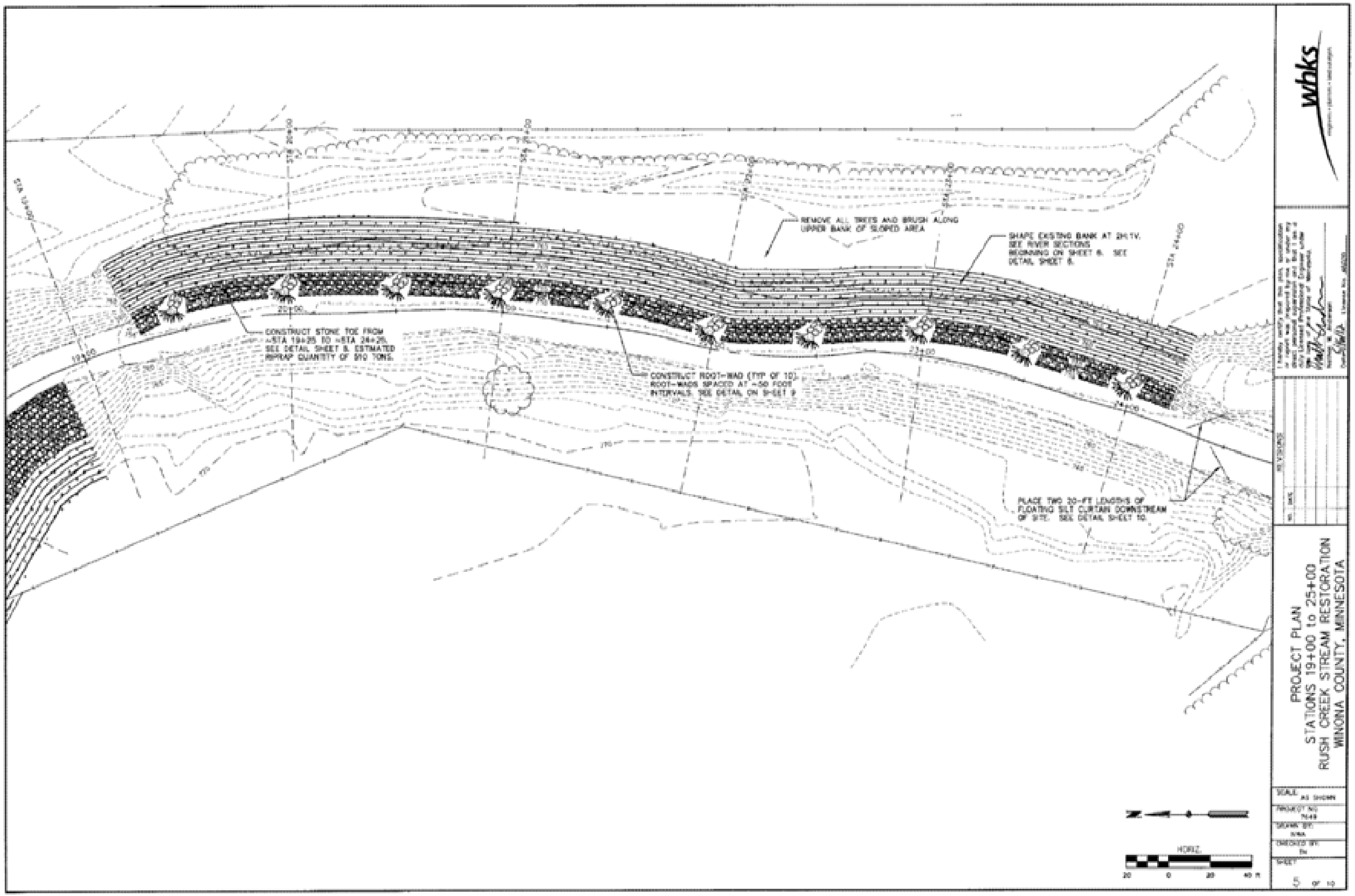


Figure 29-5 Sheet 5 of the construction plan set showing treatments from Station 19+00 through Station 24+00.

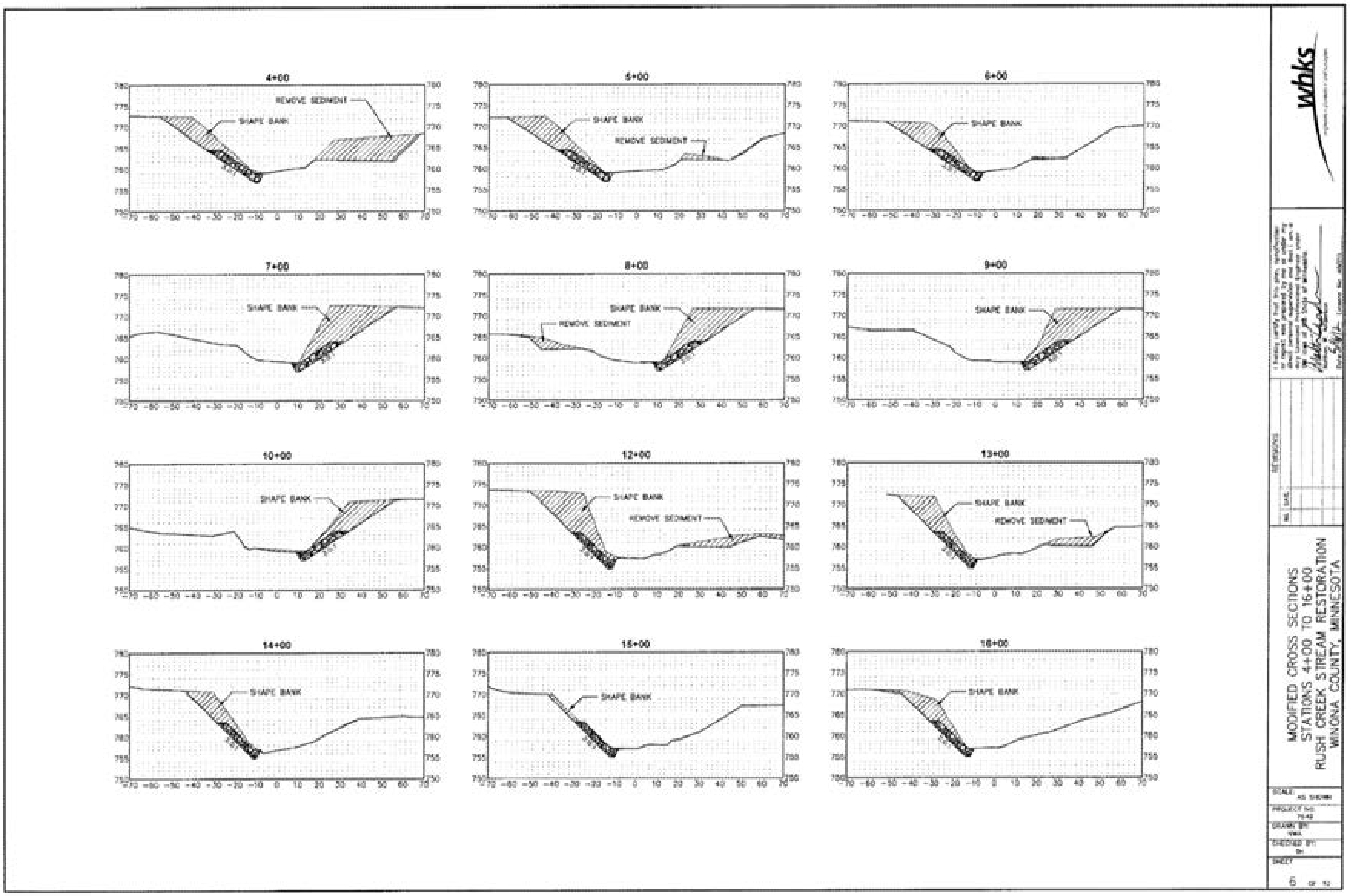


Figure 29-6 Sheet 6 of the construction plan set showing existing and proposed cross sections.

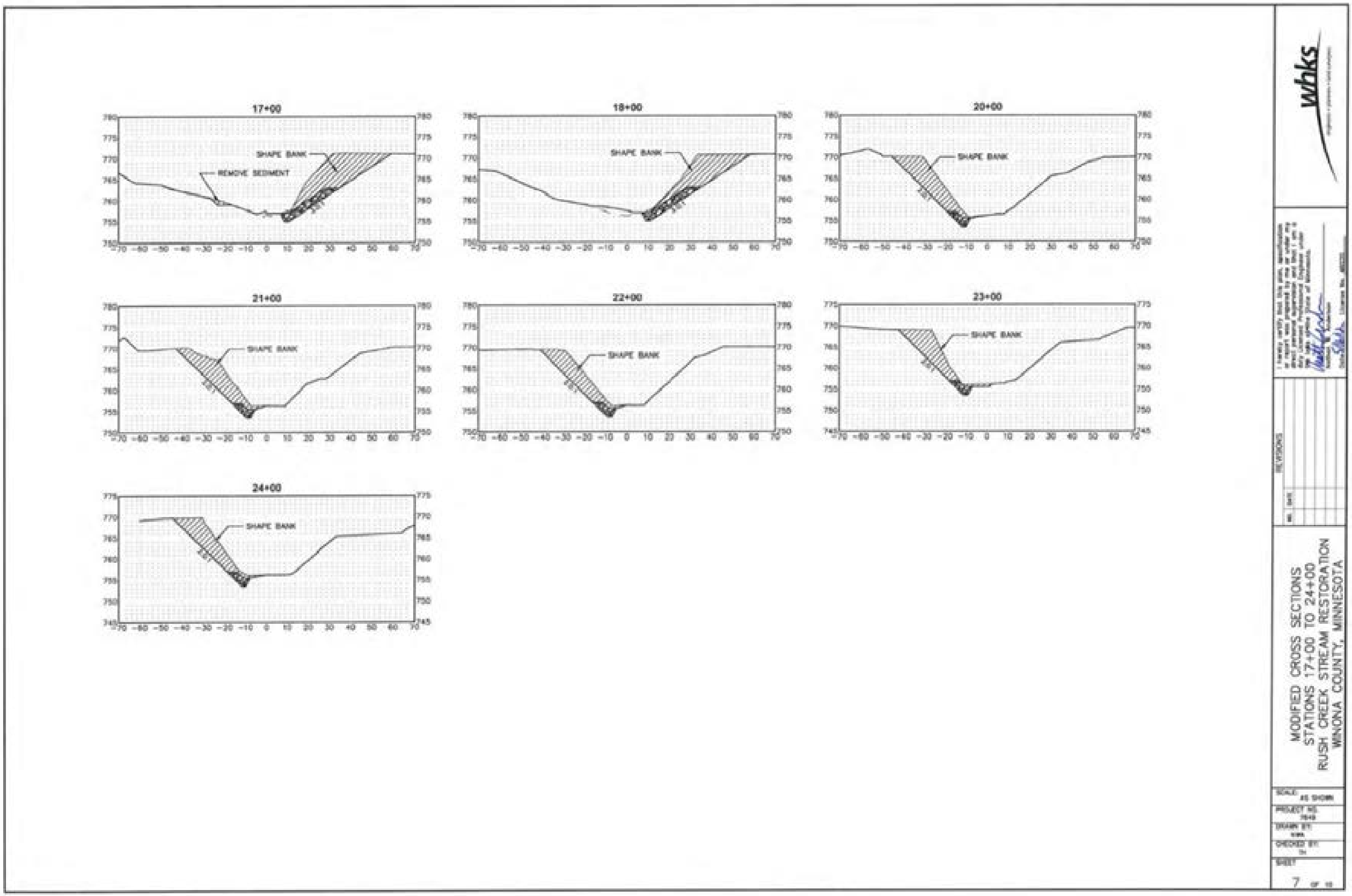
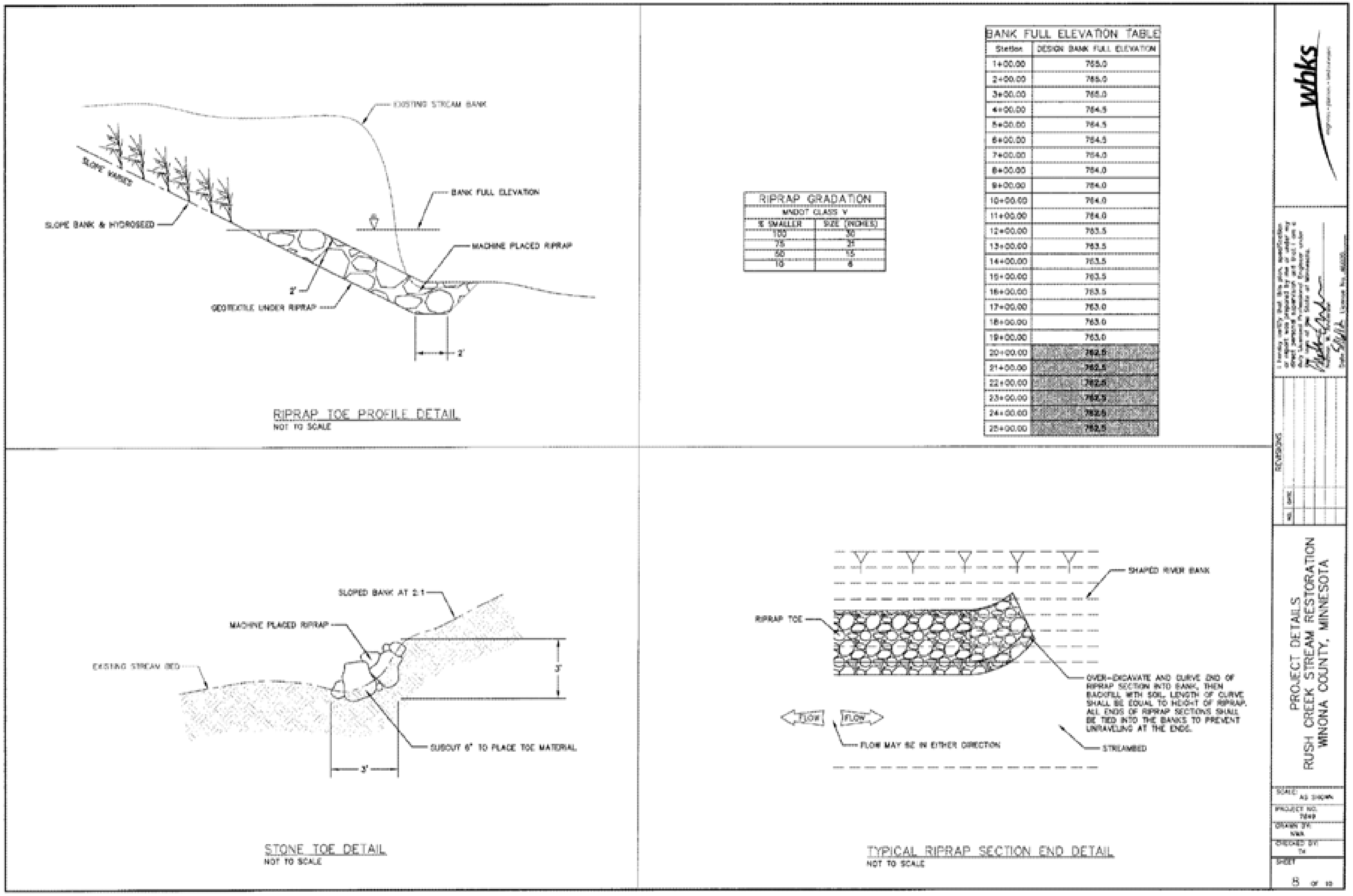


Figure 29-7 Sheet 7 of the construction plan set showing existing and proposed cross sections.



RIPRAP GRADATION	
MNDOT CLASS V	
% SMALLER	SIZE (INCHES)
100	30
75	21
50	15
10	6

BANK FULL ELEVATION TABLE	
Station	DESIGN BANK FULL ELEVATION
1+00.00	765.0
2+00.00	765.0
3+00.00	765.0
4+00.00	764.5
5+00.00	764.5
6+00.00	764.5
7+00.00	764.0
8+00.00	764.0
9+00.00	764.0
10+00.00	764.0
11+00.00	764.0
12+00.00	763.5
13+00.00	763.5
14+00.00	763.5
15+00.00	763.5
16+00.00	763.5
17+00.00	763.0
18+00.00	763.0
19+00.00	763.0
20+00.00	762.5
21+00.00	762.5
22+00.00	762.5
23+00.00	762.5
24+00.00	762.5
25+00.00	762.5

Figure 29-8 Sheet 8 of the construction plan set showing construction details.

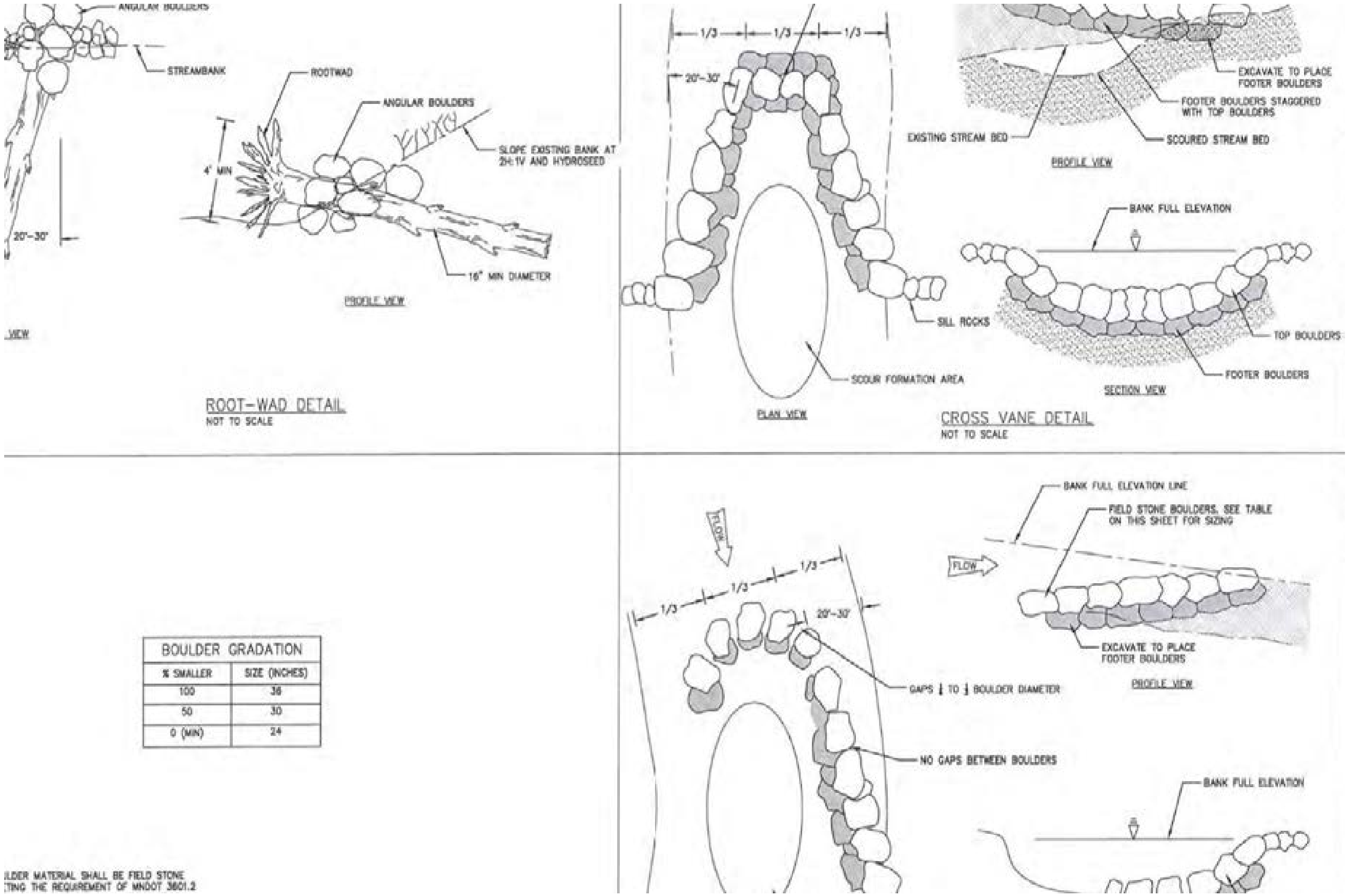


Figure 29-9 Sheet 9 of the construction plan set showing construction details.

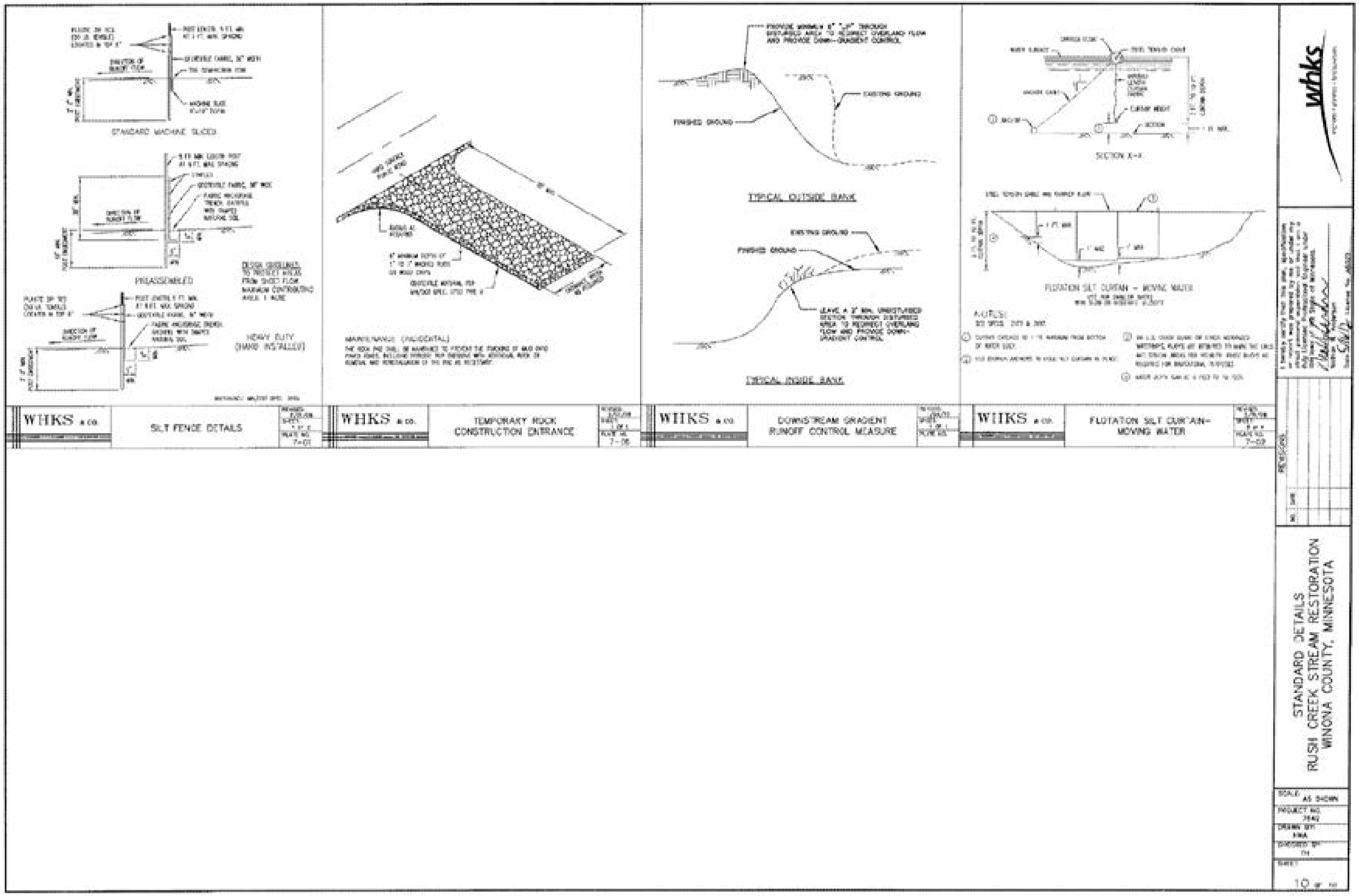


Figure 29-10 Sheet 10 of the construction plan set showing construction details.

Table 29-1 Results of meander survey through project area. Cover ranges were estimated visually. Meander survey occurred 10/17/19 by Mark Pranckus, Cardno. Meander times were 10:15 – 11:45.

Scientific Name	**Common Name**	**Cover Range**	**Species Planted/Seeded**	**Species Status**
Andropogon gerardii	Big Bluestem	25-50%	Yes	Native
Solidago spp. *(S. altissima* and *S. gigantea)*	Canada Goldenrod	25-50%	No	Native
Setaria pumila	Yellow Foxtail	25-50%	No	Non-Native
Bromus inermis	Smooth Brome	25-50%	No	Non-Native
Asclepias syriaca	Common Milkweed	1-5%	Yes	Native
Arctium minus	Lesser Burdock	1-5%	No	Non-Native
Achillea millefolium	Common Yarrow	1-5%	No	Native
Zizia aurea	Golden Alexanders	1-5%	Yes	Native
Phalaris arundinacea	Reed Canary Grass	5-25%	No	Native
Monarda fistulosa	Wild Bergamot	5-25%	Yes	Native
Ambrosia trifida	Giant Ragweed	1-5%	No	Native
Verbena urticifolia	White Vervain	1-5%	No	Native
Rumex crispus	Curly Dock	0-1%	No	Non-Native
Taraxacum officinale	Common Dandelion	0-1%	No	Native
Agrostis gigantea	Redtop	1-5%	No	Non-Native
Melilotus officinalis	Sweet Clover	5-25%	No	Non-Native
Persicaria hydropiper	Marshpepper Knotweed	0-1%	No	Native
Bouteloua curtipendula	Side-Oats Grama	0-1%	Yes	Native
Panicum virgatum	Switchgrass	1-5%	Yes	Native
Sorghastrum nutans	Indian Grass	5-25%	Yes	Native
Oenothera biennis	Common Evening Primrose	1-5%	No	Native
Ratibida pinnata	Pinnate Prairie Coneflower	1-5%	No	Native
Symphyotrichum ericoides	Heath Aster	5-25%	Yes	Native
Salix exigua	Narrowleaf Willow	5-25%	No	Native
Elymus virginicus	Virginia Wild Rye	1-5%	Yes	
Trifolium pratense	Red Clover	1-5%	No	Non-Native
Dalea candida	White Prairie Clover	1-5%	Yes	Native
Asclepias tuberosa	Butterfly Milkweed	0-1%	Yes	Native
Elymus trachycaulus	Slender Wheatgrass	1-5%	Yes	Native
Geum aleppicum	Yellow Avens	5-25%	No	Native
Bidens connata	Purple-Stem Beggarsticks	0-1%	No	Native

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Symphyotrichum laeve	Smooth Aster	5-25%	Yes	Native
Mentha arvensis	Wild Mint	5-25%	No	Native
Rudbeckia laciniata	Cutleaf Coneflower	1-5%	Yes	Native
Eupatorium perfoliatum	Common Boneset	0-1%	Yes	Native
Lobelia siphilitica	Great Lobelia	0-1%	Yes	Native
Carex stricta	Tussock Sedge	0-1%	Yes	Native
Cirsium arvense	Canada Thistle	0-1%	No	Non-Native
Abutilon theophrasti	Velvetleaf	1-5%	No	Non-Native
Amaranthus albus	Prostrate Pigweed	0-1%	No	Non-Native
Verbena hastata	Blue Vervain	1-5%	Yes	Native
Salix petiolaris	Meadow Willow	0-1%	No	Native
Tanacetum vulgare	Common Tansy	1-5%	No	Non-Native
Chamaecrista fasciculata	Partridge Pea	0-1%	Yes	Native
Urtica dioica	Stinging Nettle	1-5%	No	Native
Calystegia sepium	Hedge False Bindweed	1-5%	No	Native
Plantago major	Common Plantain	1-5%	No	Non-Native
Helianthus giganteus	Giant Sunflower	0-1%	No	Native

Appendix B: Site Photographs

Photo 29-3 Example of an eroding bank taken in 2011 prior to the construction project. Photo provided by John Lenczewski, MNTU.

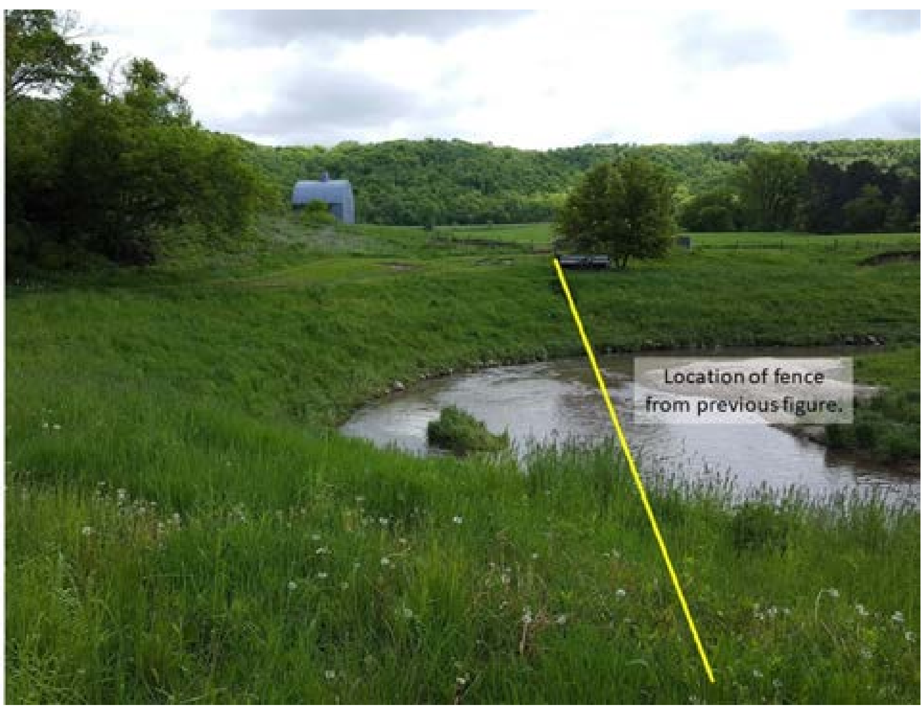


Photo 29-4 Example of the same bank as Photo 29-1 in July 2019, 8 years after the project was completed. Photo provided by John Lenczewski, MNTU.

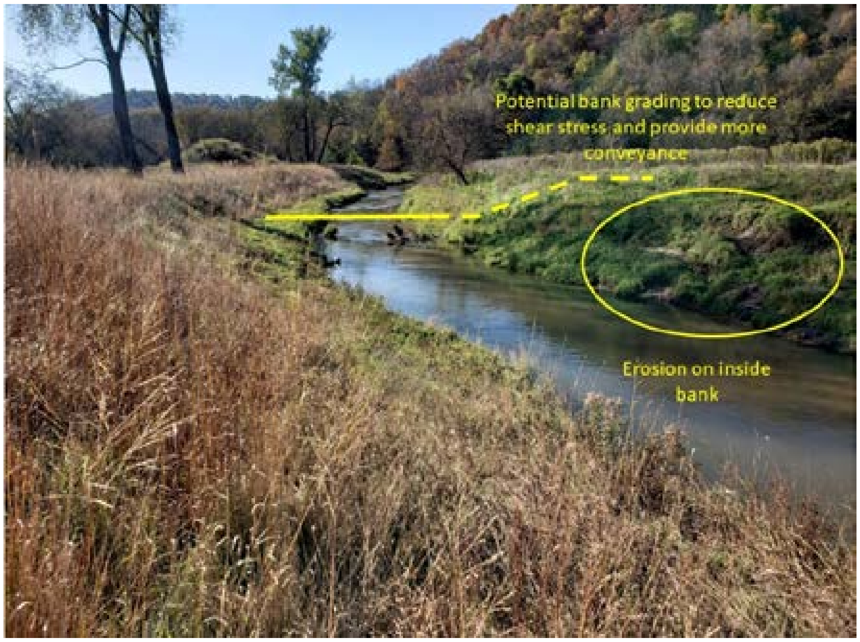


Photo 29-5 Example of looking downstream at the lower third of the project. A bench is forming on the left downstream bank where sediment is depositing on top of riprap. The dashed line represents where grading could have occurred to further improve floodplain connection and promote stream stability. Photo taken on 10/18/19 by Mark Pranckus, Cardno.

Photo 29-6. Example looking upstream near the middle of the project reach. Random boulder cluster in the foreground. A J-hook with a designated cattle crossing where riffles are occurring. Photo taken on 10/18/19 by Mark Pranckus, Cardno.

Photo 29-7 Example of three habitat features including a rootwad, random boulder cluster, and wood that was recruited into the stream reach during a past high flow event. Photo taken on 10/18/19 by Mark Pranckus, Cardno.

Photo 29-8. Example of the rootwads installed into the bank on the lower third of the project reach to provide some habitat complexity. Photo taken on 10/18/19 by Mark Pranckus, Cardno.

Photo 29-9 Example of one of the cross vanes installed for the project creating and maintaining a scour pool for fish habitat and energy dissipation. Photo taken on 10/18/19 by Mark Pranckus, Cardno.

Photo 29-10 Example of small gravel associated with a downstream cross vane and upstream random boulder cluster. Gravel serves as a spawning location for trout where they make a depression to lay eggs (redd). Adults were observed on a redd during the field assessment. Photo taken on 10/18/19 by Mark Pranckus, Cardno.

Photo 29-11 Example of non-game benefits to the project. An embankment made of excavation spoils in the uplands was left with a sheer face to provide bank swallow habitat. Eight years later and the bank is still available for bank swallow nesting. Photo taken on 10/18/19 by Mark Pranckus, Cardno.

30) Sauk River Dam Removal and Streambank Restoration

Project Background

Project Name: Sauk River Streambank Stabilization

Project Site: City of St. Cloud – Whitney Park

Township/Range Section: Township 124N Range 28W Section 3

Project Manager / Affiliated Organization: Scott Zlotnik, City of St. Cloud

Fund: OHF - CPL ***Fiscal Year Funds:*** FY15

Project also used FY 2013 CWF – Clean Water Assistance grant (Whitney Park, City of Cold Spring and City of Sauk Centre)

Project Start Date: July 2017

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Establishment Phase

County: Stearns

Primary Activity: Stream/River Enhancement

Project Size: 450 linear feet

Project Completed: May 2018

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   An eroding bank on the Sauk River was stabilized by installing a toewood bench and two rock stream barbs at the upstream and downstream ends of the bank treatment. The eroding bank above the toewood bench was sloped, covered with erosion control material and planted with native vegetation. A lowhead dam approximately 260 feet upstream of the project area was removed because it was causing erosion at the project area during storm events. Additional project goals included restoring and preserving riparian fish and wildlife habitat.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Two page project summary that includes the goal of the project, the outcome, and before, during, and after photos.
   A construction plan set for the bank stabilization portion of the project with as-built mark-ups.

A two page construction plan set with as-built mark-ups for slope repairs following completion of the first phase of construction.

3. ***What are the stated goals of the project?***
   The goal of the project was to reduce sediment and nutrients produced from an eroding bank on the Sauk River through stabilization using techniques (stream barbs, toewood, and native vegetation) that improve and support aquatic and riparian habitat.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   The desired outcome is a long-term reduction in sediment and nutrients inputs to the Sauk River directly contributed by the treatment bank.
5. ***Were measures of restoration success identified in plans? Yes***
   If yes, list specific measurements.
   An estimate in the annual reduction of the total tons of sediment and phosphorus produced by the treatment bank was provided in the brief project summary. These estimates are made by applying a standard methodology based on pre-project conditions and proposed post-project conditions. Monitoring of the site conditions in the future could verify that sediment and nutrient reduction were achieved.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   West Central Technical Service Area (WCTSA) Detail Plans for Bid Package #2 Whitney Park – St. Cloud Streambank Restoration, Stearns County, Minnesota. 2017 as-built plan set following initial construction of the project. The seven-page plan set includes as-built markups, treatment locations, existing and proposed cross sections, and construction details.

   West Central Technical Service Area (WCTSA) Detail Plans for Whitney Park – St. Cloud Streambank Restoration, Stearns County, Minnesota. 2018 as-built plan set for repairs to three slope failures post-project that occurred on the upper portion of the slope due to the influence of groundwater seeps. The two-page plan set includes as-built markups, treatment locations and specifications.

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   The bank was stabilized using a combination of in-stream structures, woody material, and native vegetation. Additionally, surface water to the bank and groundwater seeps within the treatment bank was managed through the installation of a French drain system at the top of the slope. This helps to prevent erosion and slope failure. An upstream lowhead dam was removed to reduce high flows being direct into the treatment bank by the dam spillway. The combination of all these facets are typical of current science for taking a multi-pronged approach to stabilizing eroding streambanks in a manner that provides stability and adds habitat value (toewood – fish and aquatic invertebrates, native vegetation – pollinator and wildlife that utilize riparian corridors).

   The toe of the eroding bank was stabilized by installing rootwads, logs, and coarse woody material to an elevation that creates a bench and is typically at or above the bankfull (1.5-year storm return interval) elevation. Long-term bank stabilization will be provided by the seeded and planted native vegetation. The City of St. Cloud also has a management contract with a natural resource management company to provide maintenance for the native plant community during establishment, which is a key to promoting long-term success of the project.

The two stream barbs will help direct high flows away from the bank, reducing shear stress.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Repairs were made to three areas along the upper slope to groundwater seeps causing slope failures post-project. Two iterations of the repairs were required to stabilize the slope. The first iteration used heavy duty erosion control materials including turf reinforcement matting and a technical anchoring system. The second iteration used draintiles to capture groundwater and carry it to the bottom of the slope to prevent bank saturation and slumping.
9. ***In what ways did alterations change the proposed project outcome?***
   The alterations improved the overall outcome because without the repairs the upper slope would continue to erode and contribute sediment and nutrients to the Sauk River.

Site Assessment

Field Review Date: **6/26/2019**

Field Visit Attendees: Greg Berg, Stearns County SWCD, Gina Quiram MN DNR (Ecological and Water Resources), Wade Johnson MN DNR (Ecological and Water Resources), Mark Pranckus, Cardno (Contracted Assessor), Jason Hilst (City of St. Cloud), Chyann Erickson (City of St. Cloud), Noah Czech (City of St. Cloud), Scott Zlotnik (City of St. Cloud).

10. ***Surrounding Landscape Characteristics:***
    The project is located within the City of St. Cloud adjacent to Whitney Park, a heavily used athletic complex with ball fields, soccer fields, walking paths, and tennis courts. The primary land cover in Whitney Park is managed turf grass. Other adjacent landscape characteristics include mix of residential housing areas on the upstream and downstream ends of the project and floodplain forest primarily along the inside bends of the Sauk River. The floodplain forest helps to make up the riparian corridor and is approximately 800 feet wide within the project area.
11. ***Site Characteristics:***
    a. ***Soil Series:***
    Arvilla sandy loam
    b. ***Topography:***
    Steep slopes – 30 to 45 percent slopes
    c. ***Hydrology:***
    Well-drained, but at least three locations on the slope where groundwater seeps are present.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***

The bank is a combination of grasses, forbs, and woody species that were seeded and planted following construction.

*e. **Vegetation B: Meander Search Species List (as appropriate for site)***

See Table 30-1 in Appendix A for species observed during the site visit.

12. *Is the plan based on current science?* Yes

Yes. The combination of toewood to stabilize the base of an eroding slope with bank grading and native vegetation is an excepted practice for stream stabilization. The other techniques such as stream banks, removing the lowhead dam, and controlling surface and groundwater within the project area to prevent other erosion sources are typical of techniques that provide a comprehensive and additive approach to this type of project.

13. List indicators of project goals at this stage of project:

Little to no erosion at the base of the slope was observed. During the site visit, the Sauk River was at a stage where the stream barbs could be observed to be working in re-directing the flow away from the treatment bank. Native vegetation was extremely well-developed at the base of the slope including both woody vegetation material and seeded species.

The repaired portions of the slope appear to be stabilized. Vegetation on the mid to upper slopes is developing and will likely develop at a slower rate than the lower portion to due slope, soils, and that these areas have been recently disturbed due to repair construction.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes. Bank erosion has been significantly reduced through the toewood installation to prevent bank toe failure. Native vegetation, which will provide for long-term slope stability on the upper slopes will take time to develop, but the City of St. Cloud has invested in a maintenance contract with a natural resource management company to support the development process.

15. Are corrections or modifications needed to achieving proposed goals?

No. None needed at this point.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

The proposed and planned future steps including maintenance of the native plant community appear to be both practical and reasonable. For the scope and scale of the project, opportunities to improve project goals and outcomes were minimal because the project was well-done from the start and addressed unknowns such as the groundwater seeps along the upper slope after the initial construction. This is a good example of a project moving forward with early consultation of a comprehensive project team (including the City of St. Cloud parks and stormwater management staff, Sauk River Watershed District, Stearns SWCD, and DNR area hydrologists and Clean Water Specialists). The project also used the best information available and adapted as unknowns were discovered during and after the construction process.

A project like this is always challenging because issues and causes that help contribute to bank instability such as increased flooding due to watershed development or changing climatic patterns are difficult to address with one project. However, the project addressed three of the main causes of bank erosion that could be controlled: removing the dam that was directly flow into the bank, stabilizing the toe, and controlling groundwater seep influences.

Increased frequency and intensity of flooding, land use changes, invasive plant species within the stabilized bank will be continued challenges in the future.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No. Annual monitoring of the project area should occur to make sure that all the facets of the project are continuing to work as planned. If issues are identified, maintenance should occur to prevent them from developing into larger problems.
18. ***Are follow-up assessments needed? Explain.***
    No.
19. ***Additional comments on the restoration project.***
    This project was a good example of partnerships between different departments of the City of St. Cloud, Stearns County Soil and Water District, and the West Central Technical Service Area. Each partner was able to recognize their strengths and help increase the capacity to complete the project.

    Project team members commented that uncertainty related to permitting timelines and weather resulted in the project timeline being extended longer than initially planned. They expressed the need for project funders to be flexible and understanding that delays can sometimes be beyond their control and that the project team needs to be flexible to respond as needs arise.

    The project required a lot of administrative and progress tracking to complete. This effort was shared across the project team. If one person or entity were to be responsible for it, it may be a lot given other job responsibilities.

    The City of St. Cloud Stormwater Department and Stearns County Soil and Water District would have funds available for minor maintenance issues that develop; however, if significant repairs or maintenance were required, dedicated funds would not be available and would need to be found elsewhere.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium
22. ***Provide explanation of reason(s) for determination.***

The project is successful in addressing the immediate issues of bank erosion and instability in a manner that will provide long-term success. The challenge in the future will be influences from large scale factors such as changing climatic patterns and overall watershed hydrology that may make the confidence in future success limited. There is high confidence that the project team addressed the factors they could control to promote project success.

23. ***Site Assessor(s) Conducting Review:***

Mark Pranckus, Cardno

Appendix A: Site maps, Project plans or Vegetation tables

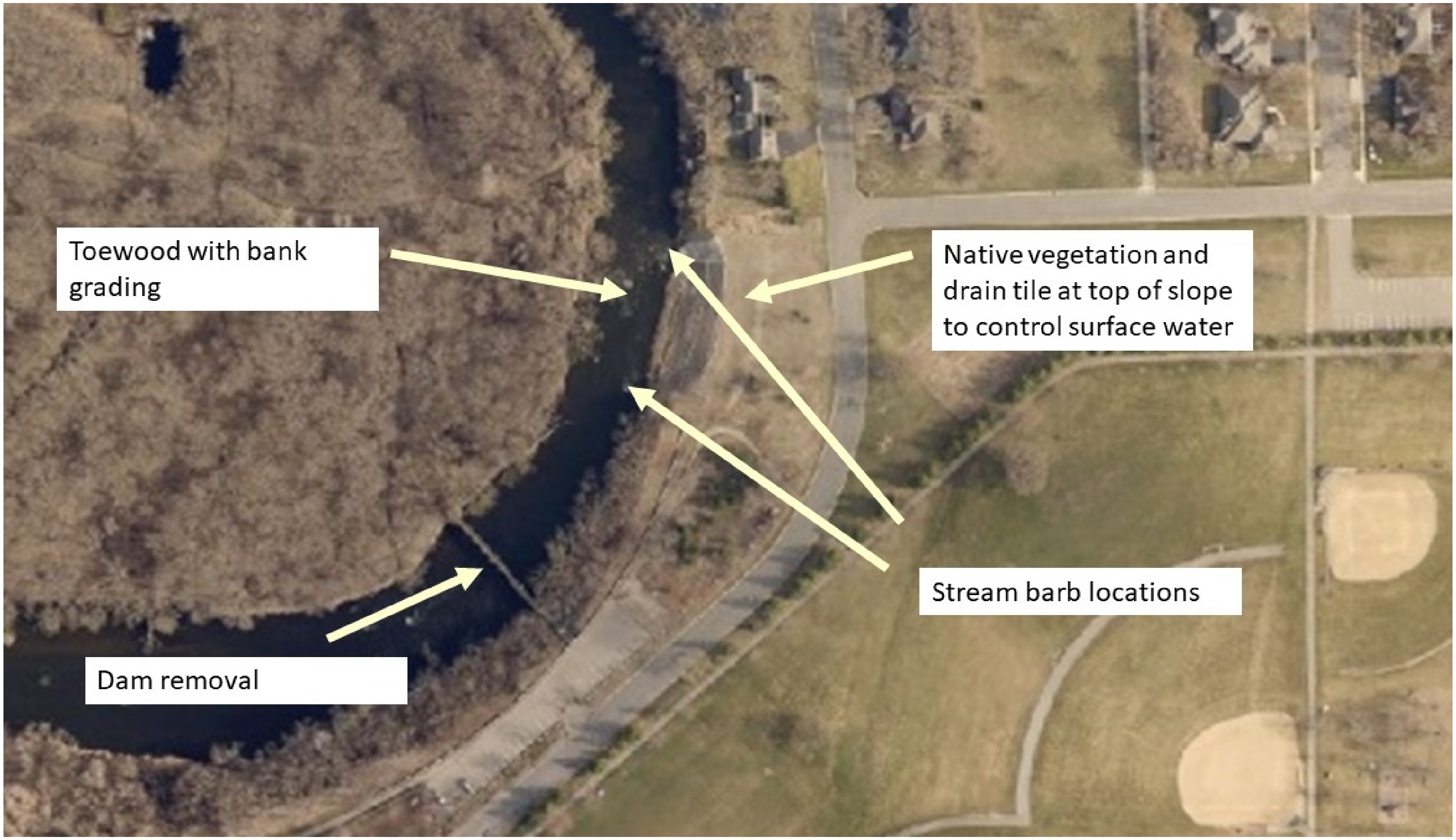


Figure 30-1. Aerial image of the project area from 2018 following the initial construction. Locations for the toewood installation, stream barbs, dam removal and drain tile to manage surface water are indicated on the map. Aerial image provided by Stearns County (https://gis.co.stearns.mn.us/Landuse-Restriction/default.aspx).

Figure 30-2. Aerial image of the project site in 2013 prior to the construction project. The area highlighted in the circle demonstrates the severely eroding bank. Aerial photography is from September 2013 and provided by Google Earth (link http://www.google.com/earth/download/ge/).

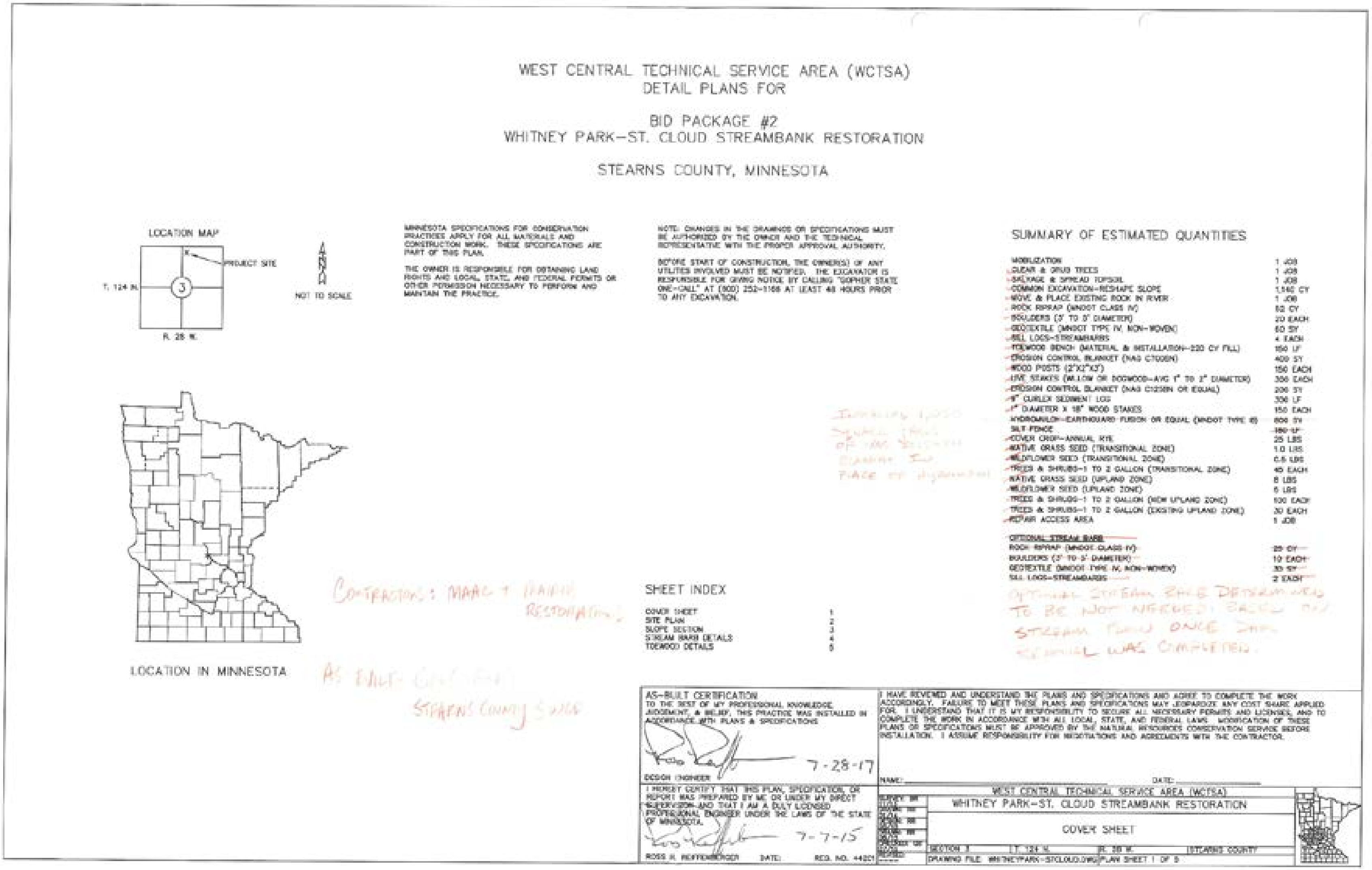


Figure 30-3. Sheet 1 of as-built construction plan set for initial bank stabilization.

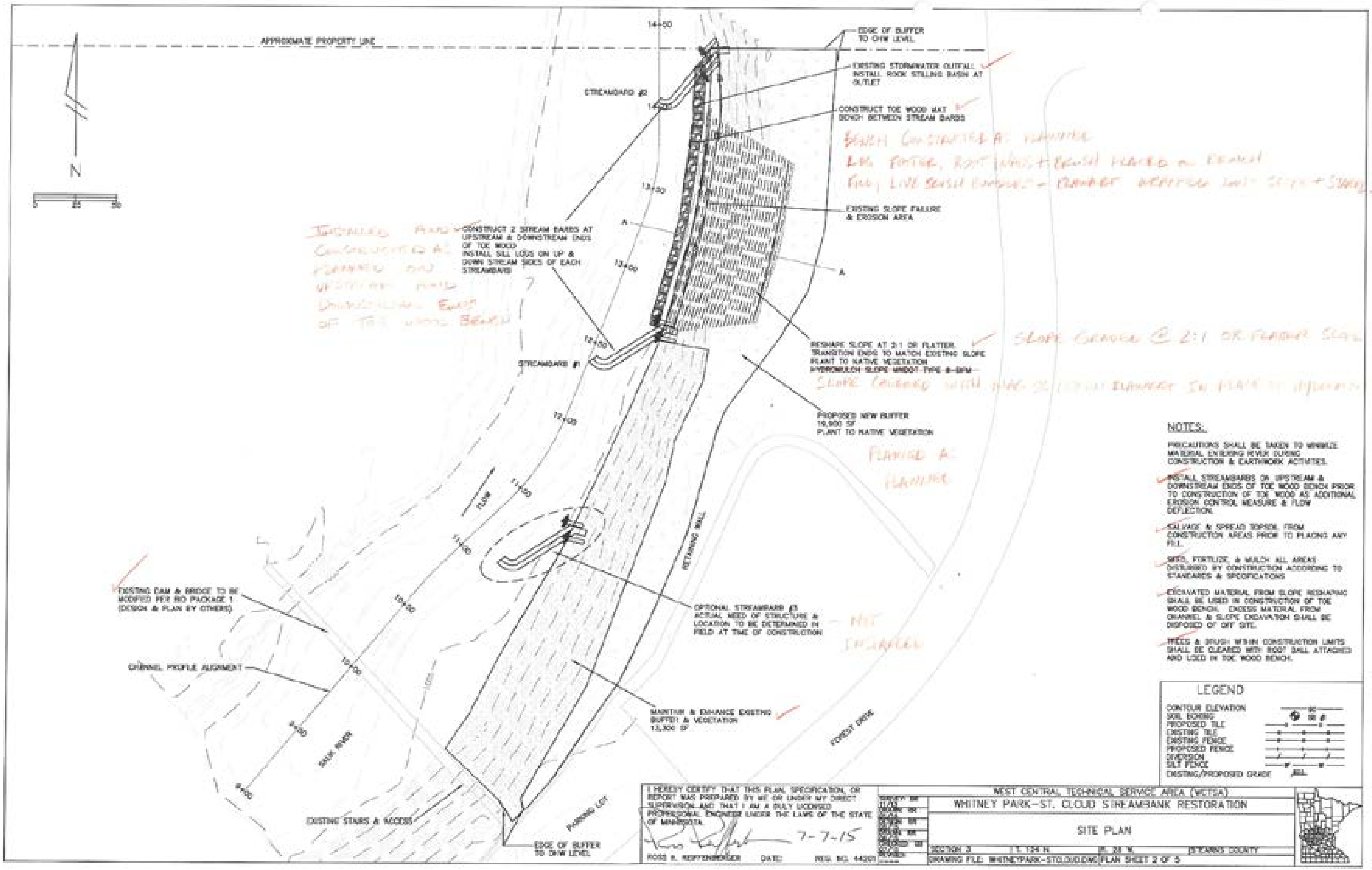


Figure 30-4 . Sheet 2 of the as-built construction plan set indicating the location of the treatment structures.

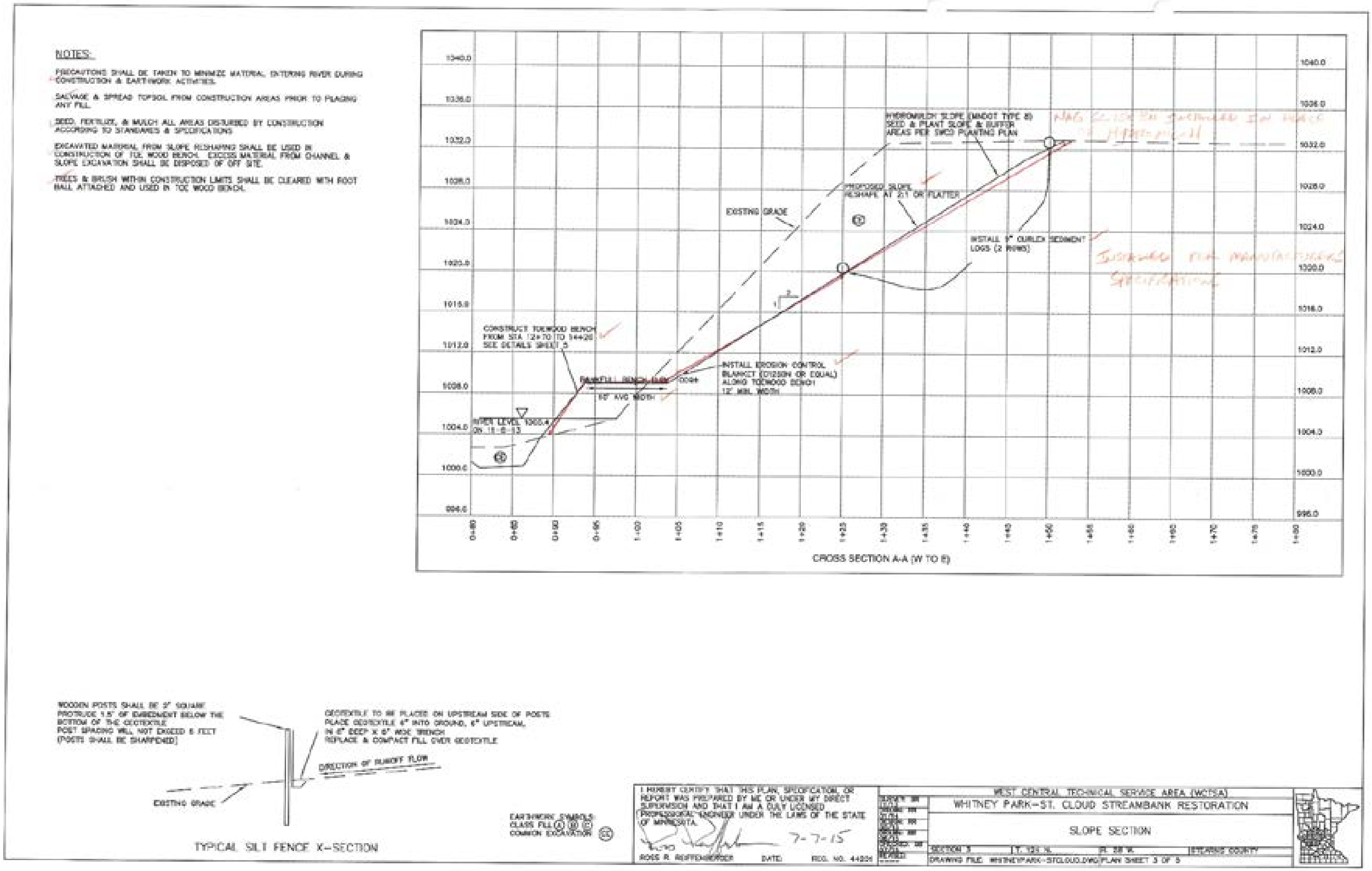


Figure 30-5. Sheet 3 of the as-built construction plan set indicating existing and proposed bank cross sections.

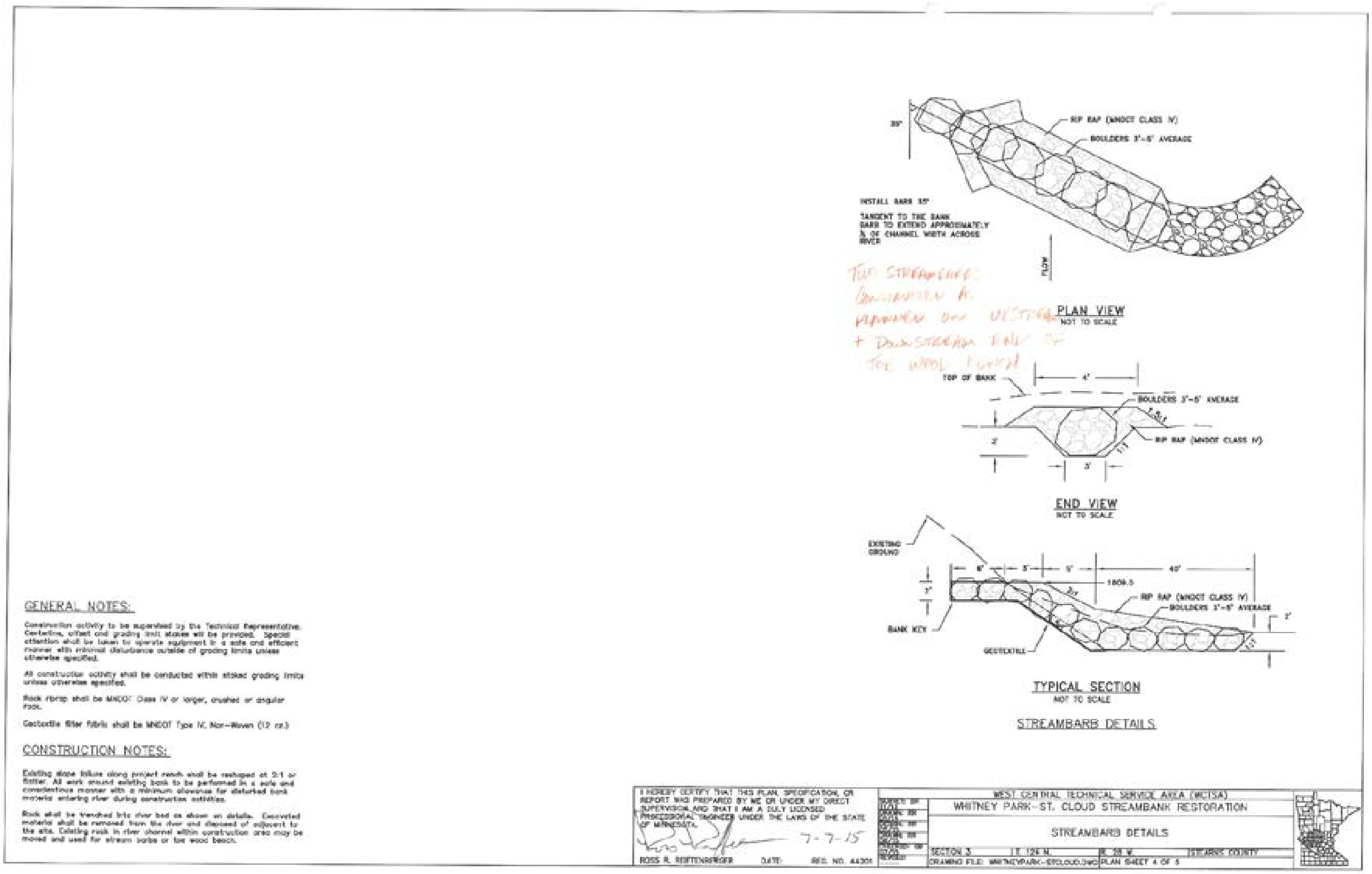


Figure 30-6. Sheet 4 of the as-built construction plan set providing a construction detail for the stream barbs.

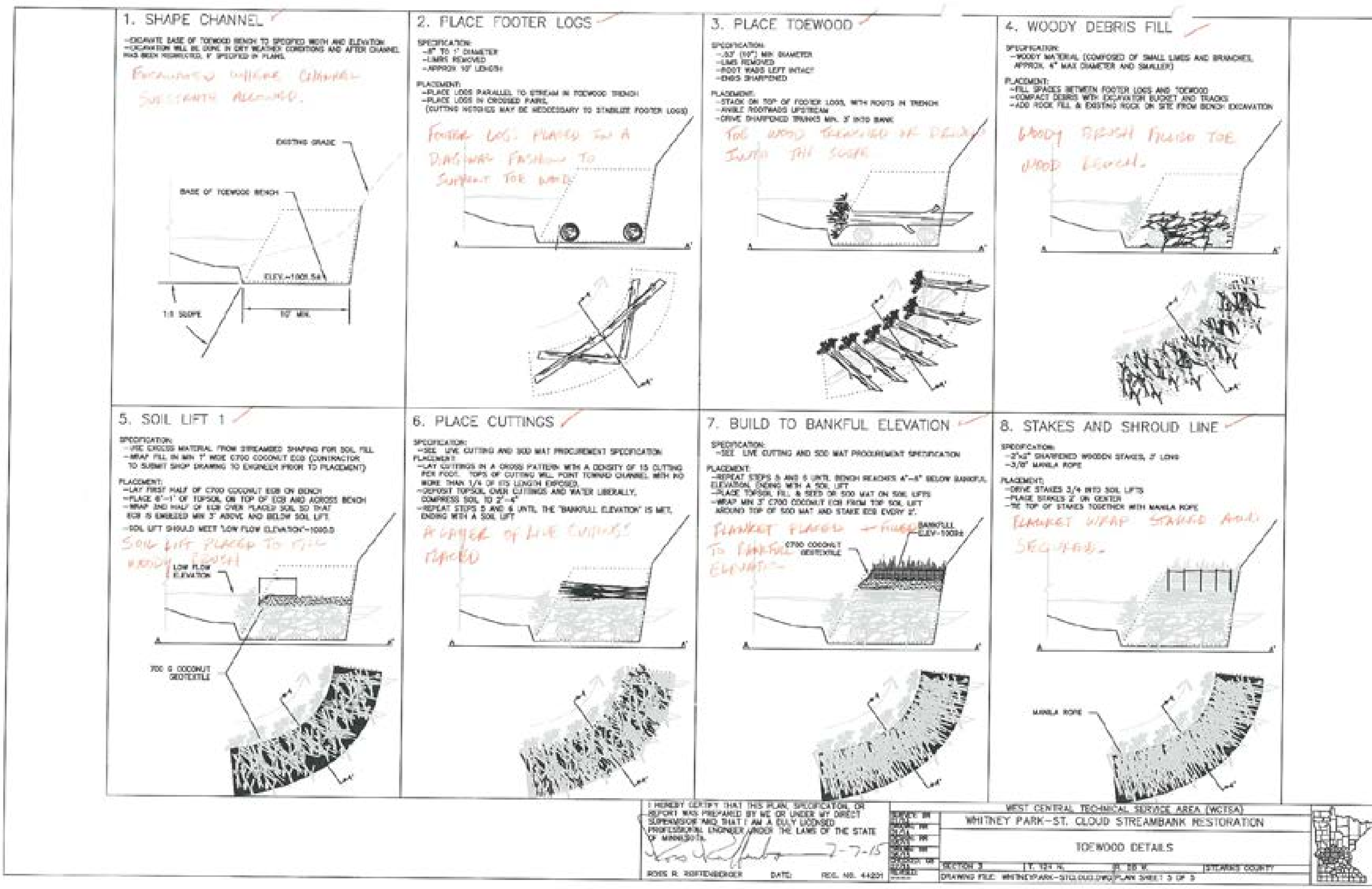


Figure 30-7. Sheet 5 of the as-built construction plan set providing a detail of the toewood installation.

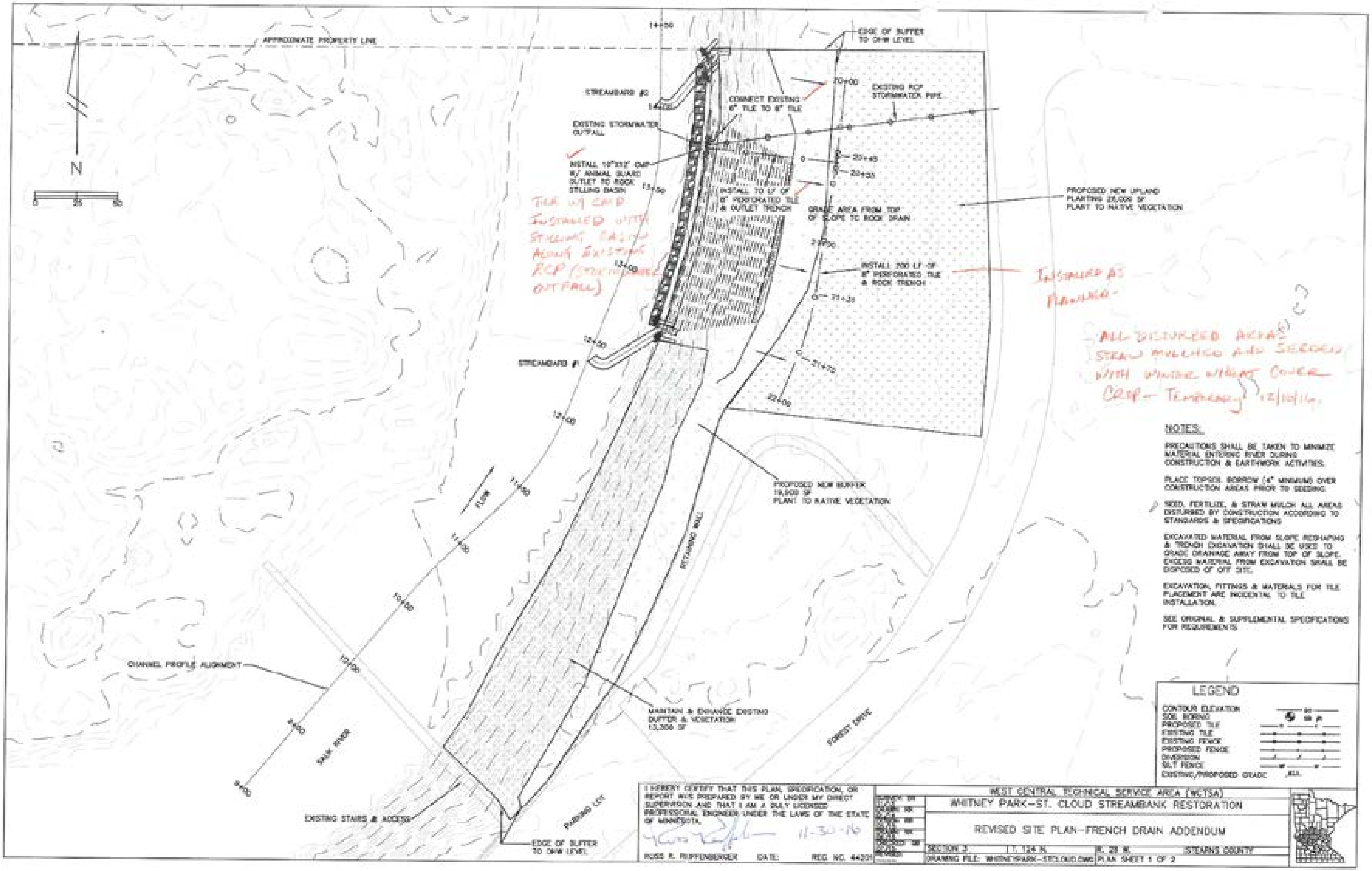


Figure 30-8. Sheet 6 of the as-built construction plan set detailing the French drain installed at the top of the slope.

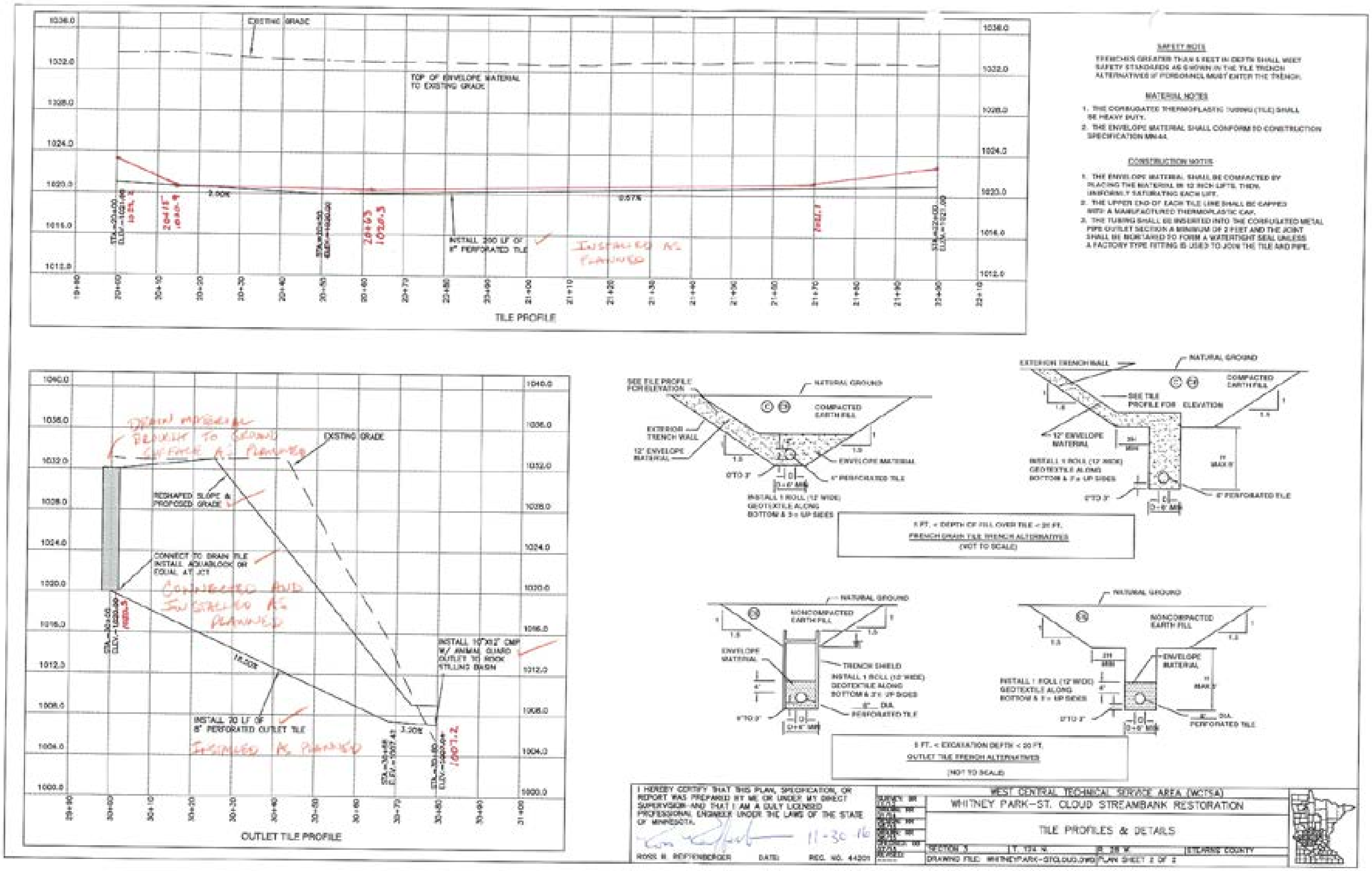


Figure 30-9. Sheet 7 of the as-built construction plan set detailing the cross section of the French drain installation at the top of the slope.

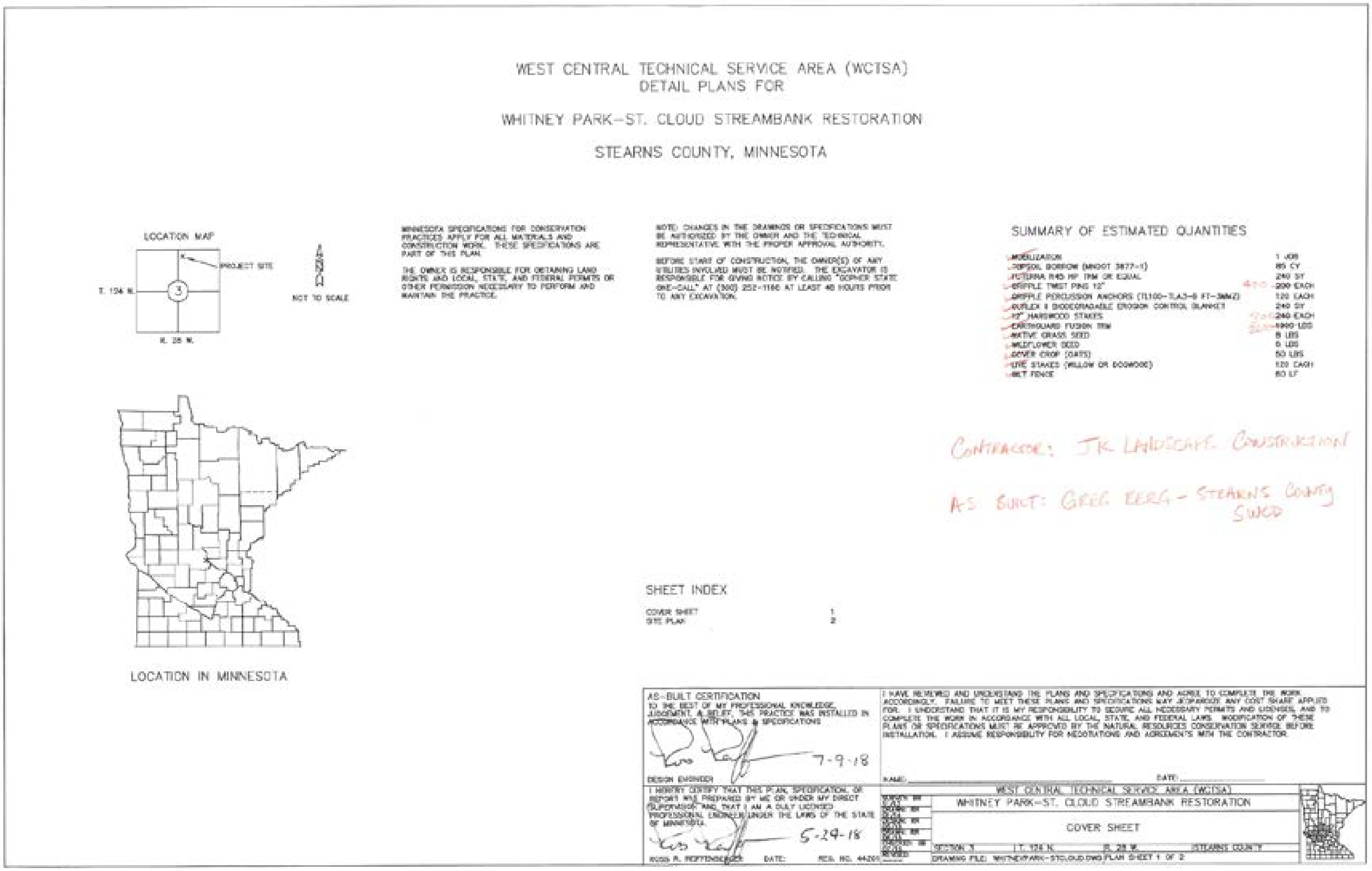


Figure 30-10. Sheet 1 of the as-built construction plan set for the slope repairs following construction.

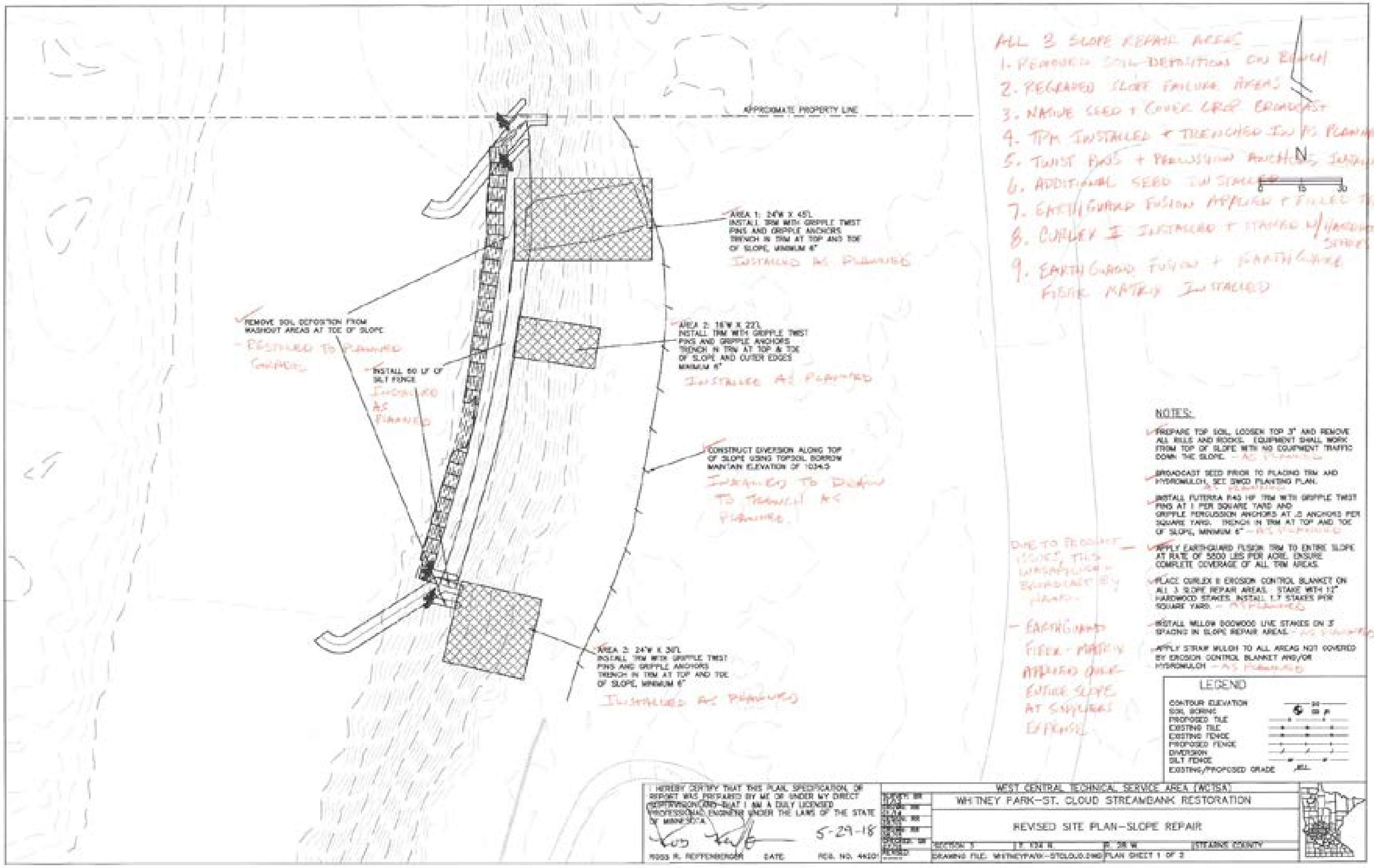


Figure 30-11. Sheet 2 of the as-built construction plan set for the slope repairs following construction. The sheet details the drain tile slope and details of the tile installation.

Table 30-1. Results of meander survey through project area. Cover ranges were estimated visually. Meander survey occurred 6/26/19 by Mark Pranckus, Cardno. Meander times were 11:30 – 11:45.

Scientific Name	Common Name	Species Planted/Seeded	Species Status
Cirsium arvense	Canada Thistle		Non-native
Verbena hastata	Blue Vervain		Native
Cornus sericea	Red-osier Dogwood	planted	Native
Lotus corniculata	Birds-foot Trefoil		Non-native
Taraxacum officinale	Common Dandelion		Non-native
Erigeron annuus	Daisy Fleabane		Non-native
Rudbeckia hirta	Black-eyed Susan	Seeded	Native
Scirpus microcarpus	Small-fruited Bulrush		Native
Pycnanthemum virginianum	Mountain Mint	Seeded	Native
Rumex crispus	Curly Dock		Non-native
Carex vulpinoidea	Fox Sedge	Seeded	Native
Symphyotrichum puniceum	Swamp Aster		Native
Desmodium canadense	Canada Tick Trefoil	Seeded	Native
Elymus virginicus	Virginia Wild Rye	Seeded	Native
Solidago gigantea	Giant Goldenrod		Native
Viola sororia	Common Blue Violet		Native
Ambrosia trifidum	Giant Ragweed		Native
Equisetum arvense	Common Horsetail		Native
Rosa arkansana	Prairie Rose	Planted	Native
Eupatorium perfoliatum	Common Boneset	Seeded	Native
Scirpus atrovirens	Dark Green Bulrush		Native
Silene latifolia	White Campion		Non-native
Zizia aptera	Heart-shaped Alexanders	Maybe team meant this instead of Z. aurea?	Native
Helenium autumnale	Sneezeweed	Seeded	Native
Apocynum cannabinum	Hemp-dogbane		Native
Corylus americana	American Hazelnut	Planted	Native
Monarda fistulosa	Wild Bergamot	Seeded	Native
Berteroa incana	Hoary alyssum		Non-native
Heliopsis helianthoides	False Sunflower	Seeded	Native
Cirsium vulgare	Bull Thistle		Non-native
Robinia pseudoacacia	Black Locust		Native

Scientific Name	Common Name	Species Planted/Seeded	Species Status
Eutrochium maculatum	Joe Pye Weed	Seeded	Native
Impatiens capensis	Orange Jewelweed		Native
Apocynum sibiricum	Clasping dogbane		Native
Securigera varia	Crown Vetch		Non-native
Linaria vulgaris	Butter and Eggs		Non-native
Ulmus sibiricum	Siberian Elm		Non-native
Viburnum trilobum	Highbush Cranberry	Planted	Native
Rhus glabra	Smooth Sumac	Planted	Native
Crepis tectorum	Narrow-leaved Hawksbeard		Non-native
Uvularia grandiflora	Large-flowered Bellwort		Native
Asclepias syriaca	Common Milkweed		Native
Ambrosia artemisiifolia	Common Ragweed		Native
Plantago rugelii	Red-stemmed Plantain		Native
Conyza canadensis	Canadian Horseweed		Native
Melilotus officinale	Sweet Clover		Non-native
Potentilla recta	Sulphur Cinquefoil		Non-native
Abutilon theophrasti	Velvet Leaf		Non-native
Trifolium campestre	Yellow Hop Clover		Non-native
Salix petiolaris	Meadow Willow		Native
Amorpha fruticosa	False Indigo	Planted	Native
Cornus racemosa	Gray Dogwood	Planted	Native
Asclepias incarnata	Swamp Milkweed	Seeded	Native
Lonicera tatarica	Eurasian Honeysuckle		Non-native
Carex retrorsa	Retrorse Sedge		Native
Phalaris arundinacea	Reed Canary Grass		Non-Native
Vitis riparia	Riverbank Grape		Native
Ribes americanum	Wild Black Currant		Native
Rhamnus cathartica	Common Buckthorn		Non-native

Table 30-2. List of species seeded during the stream construction phase. The transition zone represents the area on the bench and up the slope. The upland zone is the area at the top of the bank.

Common name	Scientific Name	Quantity	County
Upland zone grass mix		**lbs.**	
Bottlebrush grass	Elymus hystrix	1	Benton/Houston/Winona
Big bluestem	Andropogon gerardii	2.85	Sherburne
Canada wild rye	Elymus canadensis	0.75	Benton
Little bluestem	Schizachyrium scoparium	1.75	Benton
False melic grass	Schizachne purpurascens	0.15	Carlton
Kalms brome	Bromus kalmii	0.5	Polk
Side oats grama	Bouteloua curtipendula	1	Sherburne
Upland zone flower mix		**oz.**	
Black eye susan	Rudbeckia hirta	16	Sherburne
Fragrant giant hyssop	Agastache foeniculum	6	Sherburne
Aster ciliolatus	Lindleys aster	4	St. Louis
Columbine	Aquilegia canadensis	4	Somewhere MN?
Large leaved aster	Aster macrophyllus	5	St. Louis
Northern bedstraw	Galium boreale	3	Benton
Common ox-eye	Heliopsis helianthoides	8	Sherburne
Wild bergamot	Monarda fistulosa	8	Sherburne
Stiff tickseed	Coreopsis palmata	3	Sherburne
Stiff goldenrod	Solidago rigida	3	Sherburne
Bush clover	Lespedeza capitata	10	Sherburne
Canada tick trefoil	Desmodium canadensis	2	Sherburne
Mountain mint	Pycnanthemum virginianum	8	Sherburne
Transition Zone grass mix		**lbs.**	
Bottlebrush grass	Elymus hystrix	0.15	Benton/Houston/Winona
Virginia wild rye	Elymus virginicus	0.35	Houston
Cordgrass	Spartina pectinata	0.25	Sherburne
Blue joint grass	Calamagrostis candensis	0.1	Aitkin
Fox sedge	Carex vulpinoidea	0.15	Sherburne
Transition Zone flower mix		**oz.**	
Flat topped aster	Aster umbellatus	0.5	Aitkin
Boneset	Eupatorium perfoliatum	0.75	Sherburne
Canada anemone	Anemone canadensis	0.5	Fillmore
Golden alexander	Zizia aurea	1	Sherburne
Swamp milkweed	Asclepias incarnata	0.5	Aitkin
Joe pye weed	Eupatorium maculatum	0.75	Aitkin
Mountain mint	Pycnanthemum virginianum	1	Sherburne
Blue vervain	Verbena hastata	1.5	Sherburne
Tall blazing star	Liatris pycnostachya	0.5	Sherburne
Sneezeweed	Helenium autumnale	0.5	Sherburne
Obedient plant	Physostegia virginiana	0.5	Somewhere MN?

Table 30-3. List of species planted during the stream construction phase. The transition zone represents the area on the bench and up the slope. The upland zone is the area at the top of the bank.

Common name	Scientific Name	Quantity	County
Transition zone trees/shrubs			
False indigo	Amorpha fruiticosa	10	Millie Lacs
Red twig dogwood	Cornus sericea	8	Sherburne
Highbush cranberry	Viburnum trilobum	8	St. Louis
Nannyberry	Viburnum lentago	8	Sherburne
Meadowsweet	Spirea alba	8	Sherburne
Gray dogwood	Cornus racemosa	3	Sherburne
Upland zone trees/shrubs			
Hazelnut	Corylus americana	10	Sherburne
Bush honeysuckle	Diervilla lonicera	10	St. Louis
Chokecherry	Prunus virginiana	10	St. Louis
Wild black cherry	Prunus serotina	10	Sherburne
Prairie rose	Rosa arkansana	10	Sherburne
Smooth sumac	Rhus glabra	10	St. Louis
American plum	Prunus americana	10	Sherburne
Red twig dogwood	Cornus sericea	10	St. Louis
Alternate leaved dogwood	Cornus alternifolia	10	St. Louis
Meadow rose	Rosa blanda	10	St. Louis
Existing Upland Zone			
Meadow rose	Rosa blanda	8	St. Louis
Bush honeysuckle	Diervilla lonicera	8	St. Louis
Downy arrowwood	Viburnum rafinesquianum	8	St. Louis
Wild black cherry	Prunus serotina	3	Sherburne
Chokecherry	Prunus virginiana	3	St. Louis

Appendix B: Site Photographs

Photo 30-1. View looking downstream to the project area on the right hand side of the image before project work began. (Photo provided by project partners, taken 4/26/2013).

Photo 30-2. View looking downstream to the project area on the right hand side of the image after follow-up planting where vegetation had not established and robustly. (Photo provided by project partners, taken 6/27/2018).

Photo 30-3. View looking downstream to the project area on the right hand side of the image after second planting. (Photo provided by project partners, taken 7/18/2018).

Photo 30-4. View looking downstream to the project area on the right hand side of the image. Photo was taken from the pedestrian bridge where the low head dam was removed. (Photo taken 6/26/19 by Mark Pranckus, Cardno).

Photo 30-5. Looking at the form location of the low head dam at the top of the project. The dam was higher through the middle section than on the sides pushing water against the bank on the downstream end. (Photo taken 6/26/19 by Mark Pranckus, Cardno).

Photo 30-6 – Looking upstream at the upstream stream barb from the toewood bench. The majority of the stones for the barb are submerged, but are deflecting flow to the center of the channel and away from the treatment bank. (Photo taken 6/26/19 by Mark Pranckus, Cardno).

Photo 30-7. Example of the toewood bench on the treatment bank. Typically in the toewood installations the majority of the rootwads, logs, and other coarse woody material remains submerged to prevent rotting, reduce shear stress against the bank, and provide aquatic habitat for fish and invertebrates. (Photo taken 6/26/19 by Mark Pranckus, Cardno).

Photo 30-8. Example of vegetation development on the treatment bank. Vegetation on the bench and the lower portion of the slope are developing nicely. Bare areas on the upper slope where additional repairs were completed can be observed, but will fill in over time. (Photo taken 6/26/19 by Mark Pranckus, Cardno).

Photo 30-9. Example of the native vegetation seeded at the top of the slope to control surface water. Water flowing on the surface during storm events is ponded and captured in the French drain and is routed via drain tile to the base of the slope. (Photo taken 6/26/19 by Mark Pranckus, Cardno).

31) Seven Mile Creek Habitat Enhancement

Project Background

Project Name: Seven Mile Creek Habitat Enhancement

Project Site: Nicollet County, MN

Township/Range Section: Township 109 N Range 27 W Section 11 & 12

Project Manager / Affiliated Organization: John Lenczewski / MN Trout Unlimited

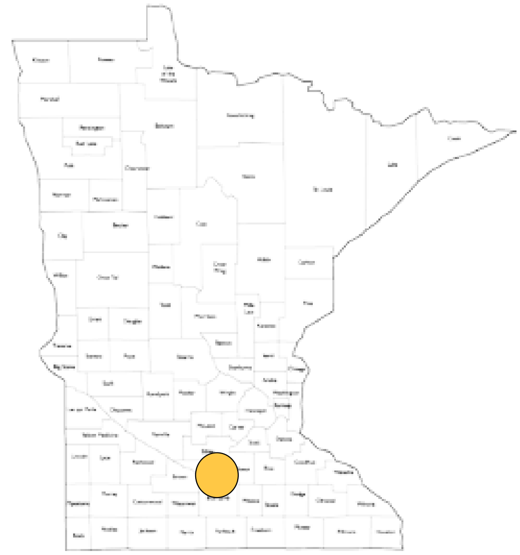
Fund: OHF ***Fiscal Year Funds:*** 2012

Project Start Date: November 2016

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest , Prairie / Savana / Grassland

Project Status: Post Establishment Phase



County: Nicollet

Primary Activity: Stream/River Enhancement

Project Size: 2,500 Linear Feet

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Streambank stabilization, channel stabilization and habitat improvement for Seven Mile creek which is a marginal trout stream that is spring fed and stocked every year with brown trout. Streambank stabilization and habitat improvement components consist of installing large woody habitat, installation of rock weirs, J-hooks and veins, installation of boulder toe, installation of cribwall, installing cover boulders and regrading and revegetating the banks of the stream where possible without impacting the open space of the County Park.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Seven Mile Creek Design Plans, Minnesota Department of Natural Resources (MN DNR), March 2017.
   Amendment to MN DNR Permits 2003-4101 and 2007-0187, Minnesota Department of Natural Resources (MN DNR), various.
   Seven Mile Creek Park Ravine Erosion Assessment – Project Targeting Report, Houston Engineering, Inc. , December 2017.
3. ***What are the stated goals of the project?***
   Enhance a 2,500’ stretch of stream by stabilizing the channel and its banks, and improve habitat.

The project is part of a larger initiative by Nicollet County to improve upland land management practices in the Seven Mile Creek watershed.

4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Continue the stream improvement work completed by the MN DNR in the early 2000's. Increase channel habitat features and diversity of the channel bottom (pools and riffles) for over-wintering and spawning habitat. Improve channel dimensions to move sediment through the system and provide as much flood storage as possible in the incised stream channel. Increasing access of stream flood flows to the surrounding floodplain is not an option because the floodplain is a heavily used County park.
5. ***Were measures of restoration success identified in plans?*** *Yes*
   If yes, list specific measurements.
   Annual fish and macroinvertebrate surveys are completed each year by MN DNR staff.
   Several fish, including some possible trout, were observed during the site visit and the park has a reputation as being very fishable in the fly-fishing community.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   Seven Mile Creek Design Plans, Minnesota Department of Natural Resources (MN DNR), March 2017. Documents include a project plan overview and close up plans showing the locations of proposed practices.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Installation of large woody habitat (rootwads) as streambank protection and stabilization is a standard in Minnesota and promoted by the MN DNR as providing additional habitat to stream organisms.

   Installation of rock weirs, J-hooks and veins to prevent streambank erosion is a standard in Minnesota as put forth in the Minnesota Pollution Control Agency (MPCA) BMP Table. These features can also be used to control the bed of the stream channel and create scour pools downstream to provide over wintering habitat that won't freeze all the way through.

   Installation of boulder toe is standard practice in Minnesota to stabilize the toe of steep side slopes, where protection of roads or other infrastructure maybe necessary, and where channel narrowing occurs on actively flowing streams.

   Installation of cribwall, more commonly called wood-toe, is a standard in Minnesota and promoted by the MN DNR River Ecology Unit as providing toe protection of regraded streambanks or narrowed channels, while also providing additional habitat to stream organisms.

   Installation of cover boulders is standard practice in Minnesota to create breaks in high flow areas of streams for fish to rest as they swim upstream.

   Regrading and revegetation of disturbed streambanks with native vegetation is industry standard in Minnesota. This project also regraded slopes to narrow the channel, effectively reducing the channel side slopes and creating a floodplain bench within the incised channel.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Several alterations were made during construction (completed in 2016), during the 1 year of standard construction warranty, and during the 2 additional years of construction inspection and warranty repair work (ended in 2018). Repair work prescribed at the end of 2018 was postponed to August 2019, due to sustained large precipitation events and high-water elevations. Alterations included adjusting the locations and configurations on several rock cross-vanes, using the material for a rock cross-vanes to harden an existing riffle instead, reconfiguring cross-vanes into single barbs and vice-versa to use the extra material for additional bank protection and to extend vanes further up the banks, and regrading and revegetating streambank failures.

   Some alterations were also done by the public, presumed to make the stream more fishable, including removing large woody debris that was installed for habitat and stream bank stabilization.

9. ***In what ways did alterations change the proposed project outcome?***
   Alterations made to the project were adjustments made base on the stream and flow characteristics and improved project outcomes

Site Assessment

Field Review Date: **8/30/2019**

Field Visit Attendees:

John Lenczewski – MN Trout Unlimited, Jack Lauer – MN Department of Natural Resources, Brady Swanson – MN Department of Natural Resources, Brad Schultz – MN Department of Natural Resources, Eric Miller – Nicollet County SWCD, Todd Meyer – Park Maintenance - Nicollet County SWCD, Mike Suska – Park Supervisor - Nicollet County SWCD, Lucius Jonett – Wenck Associates, Gina Quiram – MN Department of Natural Resources

10. ***Surrounding Landscape Characteristics:***
    Seven Mile Creek is an incised stream channel within Seven Mile Creek County Park. The park and stream are in the bottom of a ravine that is surrounded by agricultural lands.
11. ***Site Characteristics:***
    a. ***Soil Series:***
       Minneiska sandy loam (463A), 0 to 2 percent slopes, Capston-Rock outcrop complex (923), 2 to 60 percent slope, Lester-Storden-Estherville complex (944F), 18 to 70 percent slope, Lester-Storden-Estherville complex (945F), 22 to 40 percent slope.
    b. ***Topography:***
       Seven Mile Creek is an incised stream channel in Seven Mile Creek County Park. The park and stream are in the bottom of a ravine that is part of the Minnesota River valley.
    c. ***Hydrology:***

The hydrology of this stream is flashy, draining a large 23,000 acre agricultural watershed through this ravine. The lower portions of Seven Mile creek will also receive flood backwaters from the Minnesota River. This ravine and Seven Mile creek contain several cold-water springs.

d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***

Open herbaceous streambank bordering woodland. Adjacent canopy cover of mature native trees. Herbaceous component is primarily invasive grasses smooth brome and reed canarygrass, with up to 75% cover. Giant or tall goldenrod was the dominant native species, along with several other common native and weedy forb species. Several vines and shrubs were also common, but none appeared particularly dominant.

e. ***Vegetation B: Meander Search Species List (as appropriate for site)***

Refer to Appendix A, Table 31-1 for species list.

12. ***Is the plan based on current science?*** Portions

Stabilization of channels and improvement of trout habitat with the practices used on this project is based on current science. Streambanks are vegetated, but not to the extent that current stream buffer rules require. This is due to in part from the stream being located in a public park where maintenance staff must access both sides of the stream and mowing to the stream's edge is used to increase usability of the park and maintain accessibility to the stream for fishing.

13. List indicators of project goals at this stage of project:

Enhance a 2,500' stretch of stream by stabilizing the channel and its banks, and improve habitat. Increased diversity of the channel profile was observed as we walked through several riffle and pool sequences. The pools that were created through the use of cross vanes have grown very deep offering potential overwintering habitat. The channel banks appeared mostly stable following the most recent maintenance work completed in August 2019, but there is concern that with such a large watershed draining through this incised channel with limited access to floodplain storage, there will be continued ongoing modifications and maintenance required. Habitat features including the cribwall, cover boulders, stabilized banks and deep pools were working as minnows and larger fish were observed in the improvement areas during the site visit.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes. The project goals are being met, and the high visibility and interest in the continued success and improvement of this stream and upstream watershed improvements by several groups will sustain project success.

15. Are corrections or modifications needed to achieving proposed goals?

Public information and education on the park, stream, watershed history and improvement projects is needed. Group consensus during the site visit was that a watershed coordinator role needs to be funded and maintained in the future.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

The current 2-year maintenance and repair work warranty included with this stream project construction contract was completed in August 2019 with final modifications and repairs of bank erosion. There is currently no additional funding or plan for additional management work of the stream should it be needed. The interest, research, and observation with this stream is very high with ongoing efforts to stock fish and monitor the stream by the MN DNR, gather stream gauge and water quality with a monitoring station already in place, ongoing faculty and graduate research by Gustavus faculty and student researchers, and continuous monitoring of the stream and park by the public. There are a lot of eyes on the stream and any issues with moving habitat features, erosion or a decline in fish populations will be quickly identified.

There are not currently funding mechanisms identified for any future work on the stream, but improvement of the watershed continues. A ravine erosion assessment of the park has identified several ravine and trail improvement projects and prioritized them based on reductions of sediment erosion and cost. While there is no current plan to fund or implement the projects, County staff are managing the park in the summer as best as they can to reduce erosion into the stream and are very interested in doing the projects as time and funding are available.
The ongoing challenge with this project is the concern that such a large watershed drains through this incised channel with limited access to floodplain storage. And there is likely going to be continued ongoing modifications and maintenance required.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No. The stream channel improvements are providing greater diversity to the channel profile by creating pools and riffles. The streambank improvements have increased the stability of the banks as best as possible given the constraints of the incised channel.
18. ***Are follow-up assessments needed? Explain.***
    No
19. ***Additional comments on the restoration project.***
    This project and it's watershed has a long and unique history that started when Nicollet, Brown and Cottonwood counties formed a Water Quality Board in the early 1990's recognizing that work needed to be done to protect water quality. The Board partnered with MPCA, MDA, Mankato State University, Gustavus Adolphus College, MN DNR, Trout Unlimited and Nicollet Soil & Water Conservation District. Together they completed a lot of upstream watershed work with agricultural best management practices such as cover crops, buffer strips, no-till practices, wetland restoration, grade staves, and sediment control on side ravines. In the early 2000's Seven Mile creek started to get the attention of the MN DNR fisheries who wanted to pursue habitat improvement projects and did several small projects. In 2012 MN Trout Unlimited got involved to help finish the stream improvement project within a watershed that had done a lot of watershed focus and work to improve and protect the water going to Seven Mile creek. The current stream improvement project was a partnership between Trout Unlimited, MN DNR and Nicollet County. The Stream Habitat Project on Seven Mile Creek actually started back in 2012 with an OHF grant and was a joint project between the DNR and Trout Unlimited. Craig Soupir who was the Fisheries Habitat Specialist in New Ulm at the time and is now the Area Fisheries Supervisor wrote the attached plan for the project. Melissa Wagner is the DNR Stream Habitat Specialist and oversaw the actual work on the project in November and December of 2016. Trout Unlimited hired consultants from EOR, Inc. to complete permitting of the project and provide construction administration.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    The extent of repair work completed in August of 2019 only occurred on a very small portion of overall project length and number of practices providing evidence that a majority of the project that has been in place for almost 3 years is stable. There have been several high precipitation events and flooding events of the Minnesota River downstream to provide a variety of damaging hydrologic events in that time. And with the project goal of improving habitat for fish there is nothing more reassuring that it is working than observing a diversity of fish species and sizes in the stream.
23. ***Site Assessor(s) Conducting Review:***
    Lucius Jonett

Appendix A: Site maps, Project plans or Vegetation tables

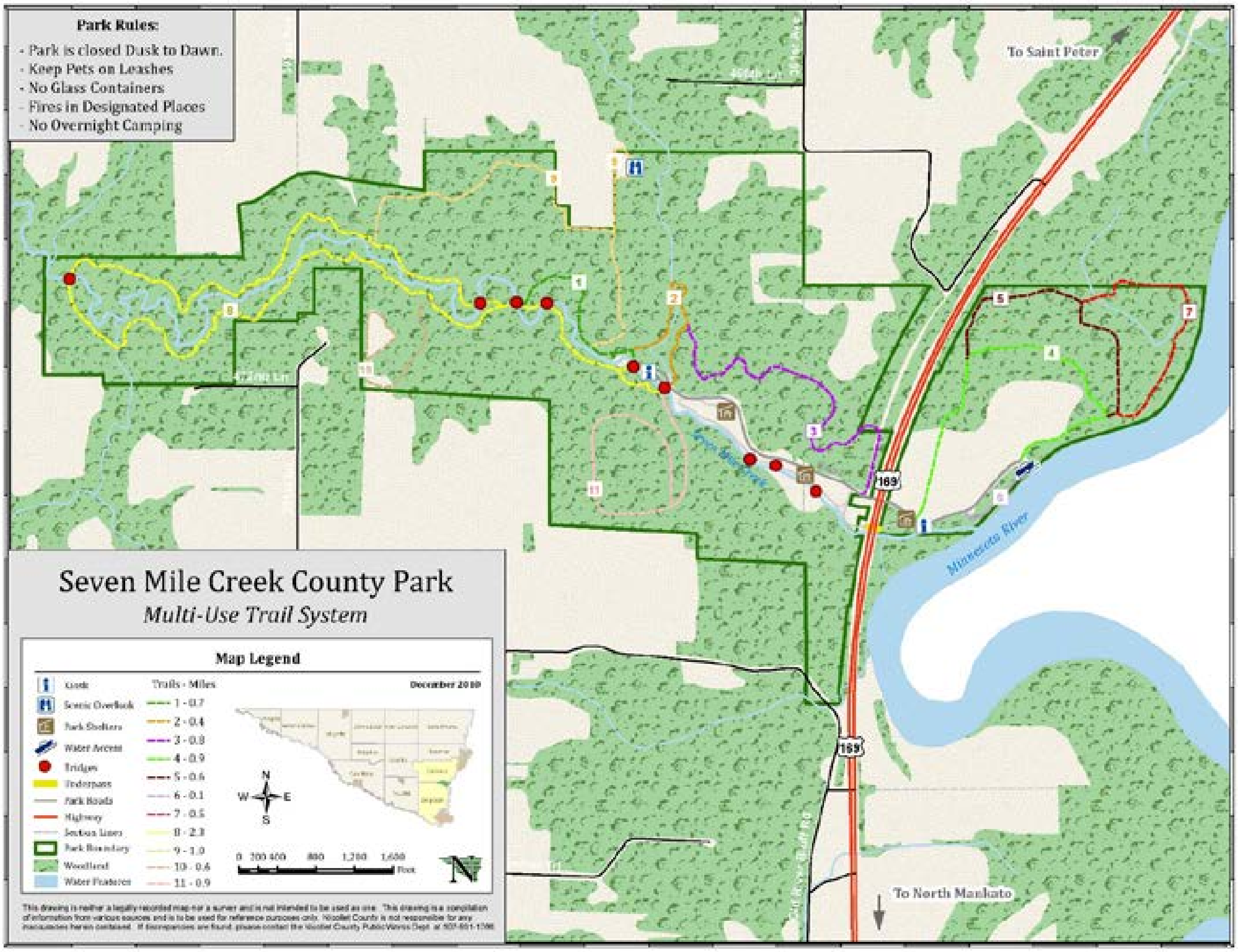


Figure 31-1 Seven Mile Creek County Park map showing the location of the stream and the park in proximity to Hwy 169 and the Minnesota River.

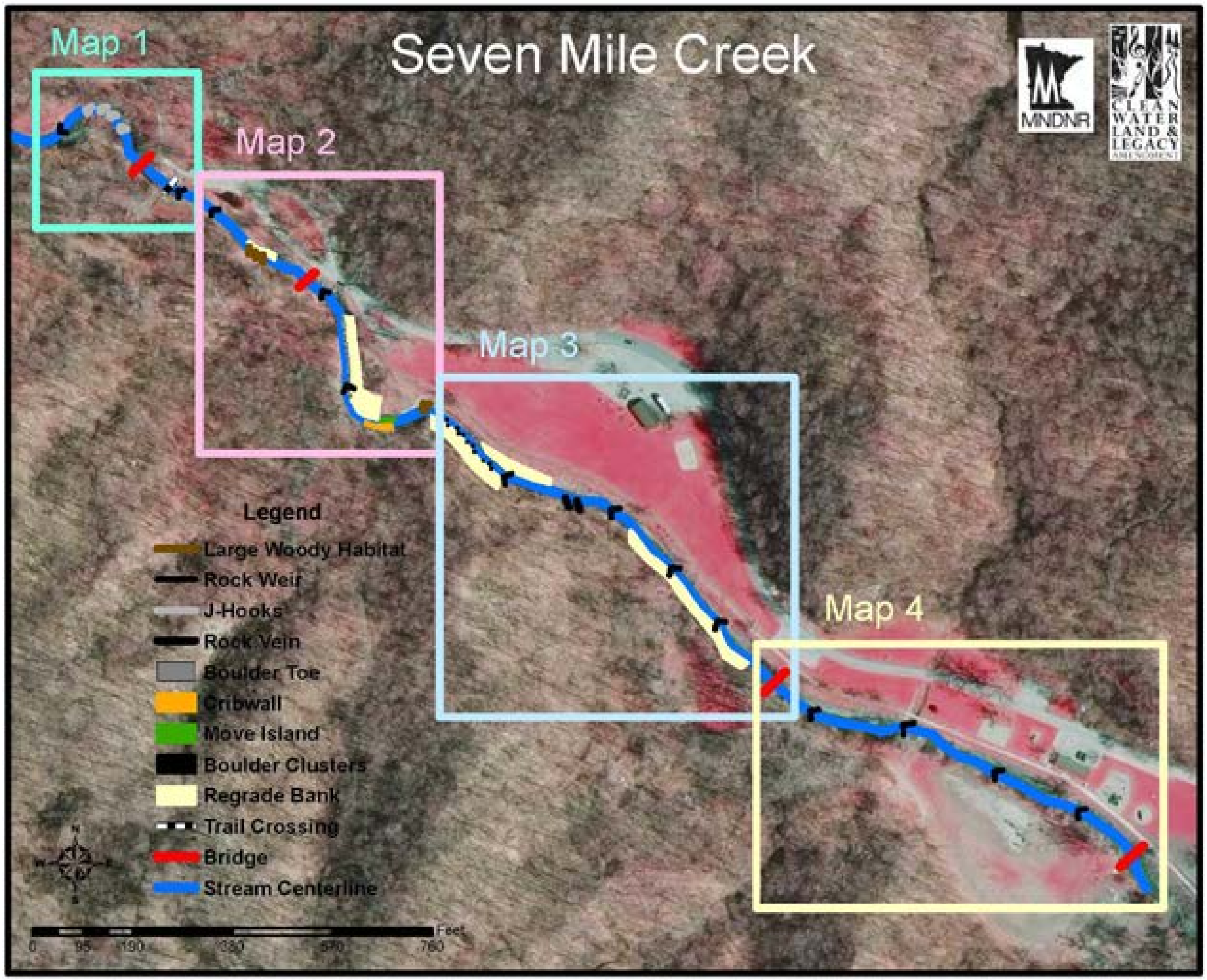


Figure 31-2 Seven Mile Creek project design plans sheet 1 of 5. Project overview map showing the stream reach included in the project with callouts to subsequent zoomed in plan sheets.

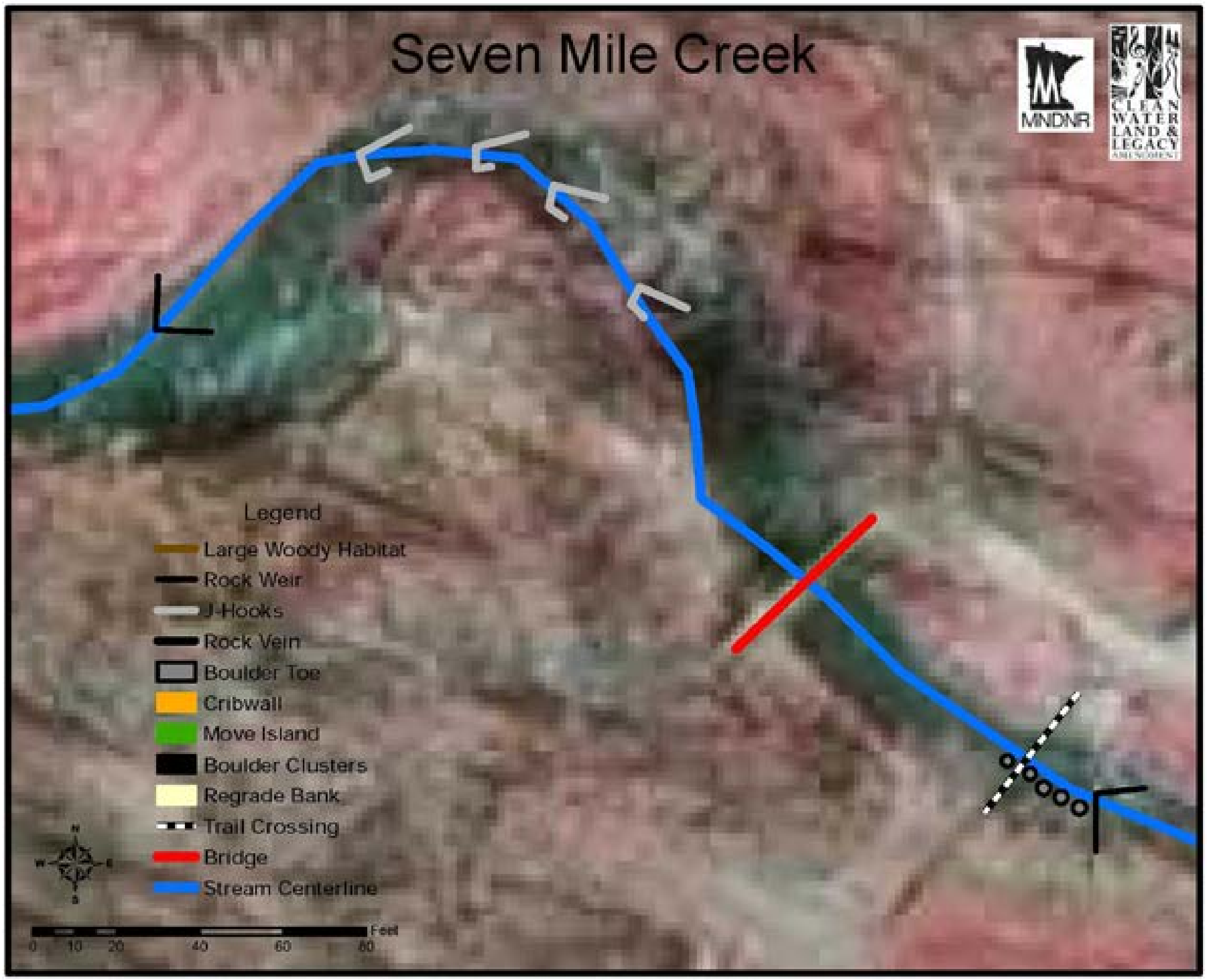


Figure 31-3 Seven Mile Creek project design plans sheet 2 of 5. Zoomed in plan sheet showing stream improvements and locations. Field observed changes from the plan include relocating the upstream cross vane to downstream of the J-hooks and using the downstream cross vane material to harden the existing riffle at the trail crossing instead of creating a new cross vane. It was noted that the J-hooks were actually single vanes previously constructed by the DNR in the early 2000's and material was used to strengthen those vanes in the single-vane configuration instead of converting them to J-hooks.

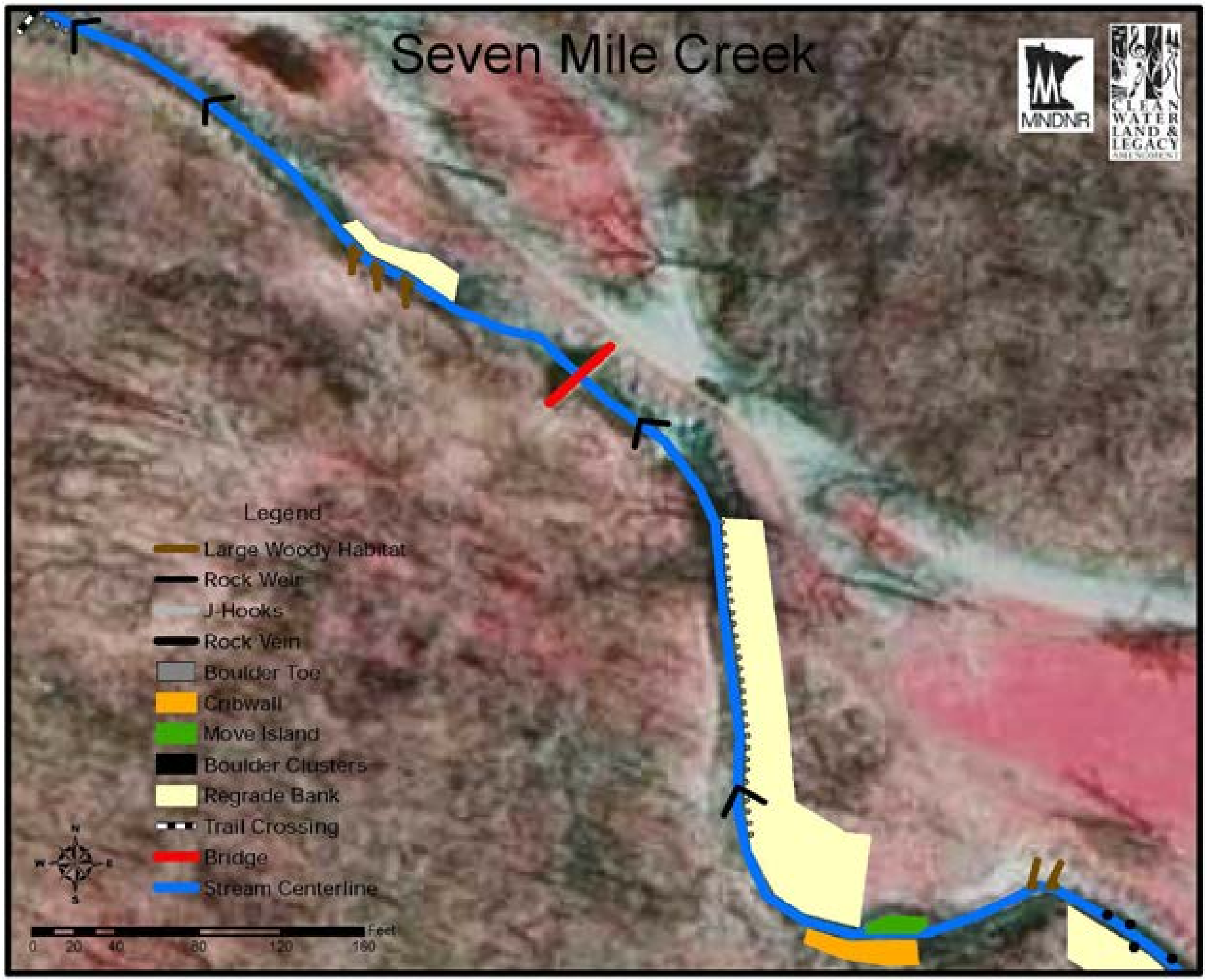


Figure 31-4 Seven Mile Creek project design plans sheet 3 of 5. Zoomed in plan sheet showing stream improvements and locations. Field observed changes from the plan include the large woody habitat upstream being removed. Three of them had been removed by unauthorized public members so that final rootwad was removed during final maintenance in August 2019.

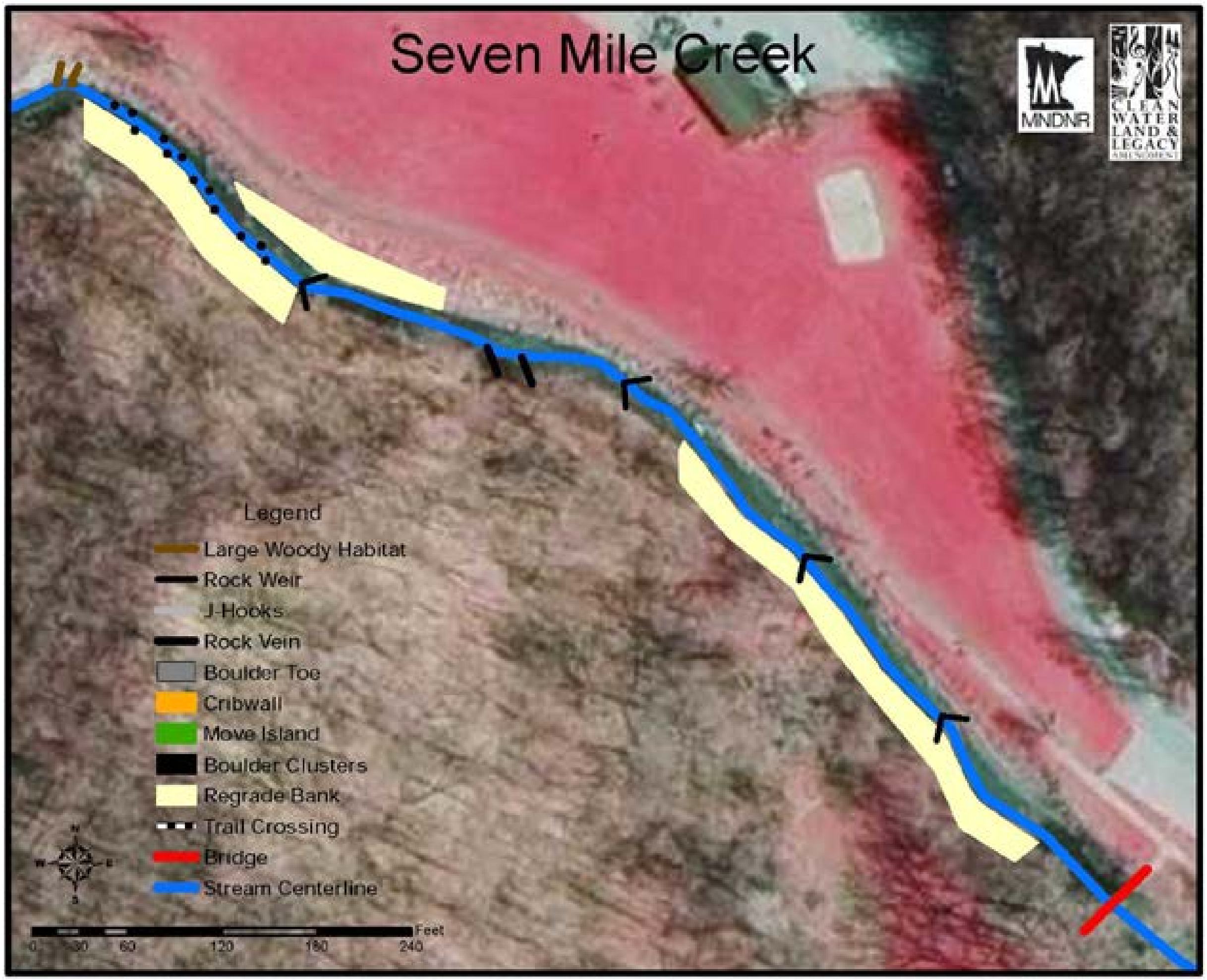


Figure 31-5 Seven Mile Creek project design plans sheet 4 of 5. Zoomed in plan sheet showing stream improvements and locations. Field observed changes from the plan include combining the two single vanes in the middle of the pictured reach into a single cross vane.

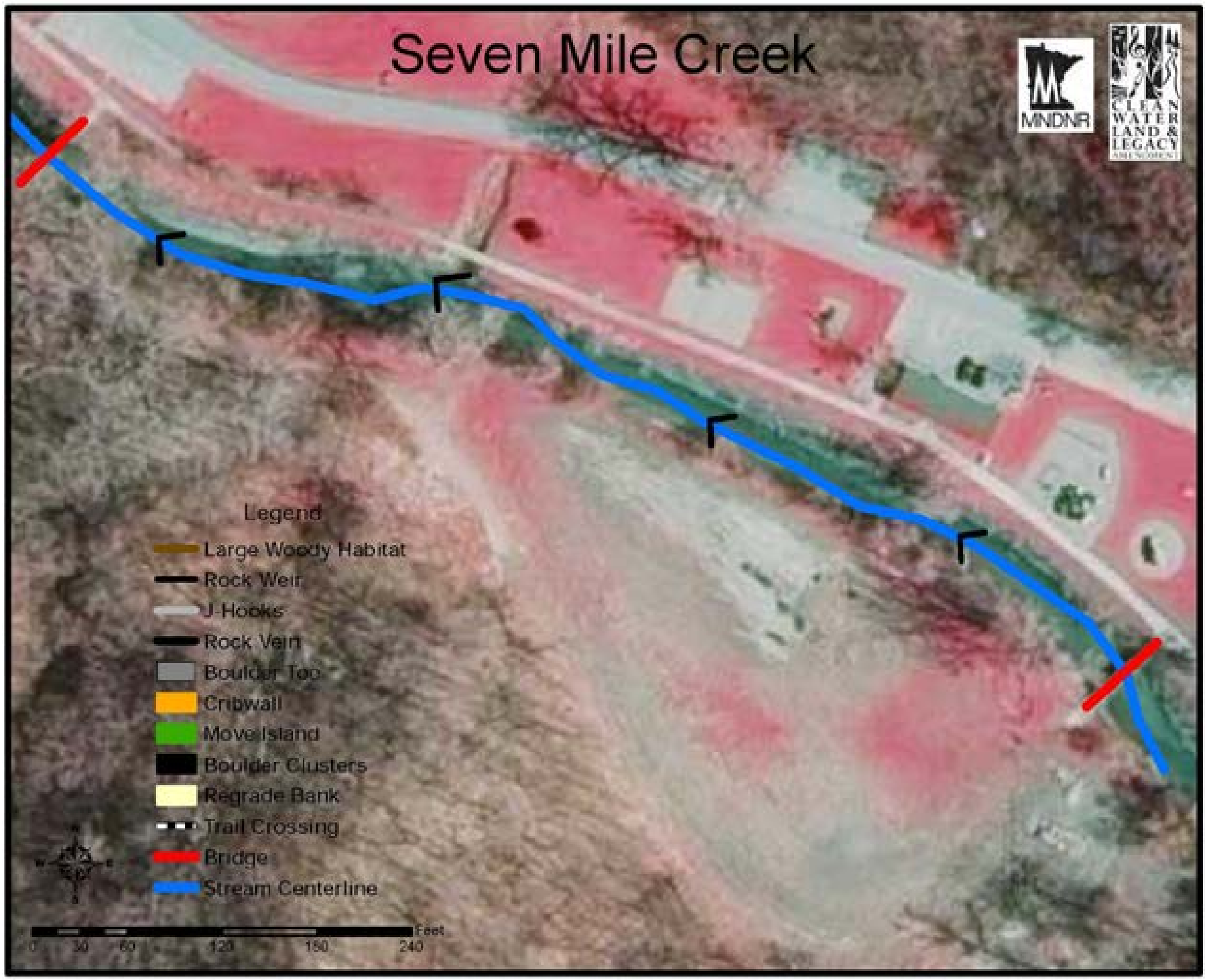


Figure 31-6 Seven Mile Creek project design plans sheet 5 of 5. Zoomed in plan sheet showing stream improvements and locations. Field observed changes from the plan include some of the proposed cross vanes being converted into single vanes and the remaining material used for bank protection.

Table 31-1 Plants observed from photos taken during site visit on 8/30/19. Photos were taken along a meander survey route for plant ID. Seed mix specified for the revegetation of regraded and disturbed banks was State Mix 34-261.

Scientific Name	**Common Name**	**Cover Range**	**Species Planted/Seeded**	**Species Status**
Asclepias syriaca	Common milkweed	<5		Native
Ulmus americana	American elm	<5		Native
Solidago gigantea/altissima	Giant/Tall goldenrod	10-25	Yes	Native
Bromus inermis	Smooth Brome	50-75		Invasive
Vitis riparia	Wild grape	<5		Native
Symphoricarpos occidentalis	Western snowberry	1-10		Native
Rumex crispus	Curly Dock	<5		Weedy
Cirsium arvense	Canada thistle	1-10		Noxious
Cf. Agastache foeniculum	Blue Giant Hyssop	<5		Native
Phalaris arundinaceae	Reed canarygrass	10-50		Invasive
Rosa sp.	Rose	1-10		Native
Urtica dioica	Stinging nettle	5-10		Native
Setaria sp.	Foxtail	1-10		Weedy
Toxicodendron rydbergii	Poison ivy	1-10		Native, Noxious
Impatiens pallida	Pale Touch-me-not	1-10		Native
Ambrosia trifida	Giant ragweed	1-10		Native, Weedy
Erigeron sp.		<5		Native
Unknown grass (cf. Sorghastrum nutans)	Leaves perpendicular, ready to bolt (Indiangrass)	<5		-
Cf. Agrimonia striata	Roadside agrimony	<5		Native
Panicum capillare	Witchgrass	<5		Native
Arctium minus	Common burdock	<5		Invasive
Cf. Bassia scoparia or Aster sp.	Kochia, aster	<5		Weedy
Salix interior	Sandbar Willow	5-10		Native
Unknown grass – cf. Andropogon gerardii	Big bluestem	<5		Native
Elymus repens	Quackgrass	5-10		Invasive
Persicaria cf. pensylvanica	Pennsylvania Smartweed	<5		Native
Acer negundo	Boxelder	<5		Native
Salix sp.	Willow; wider leaves	<5		Native
Helianthus sp.	Wild sunflower	<5	Possibly	Native
Helenium autumnale	Sneezeweed	1-10	Yes	Native
Elymus canadensis	Canada wildrye	1-10		Native
Desmodium canadense	Canada tick-trefoil	1-10		Native

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Eutrochium maculatum	Spotted Joe-pye Weed	1-10	Yes	Native
Trifolium repens	White clover	<5		Weedy
Populus deltoides	Cottonwood; seedling	<5		Native
Elymus virginicus	Virginia wildrye	<5	Yes	Native
Bidens frondosa	Devil's Beggarticks	<5		Native
Lycopus americanus	American Water Horehound	<5		Native
Scirpus/Scheonoplectus sp.	Bulrush	<5	Possibly	Native
Parthenocissus inserta	Woodbine	<5		Native
Cf. Salix amygdaloides	Peach-leaved willow	<5		Native
Fraxinus pennsylvanica	Green ash	<5; seedling		Native
Ribes sp.	Gooseberry/Currant	<5		Native
Unknown grass – cf. Poa pratensis	Fine leaves; Kentucky bluegrass	1-10		Invasive

Appendix B: Site Photographs

Photo 31-1 Upstream most riffle after original construction. (Seven Mile Creek County Park, December 2016).

Photo 31-2 Upstream most riffle observed during site visit. (Seven Mile Creek County Park, photo taken during site visit 08/30/2019).

Photo 31-3 Cribwall location before construction. (Seven Mile Creek County Park, November 2016).

Photo 31-4 Cribwall during construction. (Seven Mile Creek County Park, December 2016).

Photo 31-5 Cribwall following construction before vegetation establishment. (Seven Mile Creek County Park, December 2016).

Photo 31-6 Cribwall after vegetation establishment and prior to reconfiguration repairs. (Seven Mile Creek County Park, photo taken by Mike Majeski at EOR, Inc. July 2019).

Photo 31-7 Cribwall during reconfiguration repairs. (Seven Mile Creek County Park, photo taken by Mike Majeski at EOR, Inc. August 2019).

Photo 31-8 Cribwall bank after reconfiguration from parallel to streambank to perpendicular and placement of additional stone for ballast during final stream maintenance activities in August 2019. (Seven Mile Creek County Park, photo taken during site visit 08/30/2019).

Photo 31-9 Bank reshaping in the lower reach of the project after construction. (Seven Mile Creek County Park, December 2016).

Photo 31-10 Bank regrading creating floodplain terrace within the incised channel completed during final streambank maintenance activities in August 2019. (Seven Mile Creek County Park, photo taken during site visit 08/30/2019).

Photo 31-11 Proof of pool depth. (Seven Mile Creek County Park, photo taken by Lucius Jonett during site visit 08/30/2019).

Photo 31-12 Park maintenance mowing off the stream buffer to the top of the stream bank. (Seven Mile Creek County Park, photo taken by Lucius Jonett during site visit 08/30/2019).

32) Wedge Creek Habitat Restoration

Project Background

Project Name: Wedge Creek Habitat Restoration

Project Site: The project is located along Wedge Creek south of I-90 approximately 2.27 miles from the mouth of Wedge Creek where the creek outlets into Fountain Lake. The project was divided into 6 reaches.

Township/Range Section: Township 102N, 103N Range 21W, 22W Section 1, 6, 31, 36

Project Manager / Affiliated Organization: Andy Henschel / Shell Rock Watershed District

Fund: OHF ***Fiscal Year Funds:*** Fiscal Year 2014

Project Start Date: September 2011

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Prairie / Savana / Grassland , Forest

Project Status: Post Establishment Phase

County: Freeborn

Primary Activity: Stream/River Enhancement

Project Size: 1.95 Miles

Project Completed: 2018

Project Goals and Planning

1. ***What are the specific project components and treatments?***
   Streambank stabilization and channel stabilization improvements for Wedge Creek consisted of lowering inside bend point bars to create floodplain terraces, resloping and revegetating steep stream banks, installation of rock toe, rock weirs and rock vanes, and installation of channel cross logs. Habitat improvements consisted of cover boulders, backwater pools, escape logs and turtle hibernaculum. These streambank and habitat improvement features were installed where possible without impacting the highway and railroad infrastructure, utility line easements, or private property found through the project limits.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***

   Warm Water Stream Habitat Restoration Plan for Wedge Creek, McGhie & Betts Environmental Services, Inc., September 2011.

Warm Water Stream Habitat Restoration Plans, Details and Specifications for Wedge Creek Reach 1 and 5, McGhie & Betts Environmental Services, Inc. and WSB & Associates, Inc., September 2014.
Warm Water Stream Habitat Restoration Plans, Details and Specifications for Wedge Creek Reach 2 and 4, McGhie & Betts Environmental Services, Inc., September 2013.
Warm Water Stream Habitat Restoration Plans, Details and Specifications for Wedge Creek Reach 3, McGhie & Betts Environmental Services, Inc., September 2011.
Warm Water Stream Habitat Restoration Plans, Details and Specifications for Wedge Creek Reach 6, WSB & Associates, Inc., September 2015.
Wedge Creek Hwy 13 Station Monitoring Data, Shell Rock Watershed District, May 2005 through October 2018.

3. ***What are the stated goals of the project?***
   Install instream practices to reduce sediment erosion and improve habitat.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Reduce existing stream bank erosion, restore flood plain conditions, improve Wedge Creek water quality and restore instream habitat for fish, reptiles, amphibians and wildlife.
5. ***Were measures of restoration success identified in plans? Yes***
   If yes, list specific measurements.
   As written in the restoration plan report, monitoring and vegetation maintenance of the project for three to five years after construction will be required to ensure the control of invasive plant species and maintenance of erosion/sedimentation issues. In addition to onsite management, the Shell Rock River Watershed District (SRRWD) will continue to provide water quality monitoring data on Wedge Creek. The data will provide a basis of existing water quality conditions after habitat restoration construction is completed. Monitoring of fish and wildlife populations in the restored stream reaches will be an important part in determining the success of instream and riparian habitat restoration. Partnership between the SRRWD and the MN Department of Natural Resources to complete fish and wildlife surveys for Wedge Creek is planned to be completed yearly. These surveys will identify fish population by species and an observation of wildlife uses, sizes and population of sizes and the forage base of those species.
   It was noted in the project interview that there is an electric fish barrier at the downstream end of Wedge Creek before it enters into Fountain Lake, and that Watershed District staff would like the MN DNR to complete fish surveys on Wedge Creek, but there are no current plans to complete the survey as indicated in the restoration plan report.
   During the project interview the Watershed District identified that water quality monitoring of Reach #4 has been completed since 2008 with an ADCP (Acoustic Doppler Current Profiler) to measure stage and discharge as well as instrumentation to measure water quality including Total Suspended Solids (TSS). TSS is trending downward, but it is unclear if it is a result of the instream practices or other upland water quality projects occurring in the watershed at the same time. Staff also identified that they walk the project reaches every spring and fall to observe and inspect the project for settling or other movement of practices, new erosion features, downed trees directing flow into the streambanks, etc. In 2018 staff identified some erosion from a record flow event that triggered an application and award of FEMA repair funds to repair the streambank work. The FEMA repair work was completed September 17, 2019.
6. ***Are plan Sets available?*** **Yes** ***Have project maps been created?*** **Yes**
   If yes, provide in Appendix A and list Maps provided:

Warm Water Stream Habitat Restoration Plans, Details and Specifications for Wedge Creek Reach 1 and 5, McGhie & Betts Environmental Services, Inc. and WSB & Associates, Inc., September 2014. Documents include a project overview and location map, a construction plan, cross sections, details, and construction specifications.

Warm Water Stream Habitat Restoration Plans, Details and Specifications for Wedge Creek Reach 2 and 4, McGhie & Betts Environmental Services, Inc., September 2013. Documents include a project overview and location map, a construction plan, cross sections, details, and construction specifications.

Warm Water Stream Habitat Restoration Plans, Details and Specifications for Wedge Creek Reach 3, McGhie & Betts Environmental Services, Inc., September 2011. Documents include a project overview and location map, a construction plan, cross sections, details, and construction specifications.

Warm Water Stream Habitat Restoration Plans, Details and Specifications for Wedge Creek Reach 6, WSB & Associates, Inc., September 2015. Documents include a project overview and location map, a construction plan, cross sections, details, and construction specifications.

Wedge Creek Hwy 13 Station Monitoring Data, Shell Rock Watershed District, May 2005 through October 2018. Documents include a project overview and location map, a construction plan, cross sections, details, and construction specifications.

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***

Lowering streambanks to create a 2-stage channel with floodplain terraces in incised channels is standard practice with published guidance by the MN Department of Natural Resources River Ecology Unit.

Regrading and revegetation of steep stream banks with native vegetation is industry standard in Minnesota.

Installation of rock toe, weirs, and vanes to prevent streambank erosion is a standard in Minnesota as put forth in the Minnesota Pollution Control Agency (MPCA) BMP Table and the NRCS details provided in the construction documentation of this project.

Installation of channel cross logs to control the bed of the stream channel and create scour pools downstream to provide habitat is a standard in Minnesota as shown in NRCS details provided in the construction documentation of this project.

Installation of cover boulders is standard practice in Minnesota to create breaks in high flow areas of streams for fish to rest as they swim upstream as shown in NRCS details provided in the construction documentation of this project.

Installation of large woody habitat (escape logs) as streambank protection and stabilization is a standard in Minnesota and promoted by the MN DNR as providing additional habitat to stream organisms and as shown in NRCS details provided in the construction documentation of this project.

Installation of backwater pools and turtle hibernaculum is a standard in Minnesota and promoted by the MN DNR as providing additional habitat to stream organisms and as shown in NRCS details provided in the construction documentation of this project.

Replacement culverts. Installing more than one culvert side by side at the same invert elevations to match the stream channel bed is not current best practice. MN DNR guidance is to set one culvert lower than the other, preferably buried below the stream bottom, to provide low flow passage for fish and aquatic macroinvertebrates.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Field-fit adjustments were made to stabilization practices and structures during construction. Reaches 4 and 6 were constructed by a local contractor (Sorenson Construction) and the other reaches stabilization practices were constructed by Habitat Solutions and Bennet and Sons (installed Reach 6 culverts). WSB & Associates, Inc. and Watershed District staff provided oversight during construction. One noted adjustment was that the turtle hibernaculum were constructed out of limestone rock versus the wood shown in the construction details.
   Two 12' culverts were installed on the upstream end of the project, on the upstream end of Reach 6, to replace an existing culvert that was undersized. The two culverts were installed incorrectly with an upstream invert installed 1.7' higher than specified. Watershed District staff requested that the Contractor re-install the culvert as specified. The Contractor went to the MN Department of Natural Resources with a variance request to leave the culvert installed higher than the design required and the variance was granted. With the variance granted, Watershed District staff requested an extension of the installation warranty on the culverts from 1 year to 3 years ending December 30, 2019. Spring runoff and ice flow in 2019 pushed up and bent the upstream end of the culvert installed too high making it non-functional. Watershed District staff has written letters to the Contractor requesting that they honor the 3 year warranty extension they agreed to when accepting the variance to replace and install the damaged culvert that was not installed correctly.
9. ***In what ways did alterations change the proposed project outcome?***
   Alterations made to the stream bank and habitat improvement features installed for this project were adjustments made base on the stream and flow characteristics and improved project outcomes. The setting of one of the 12' culverts over 1.0' higher than designed was not an intended outcome based on any project decisions, but is a problem that needs to be addressed.

Site Assessment

Field Review Date: 9/20/2019

Field Visit Attendees: Andy Henschel – Shell Rock River Watershed District, Scott Christensen – Shell Rock River Watershed District, Luke Lunde – WSB & Associates, Inc., Jon Lore – MN Department of Natural Resources Wade Johnson – MN Department of Natural Resources, and Lucius Jonett – Wenck Associates, Inc.

10. ***Surrounding Landscape Characteristics:***
    A majority of Wedge Creek has been altered as it flows through agriculture dominated lands of Freeborn County. And while most reaches of the creek have been altered, buffers have been established on all County owned ditches since the 1950's.
11. ***Site Characteristics:***
    a. ***Soil Series:***

Shandep loam (517), Aquents and Histosols, ponded (1055), Kalmarville loam, frequently flooded (465), Lester-Estherville complex, 18 to 24 percent slopes (944E), Estherville sandy loam, 2 to 6 percent slopes (41B), Muskego soils, 0 to 1 percent (525).

b. Topography:

Wedge Creek is a slightly incised stream channel within a meander valley confined by 20' high valley walls and manmade infrastructure including two railroad beds and Hwy 13 that have historically straightened the creek and cutoff portions of the historic alignment.

c. Hydrology:

The hydrology of this stream is flashy, draining a large 47,000 acre agricultural watershed with approximately 200 miles of ditches.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

The reach corridor is a mix of 1. Riparian/floodplain forest; common species include Box Elder, Black Willow, American Elm, Bur Oak and Green Ash 2. Floodplain with up to 80% Reed Canary grass and a mix of native and non native forbs including spotted Jewelweed, Tall Coneflower, Red Elderberry, Beggerticks and 3. Wetlands in the lower reaches dominated by Reed Canary Grass.

e. Vegetation B: Meander Search Species List (as appropriate for site)

Refer to Appendix A, Table 32-1 for species list.

12. ***Is the plan based on current science?*** Yes

Stabilization of channels and improvement of stream habitat with the practices used on this project is based on current science. Although the benefits of these practices on improving habitat are not regularly quantified and just assumed.

13. List indicators of project goals at this stage of project:

The channel banks that were visible during full-channel flow appeared generally stable following the FEMA repair work completed in September 2019. The floodplain terraces created are well vegetated and stable providing as much floodplain storage as they can, given the large watershed draining through this incised channel with limited access to floodplain storage.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes, the project goals are being met. With the exception of the upstream culverts being installed over a foot higher than specified and resulting in ice damage that has restricted flow to only one culvert during most flow rates.

15. Are corrections or modifications needed to achieving proposed goals?

The setting of one of the 12' culverts over 1.0' higher than designed and the resulting damage blocking flow through this culvert is a problem that needs to be addressed. Long term this obstruction may impede flow and cause water in the channel to back up and overtop the berm and driveway more frequently than design. More frequent overtopping flows may cause erosion and cutting into the berm that could cause a blowout failure cutting off the landowners home from the road, damaging or destroying both culverts and releasing sediment downstream.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

Long term monitoring of the project is occurring with Watershed District staff walking the project reaches every spring and fall to observe and inspect the project for settling or other movement of practices, new erosion features, downed trees directing flow into the streambanks, etc. This approach appears practical, reasonable and part of the established routine already being demonstrated. There are currently no prescribed long-term plans for management of the native vegetation established on the restored reaches. Long-term management of the vegetation will be challenging along a long, narrow, riparian corridor surrounded by agriculture land, reed canary grass meadows and other vegetation factors outside of the boundaries of this project.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***

    Not from what was observed during the site visit, which was limited to only the top of banks due to high flow and turbid water. The stream channel improvements appear to have increased the stability of the banks as best as possible given the constraints of the incised channel confined by road and railroad infrastructure.

18. ***Are follow-up assessments needed? Explain.***

    Yes, a follow-up site visit when flow is lower and more clear is recommended to further assess the stream channel and habitat improvements to make sure they are not causing any unintended undercutting of the banks or scour of the streambed. It would also be beneficial to complete a fish and macroinvertebrate survey to help quantify any changes in population diversity and quantity as it was a stated goal that these projects are to improve habitat for fish, reptiles, amphibians and wildlife.

19. ***Additional comments on the restoration project.***

    The restored reaches of Wedge Creek are not designated County ditches and are the most natural sections of channel remaining even though they have been straightened, cutoff and altered with the installation of Muskie Avenue, State Highway 13 and two railroads. Before the project was designed, Shell Rock River Watershed District partnered with the MN DNR and completed landowner outreach to discuss project goals, features and to identify landowner preferences. In the context of the overall project, each reach has a distinct character. There are 4 landowners on the restored reaches of Wedge Creek including 2 private landowners, Freeborn County, and Shell Rock River Watershed District. No work was allowed within the utility and gas line easements, even if work was recommended, and there were several instances of active erosion that should have been stabilized. The 6 reaches were designed and constructed based on funding availability and landowner willingness for construction access. The reaches were completed in the order of Reach 3 & 5 were paired together as one project, Reach 2 & 4 were completed next and finally Reach 1 and 6. Reach 1, 2 and 3 are natural reaches of the stream Reach 4 is a narrow, straightened reach sandwiched between State Hwy 13 and a railroad corridor. The historic alignment of this reach was cutoff and remains on the east side of the highway, when the highway was built. The remaining channel of reach 4 makes 90 degree turns into the reach and out of the reach an has sandy soils that were head cutting toward the highway. Reach 5 is a more natural stream reach that is slightly incised. Raising the channel to access available floodplain storage was not an option for the landowner. Flooding would inundate his driveway and cutoff access to his home. The streambed composition of Reach 5 is rough with pebbles and cobbles. Reach 6 is a highly influence, narrow corridor with steep banks as a result of the railroad corridor created. Future projects in the project corridor include using Lessard Sam's funding to purchase the wetland complex land surrounding reach 1 and completing additional vegetation enhancement. The surrounding property around reach 3 was owned by the Nature Conservancy and has been gifted to the Watershed District.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium
22. ***Provide explanation of reason(s) for determination.***
    During the day of the project evaluation it had rained 1.88” the previous day and 0.06” the morning of the site visit according to NOAA records at the Albert Lea weather station. Water depth in a majority of the channel was slightly above bank full with some of the reaches and their floodplain (reed canary grass meadow of reach 1) totally inundated. Most of the installed practices were not visible, but there was also no signs of erosion, scour or slumping at the top of the banks surrounding the installed practices suggesting that the areas were stable and no longer eroding. Requests for photo documentation of pre-existing conditions before project implementation were not answered so there is no good basis of comparison for pre and post conditions based on this one site visit.
23. ***Site Assessor(s) Conducting Review:***
    Lucius Jonett

Appendix A: Site maps, Project plans or Vegetation tables

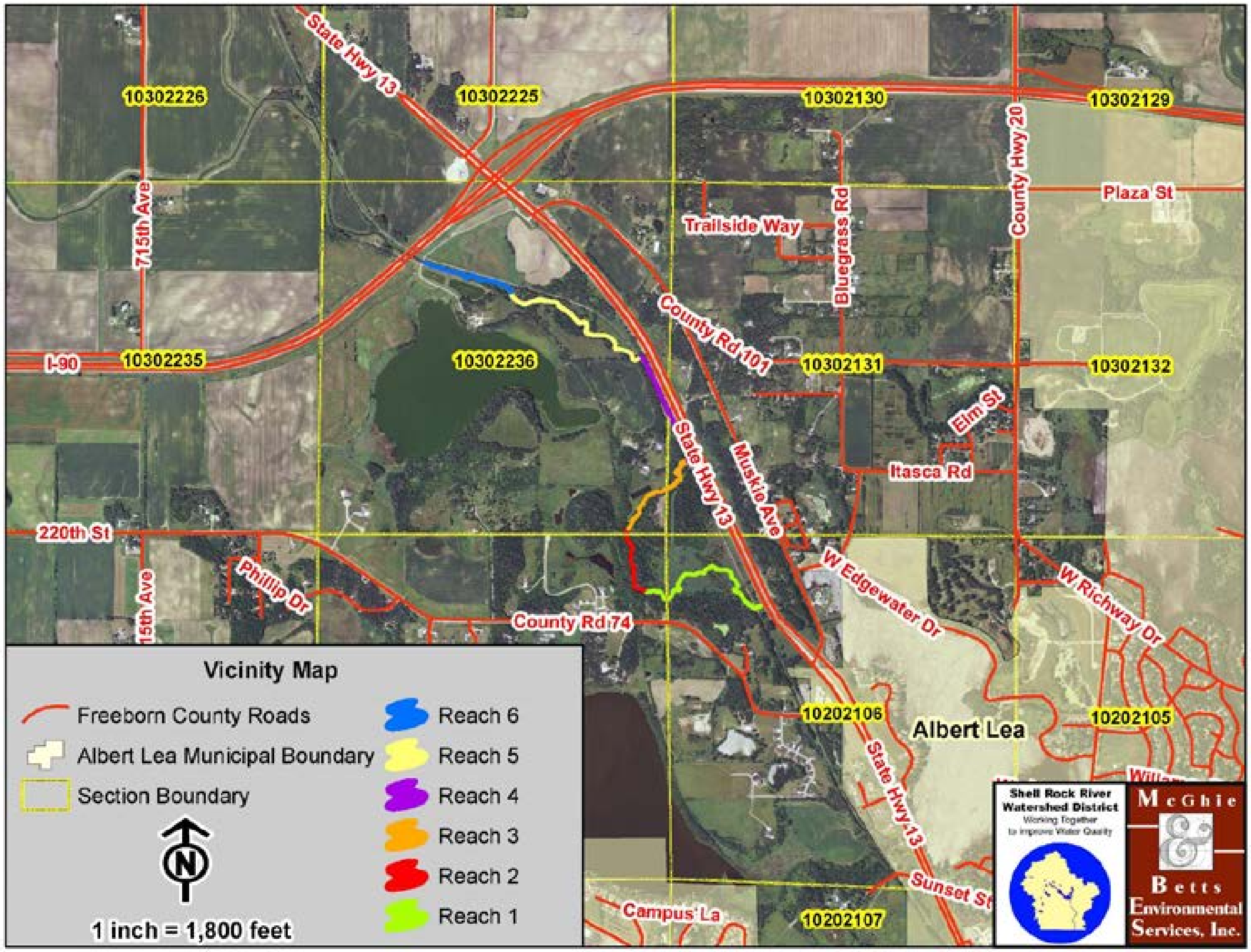


Figure 32-1 Wedge Creek project location overview map showing all 6 projects.

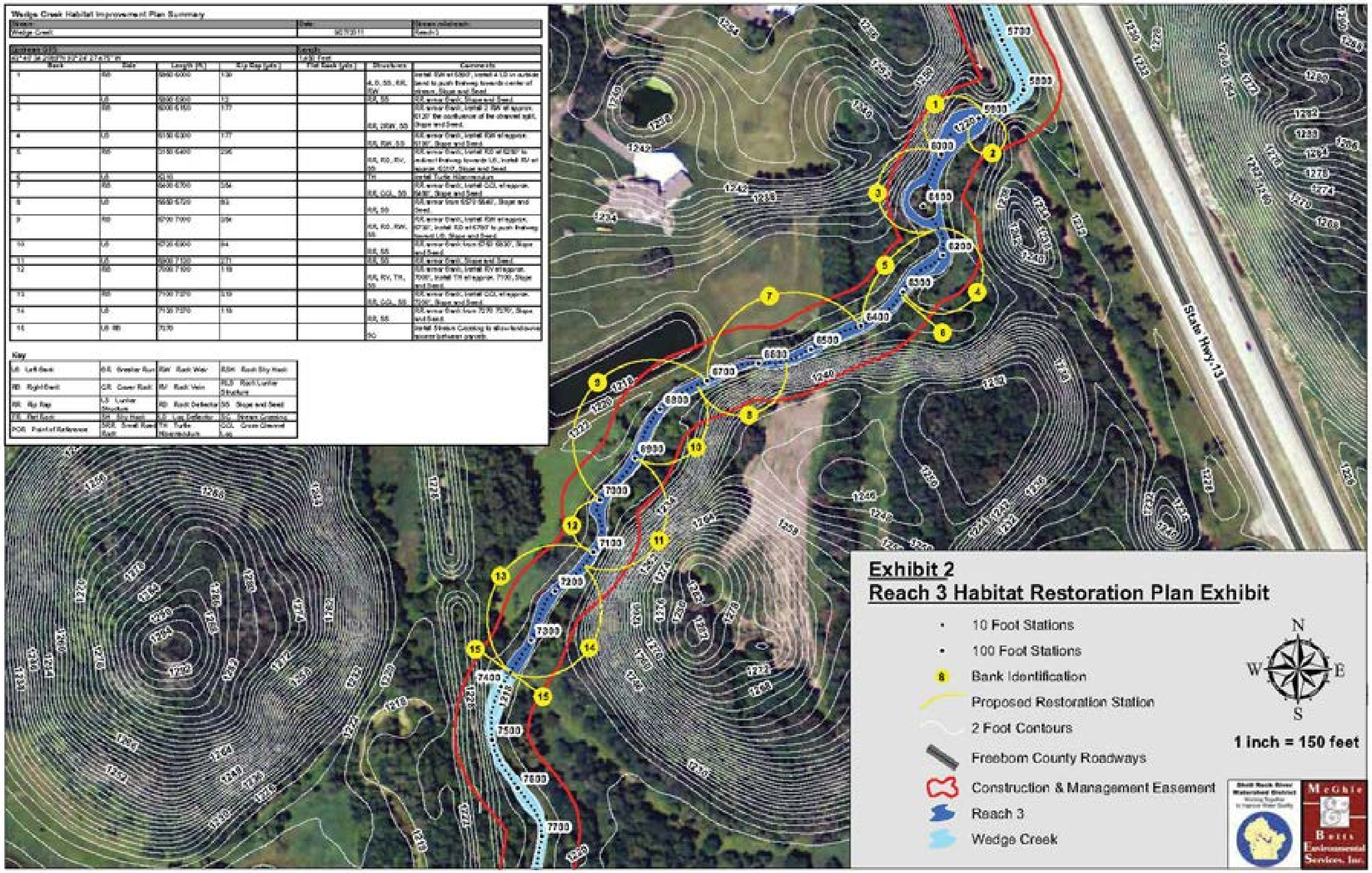


Figure 32-2 Wedge Creek Reach 3 Habitat Improvement Plan Sheet showing improvement locations. Similar plans were included for the other project reaches.

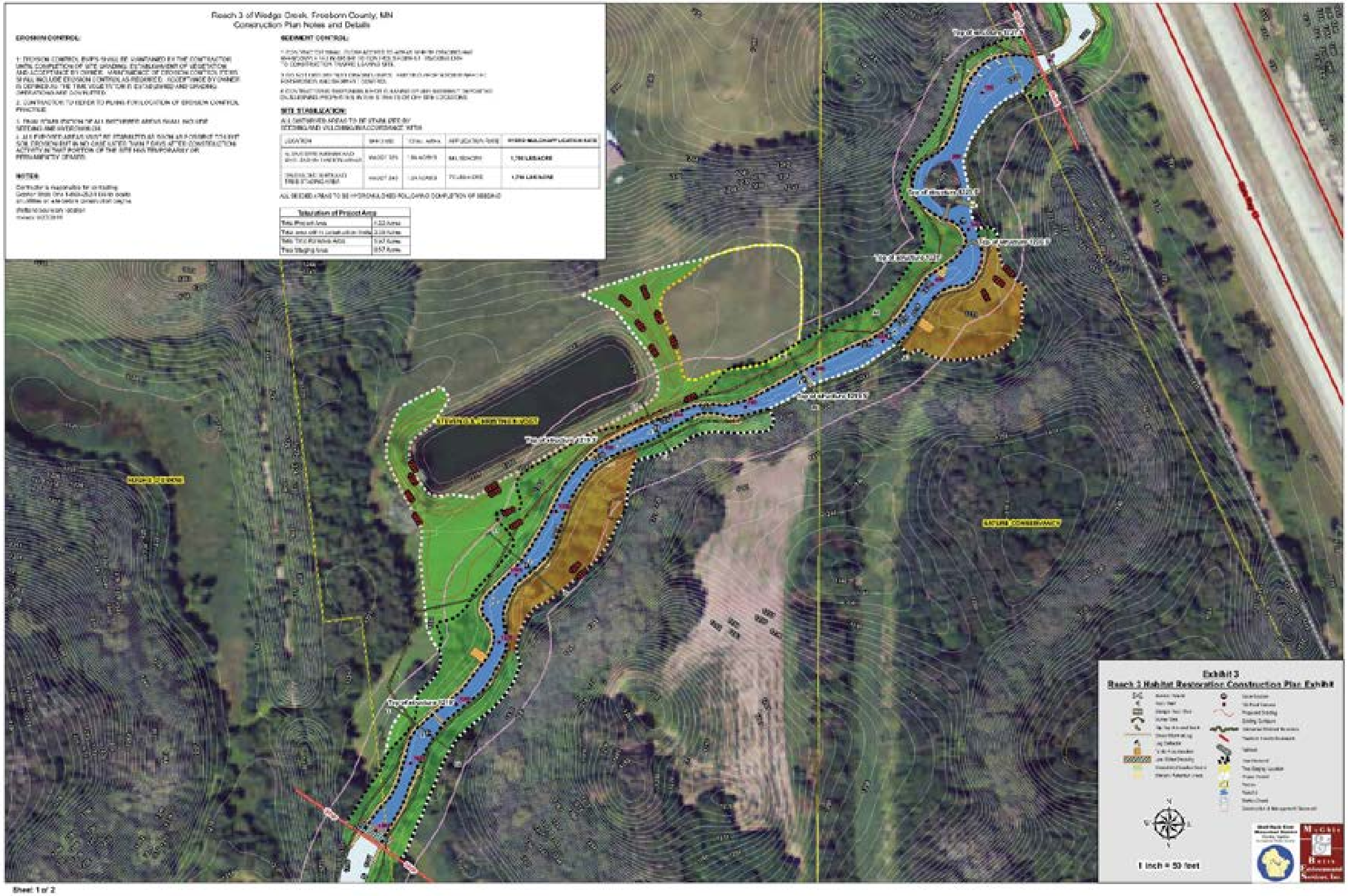


Figure 32-3 Wedge Creek Reach 3 Habitat Construction Plan Sheet showing improvement locations. Similar plans were included for the other project reaches.

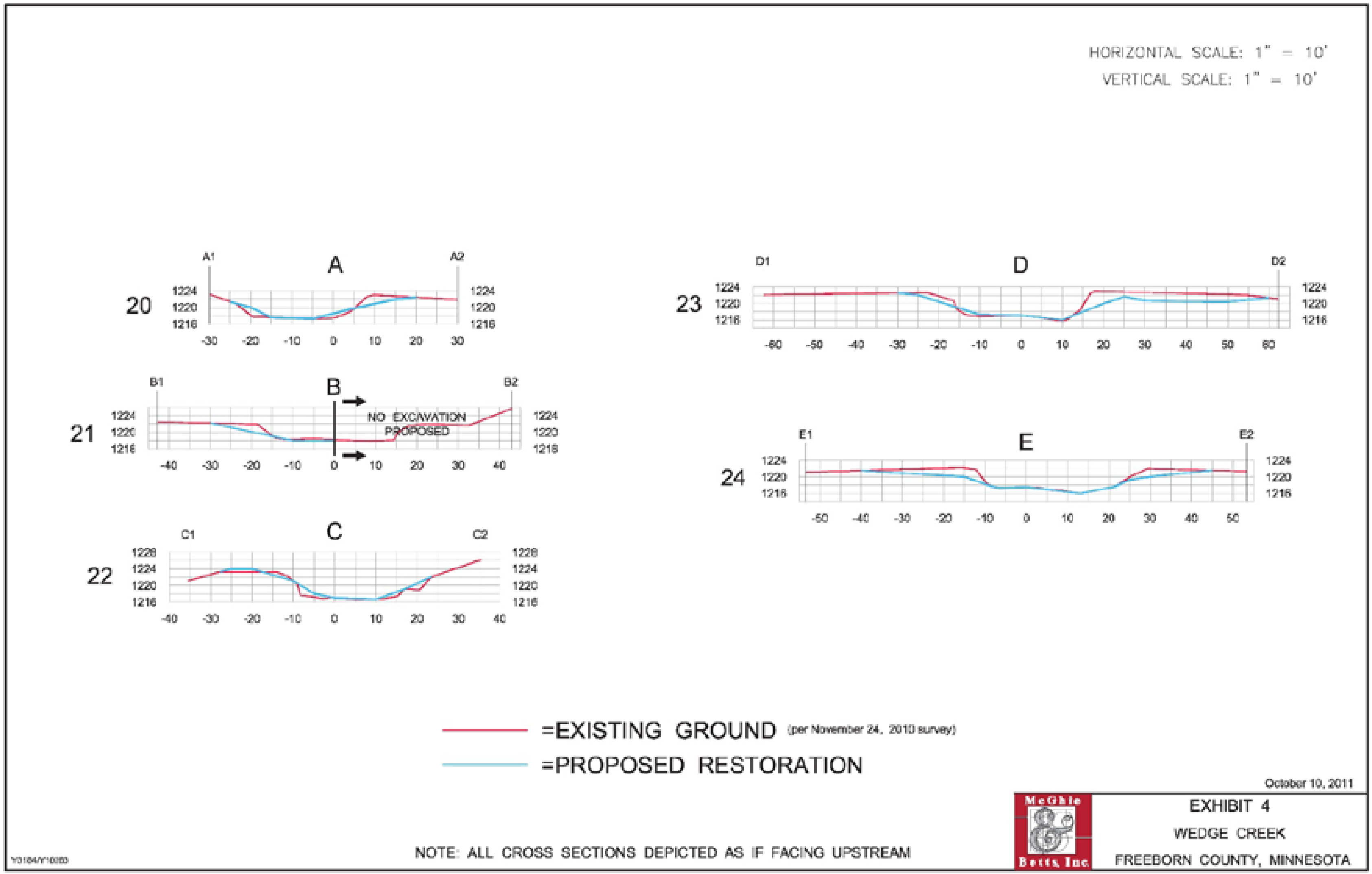


Figure 32-4 Wedge Creek Reach 3 channel cross sections showing existing channel cross section and proposed cross sections after restoration. Similar plans were included for the other project reaches.

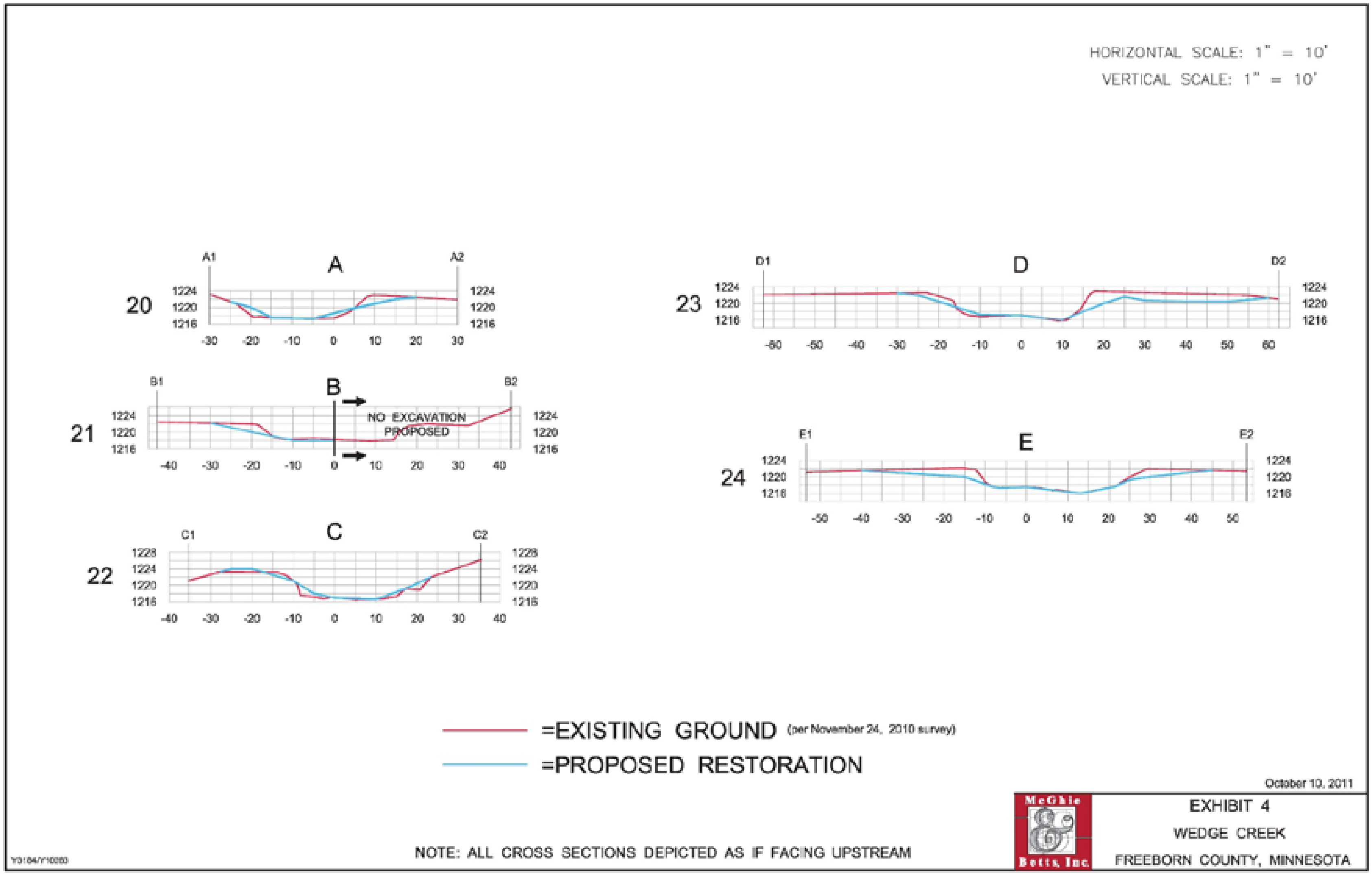


Figure 32-5 Wedge Creek Reach 3 channel cross sections showing the existing and proposed channel cross-sections. Similar plans were included for the other project reaches.

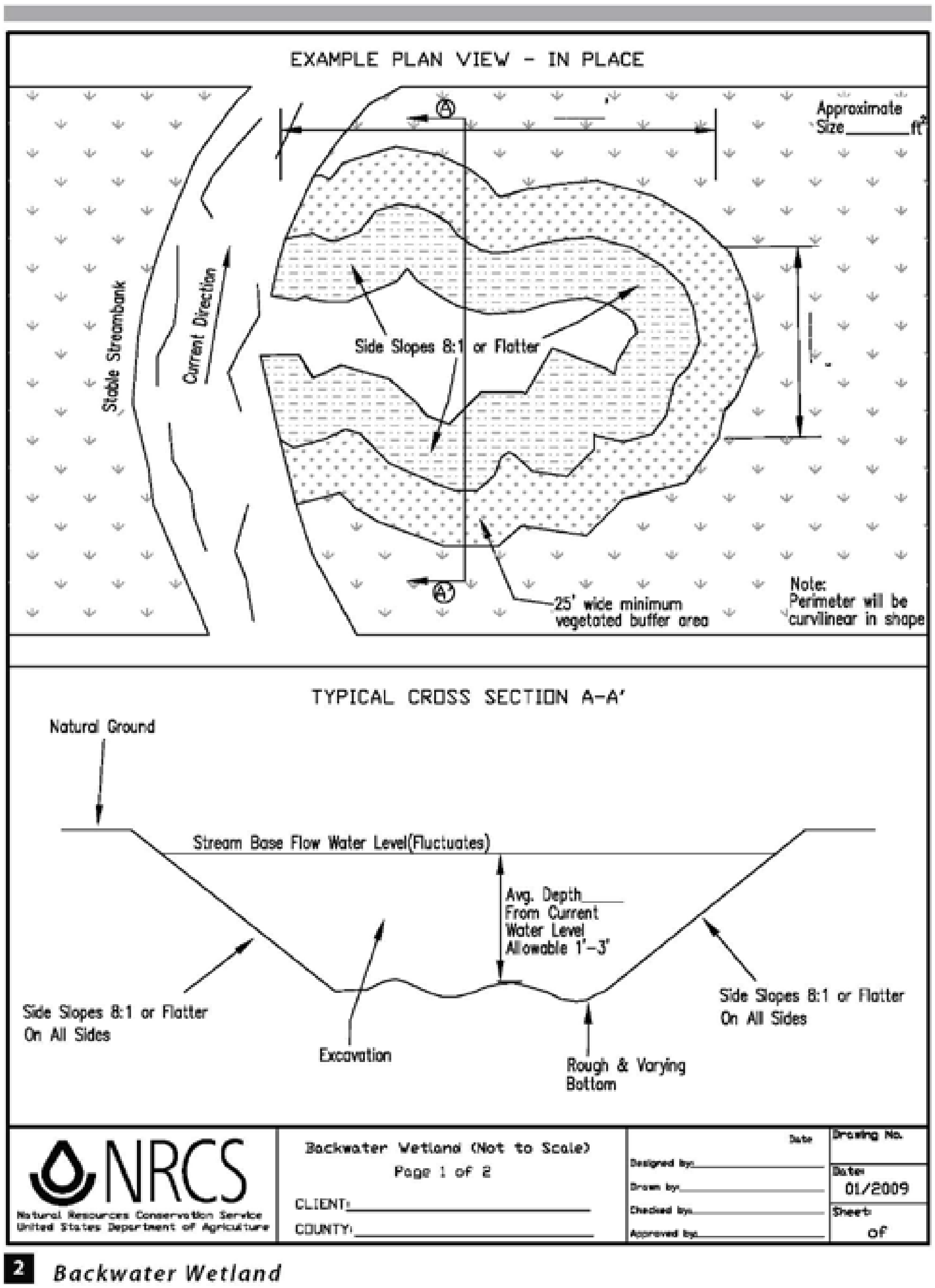


Figure 32-6 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.

CONSTRUCTION NOTES FOR BACKWATER WETLANDS

1. BACKWATER WETLANDS ARE TO BE IRREGULAR IN SHAPE WHEN COMPLETED. WHEEL RUTS ARE ALLOWED AND DESIRED. THE WETLAND NEEDS TO BE CONSTRUCTED TO THE APPROXIMATE SURFACE AREA, DEPTH AND IRREGULARITY AS WHAT IS FLAGGED BY NRCS STAFF.

2. ALL EXCAVATION SHALL BE IN ACCORDANCE WITH WISCONSIN CONSTRUCTION SPECIFICATION #2.

3. RE-TOPSOILING MAY BE NEEDED. IF NEEDED A MINIMUM OF 6' OF TOPSOIL WILL BE REMOVED FROM WETLAND SITE AND STOCKPILED FOR RE-SPREADING. BEFORE TOPSOIL IS RE-SPREAD THE DEPTH AND SLOPES MUST BE CHECKED. SEEDING SHOULD BE COMPLETED PER DRAWING WI-710 FOR INTRODUCED SPECIES OR DRAWING WI-711 FOR NATIVE SPECIES.

4. THE FINSIHED SIDE SLOPES ARE TO BE 8:1 OR FLATTER.

5. EXCAVATED SPOIL FROM THE SCRAPE SHALL BE:
   a. REMOVED FROM THE WETLAND/FLOODPLAIN AREAS AND PLACED AS INDICATED ON THE PLAN VIEW.
   b. PLACED BELOW THE PLANNED NORMAL WATER ELEVATION OF THE POOL FOR WETLAND MICROTOPOGRAPHY.
   c. SPREAD ABOVE THE PLANNED NORMAL WATER ELEVATION IN A LAYER AVERAGING NO MORE THAN 3-6 INCHES THICK. SPREAD IN THE LOCATIONS INDICATED ON THE PLAN VIEW FOR THIS PROJECT. NO FILL SHALL BE PLACED IN AN EXISTING WETLAND

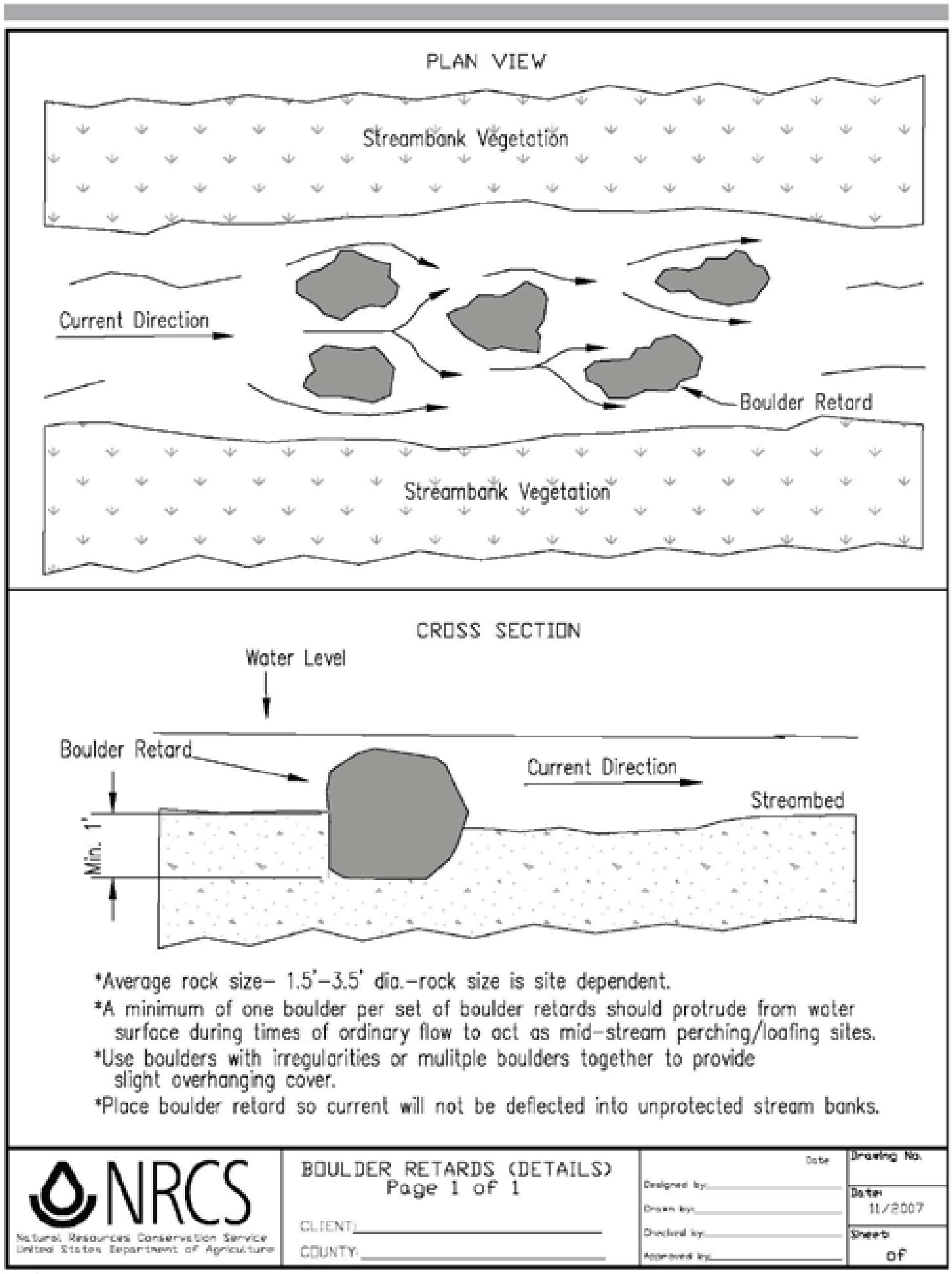
6. BASKING AREAS MAY BE ADDED AS APPROVED BY NRCS STAFF. THESE AREAS CAN CONSIST OF LOGS/WOODY DEBRIS OR PILES OF STONE ADDED TO THE WETLAND. THESE ADDITIONS SHOULD BE PLACED A MINIMUM OF 3-4 FEET FROM THE EDGE OF THE WETLAND TO ACT AS A BASKING AREA AND BE FAR ENOUGH INTO WETLAND TO MINIMIZE PREDATION.

7. BUFFER SEED MIXES SHOULD BE STRONGER IN FORB AND SHORT GRASS COMPONENTS. THIS WILL CREATE MORE INTERSTITIAL SPACE, AIDING IN REPTILE/AMPIBIAN MOVEMENT AND BASKING PER WI-710 OR WI-711.

NRCS Natural Resources Conservation Service United States Department of Agriculture	Backwater Wetland (Not to Scale) Page 2 of 2 CLIENT: COUNTY:	Date Designed by: Drawn by: Checked by: Approved by:	Drawing No. Date: 01/2009 Sheet: of

Backwater Wetland 3

Figure 32-7 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.



4 *Boulder Retards*

Figure 32-8 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.

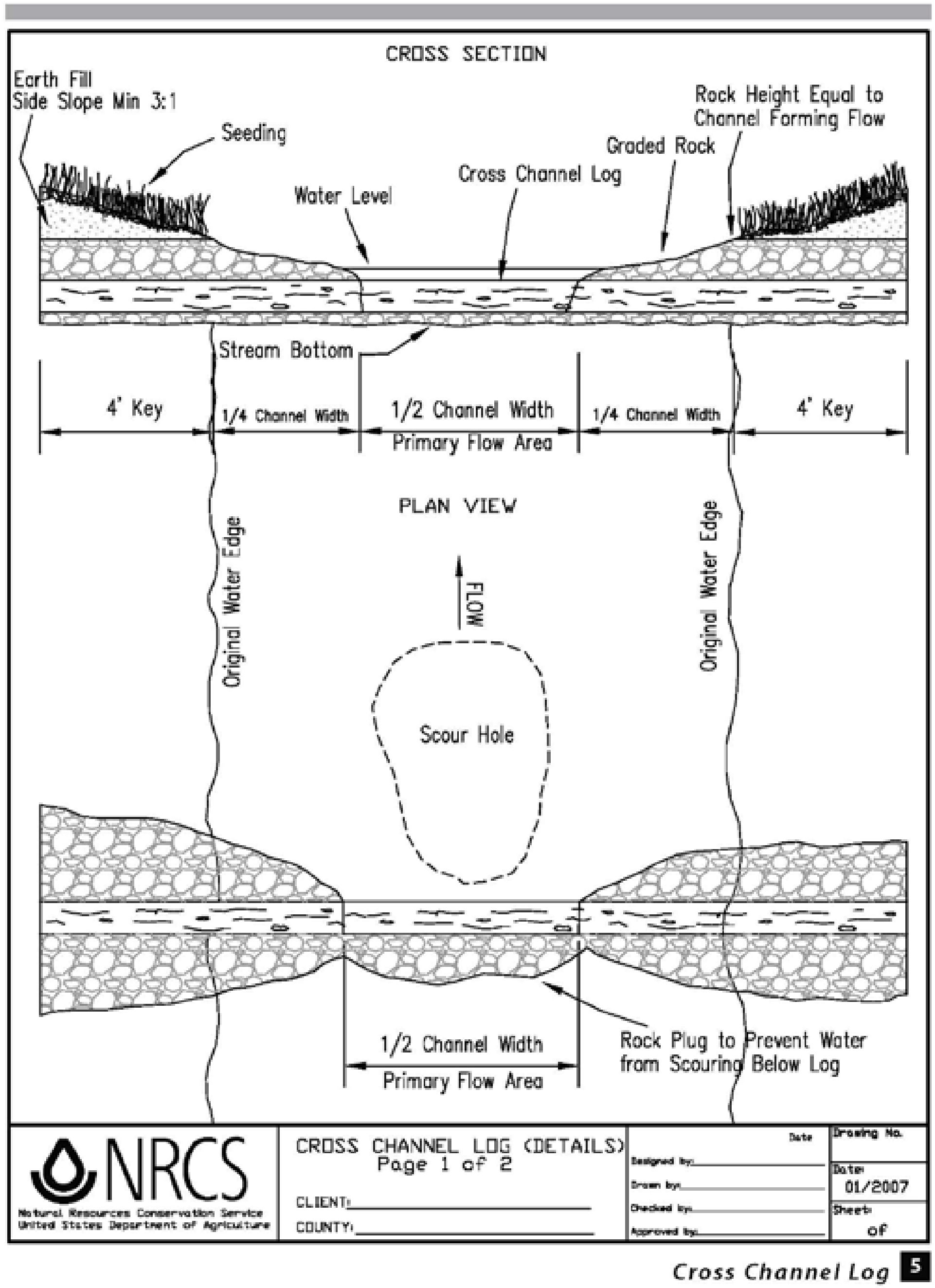


Figure 32-9 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.

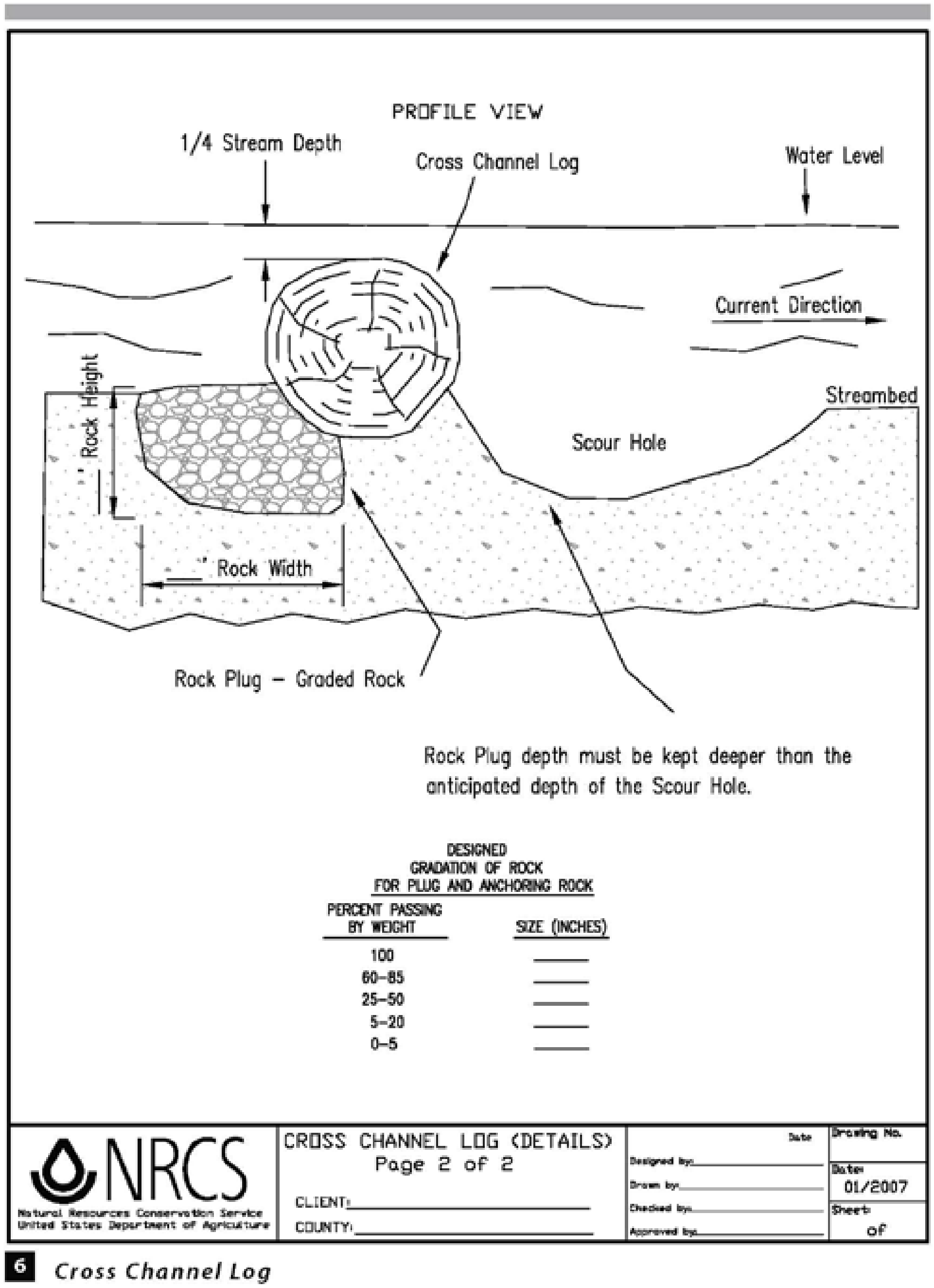


Figure 32-10 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.

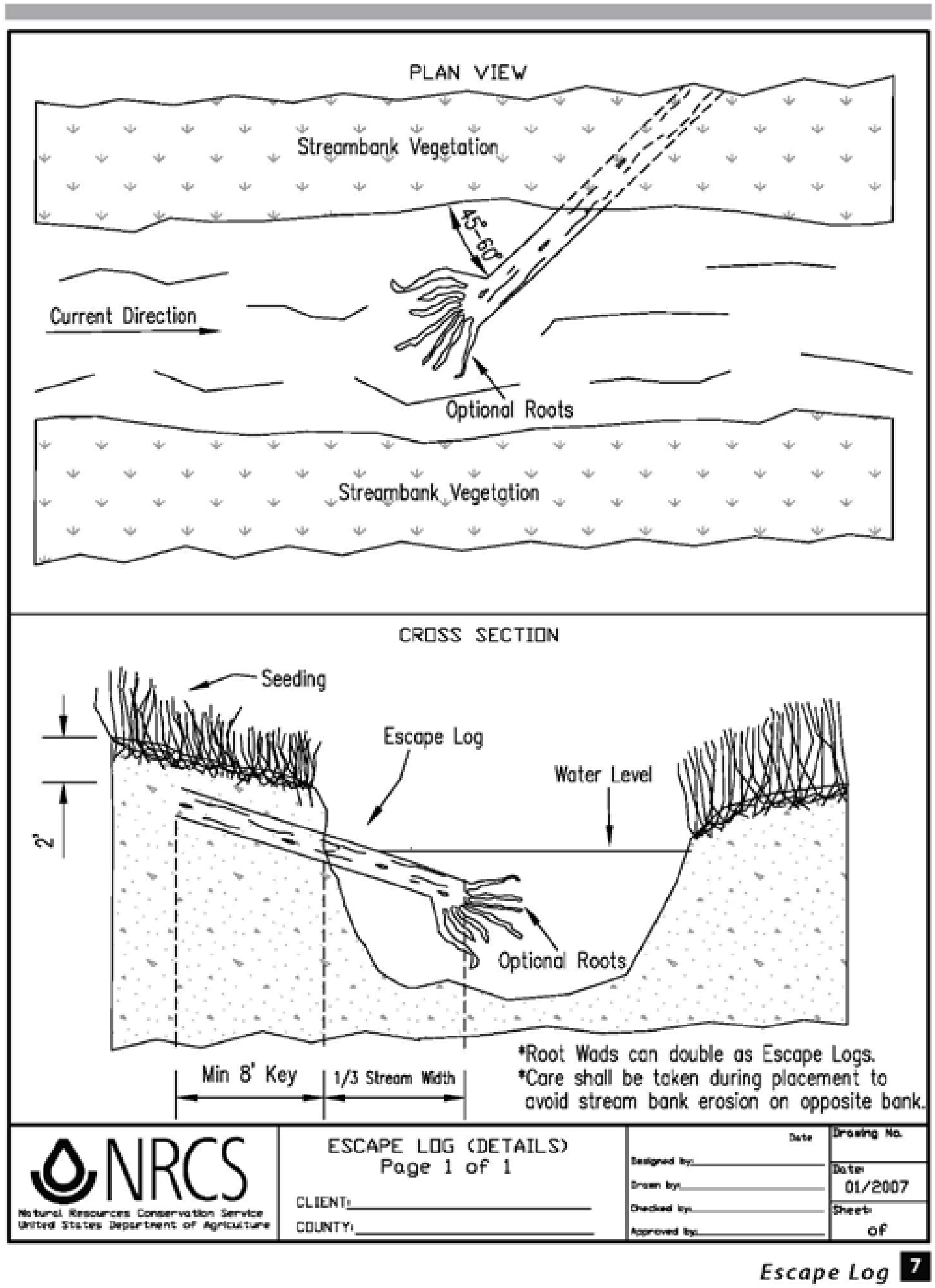


Figure 32-11 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.

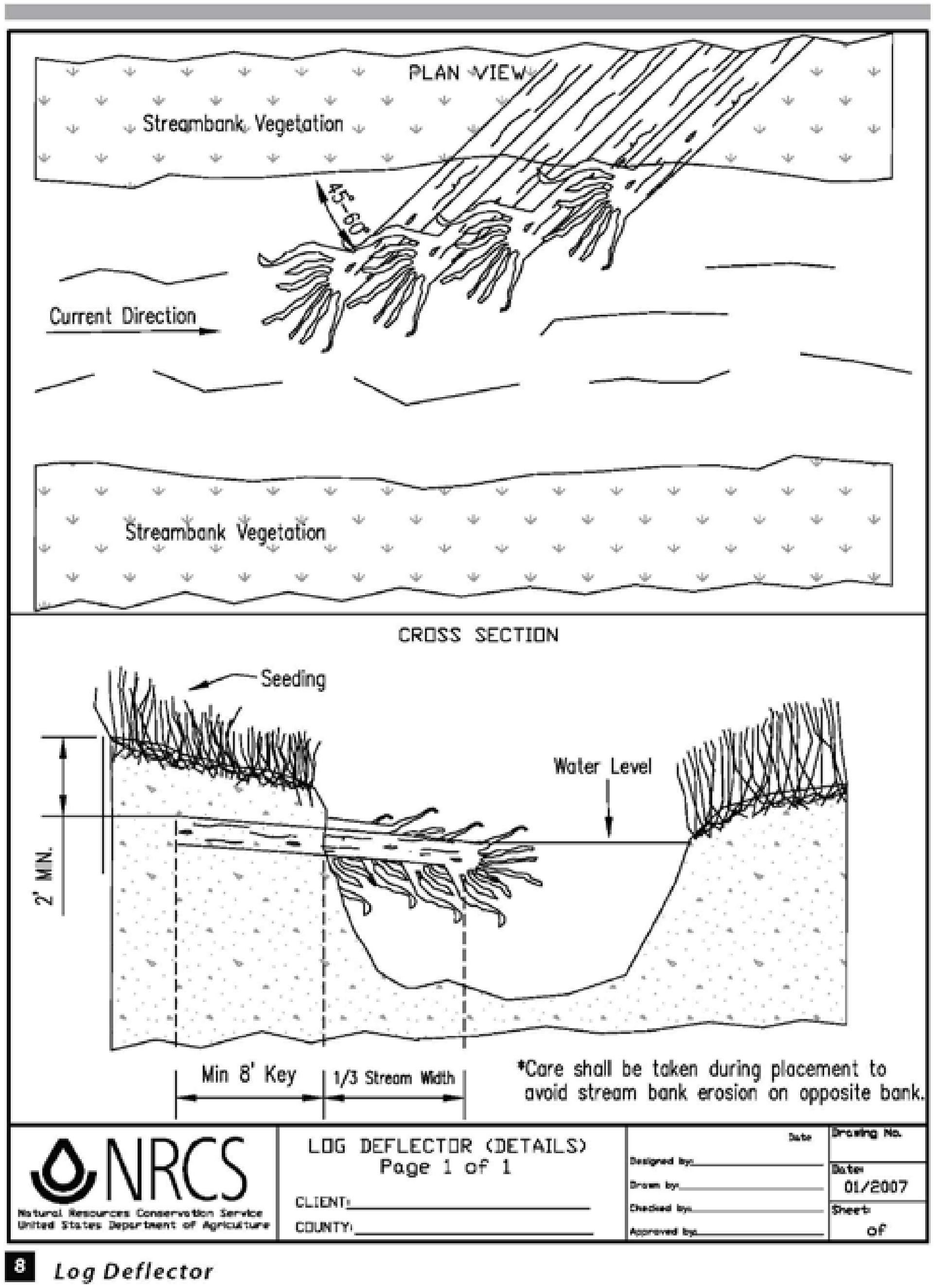


Figure 32-12 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.

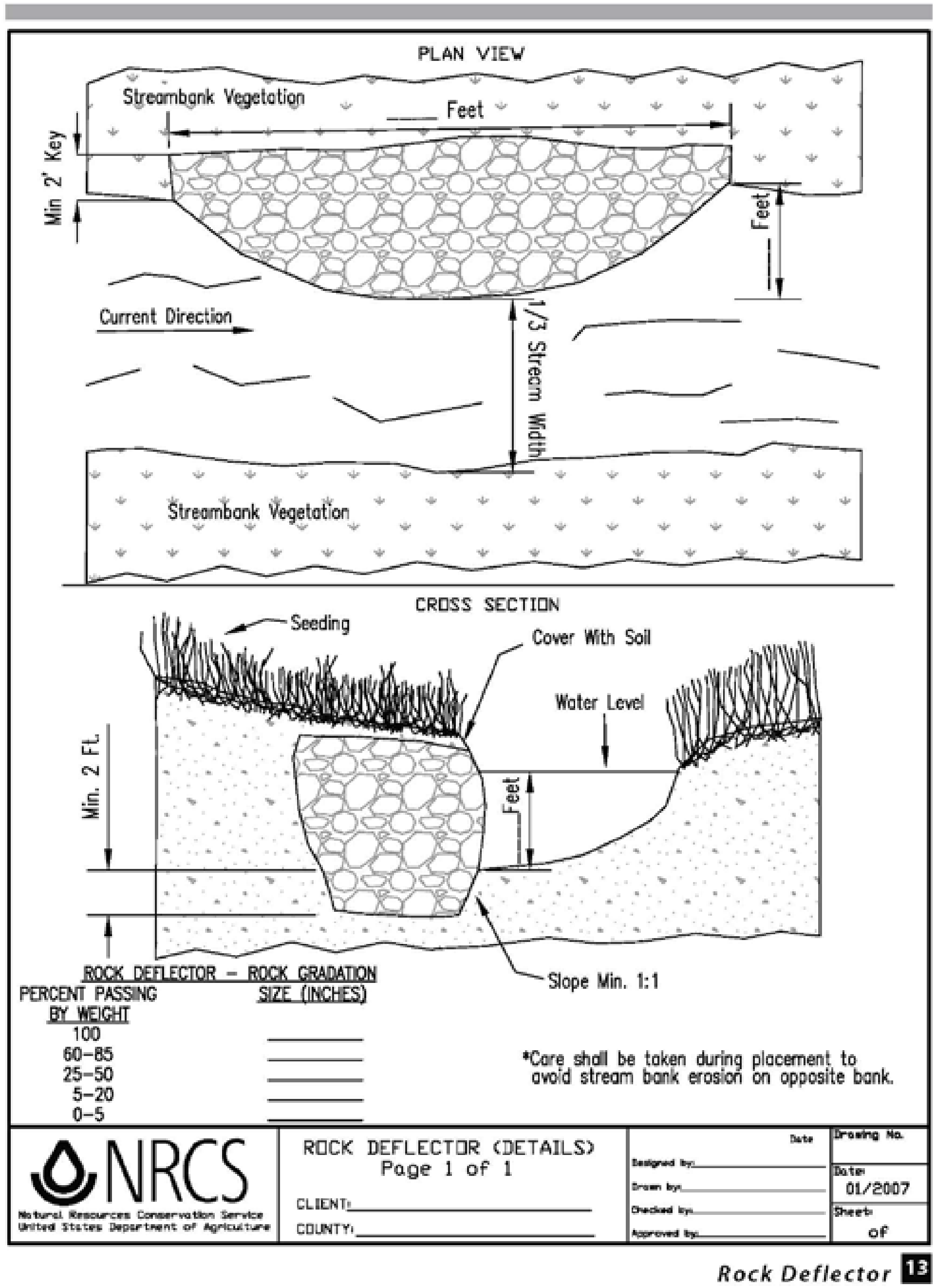
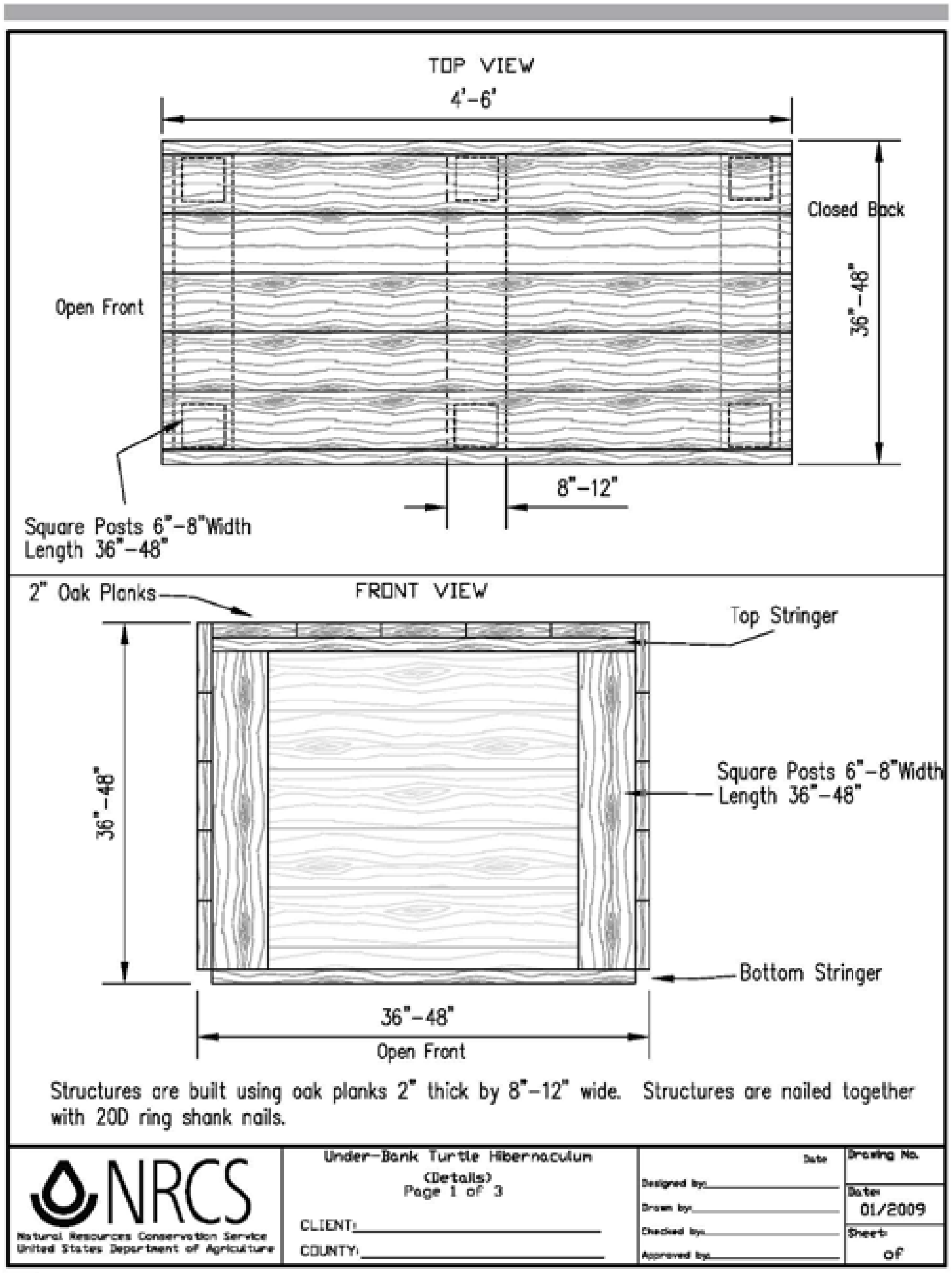


Figure 32-13 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.



16 *Turtle Hibernaculum*

Figure 32-14 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches. During construction, the turtle hibernaculum were constructed out of limestone rock versus the wood shown in the construction detail.

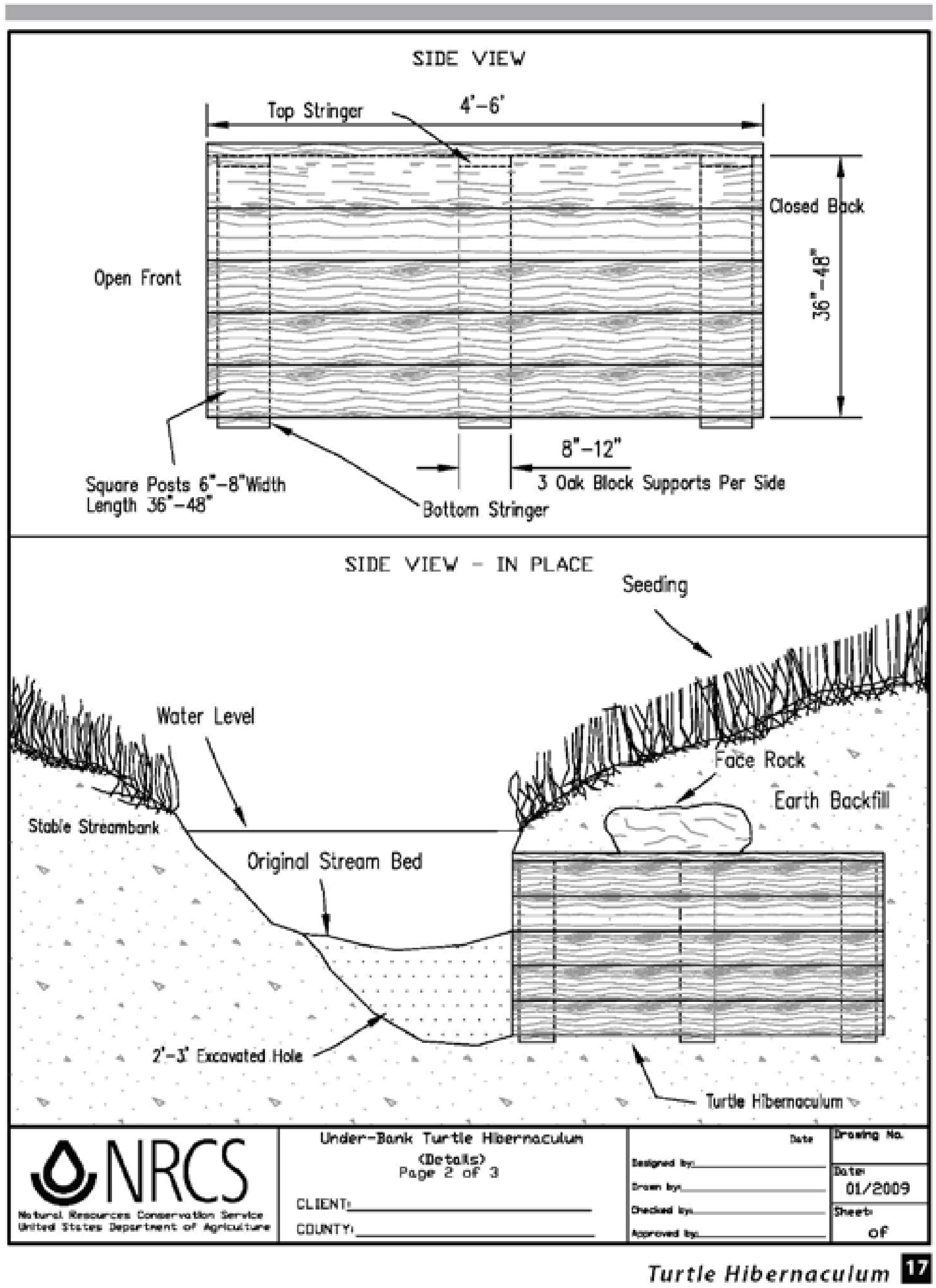


Figure 32-15 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches. During construction, the turtle hibernaculum were constructed out of limestone rock versus the wood shown in the construction detail.

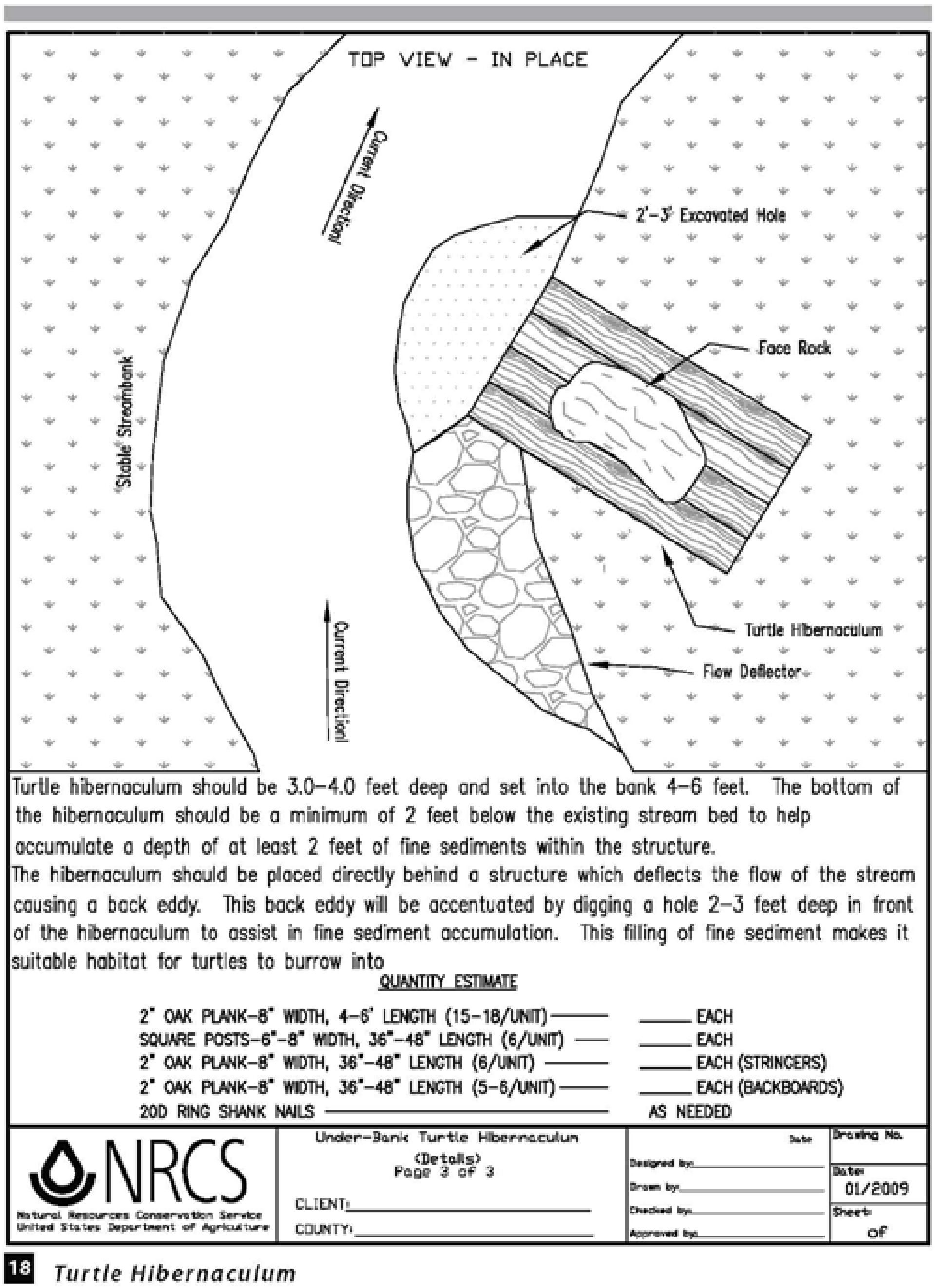


Figure 32-16 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.

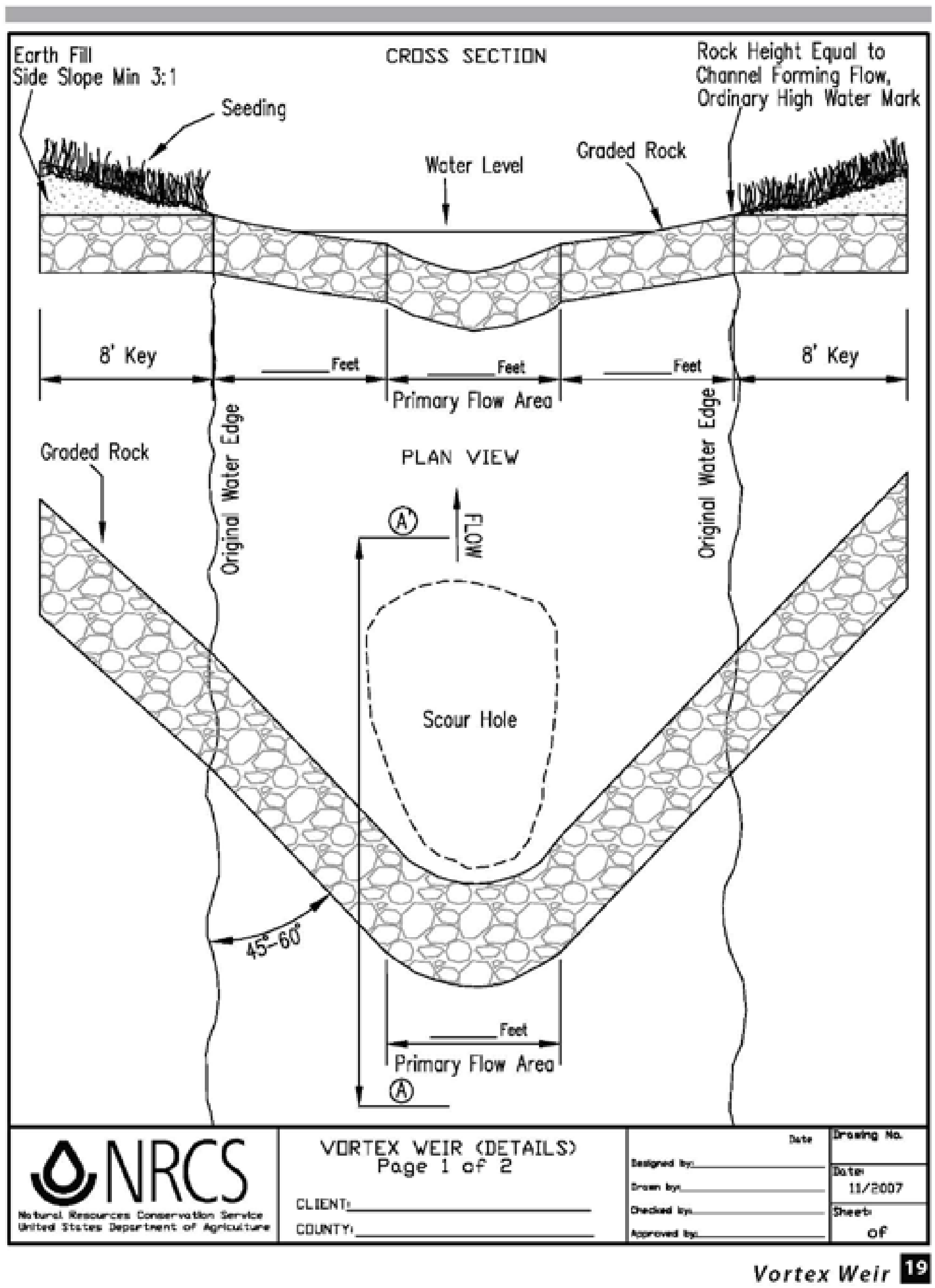


Figure 32-17 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.

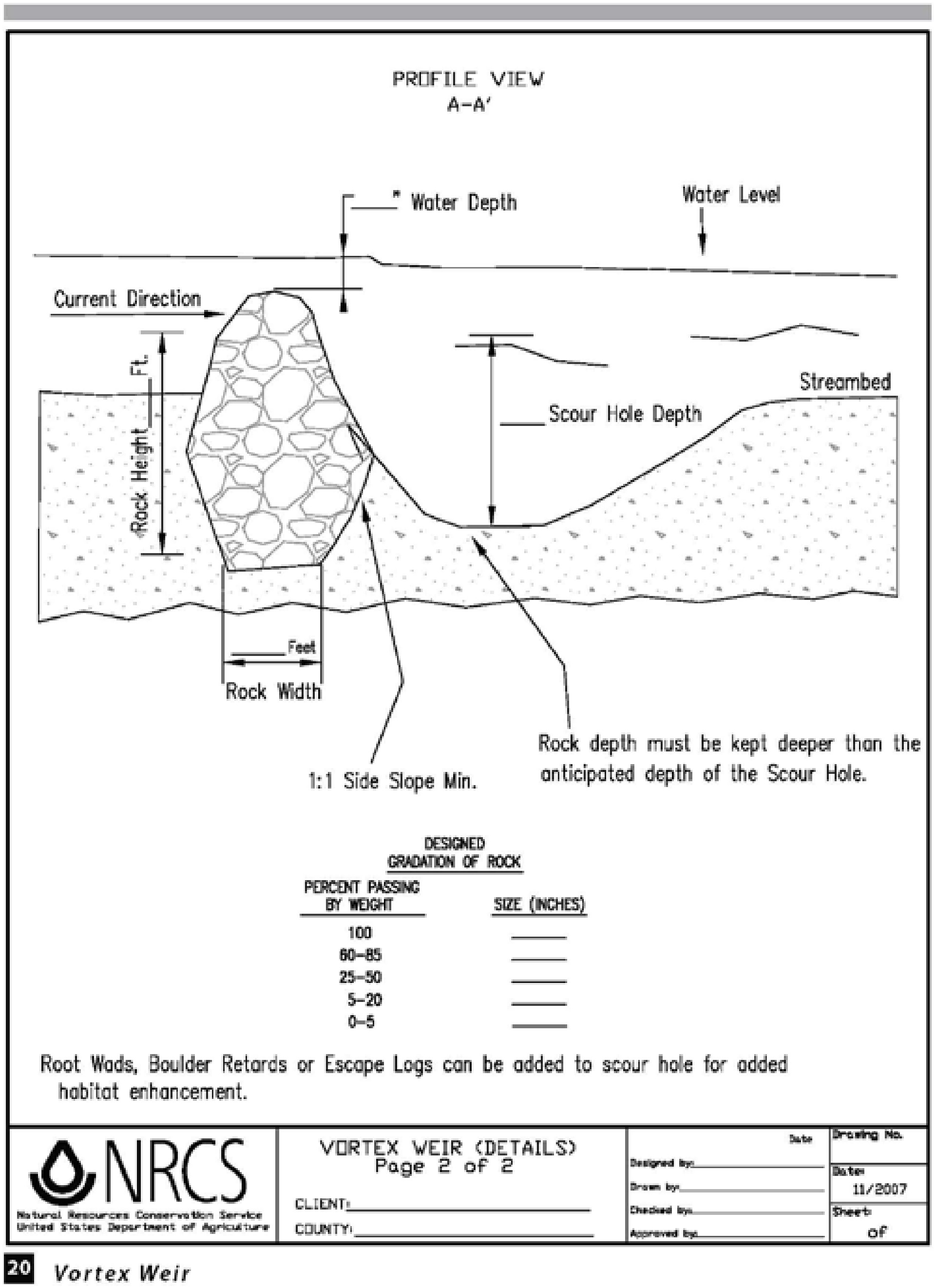


Figure 32-18 Wedge Creek Reach 3 NRCS habitat improvement construction detail. Similar plans were included for the other project reaches.

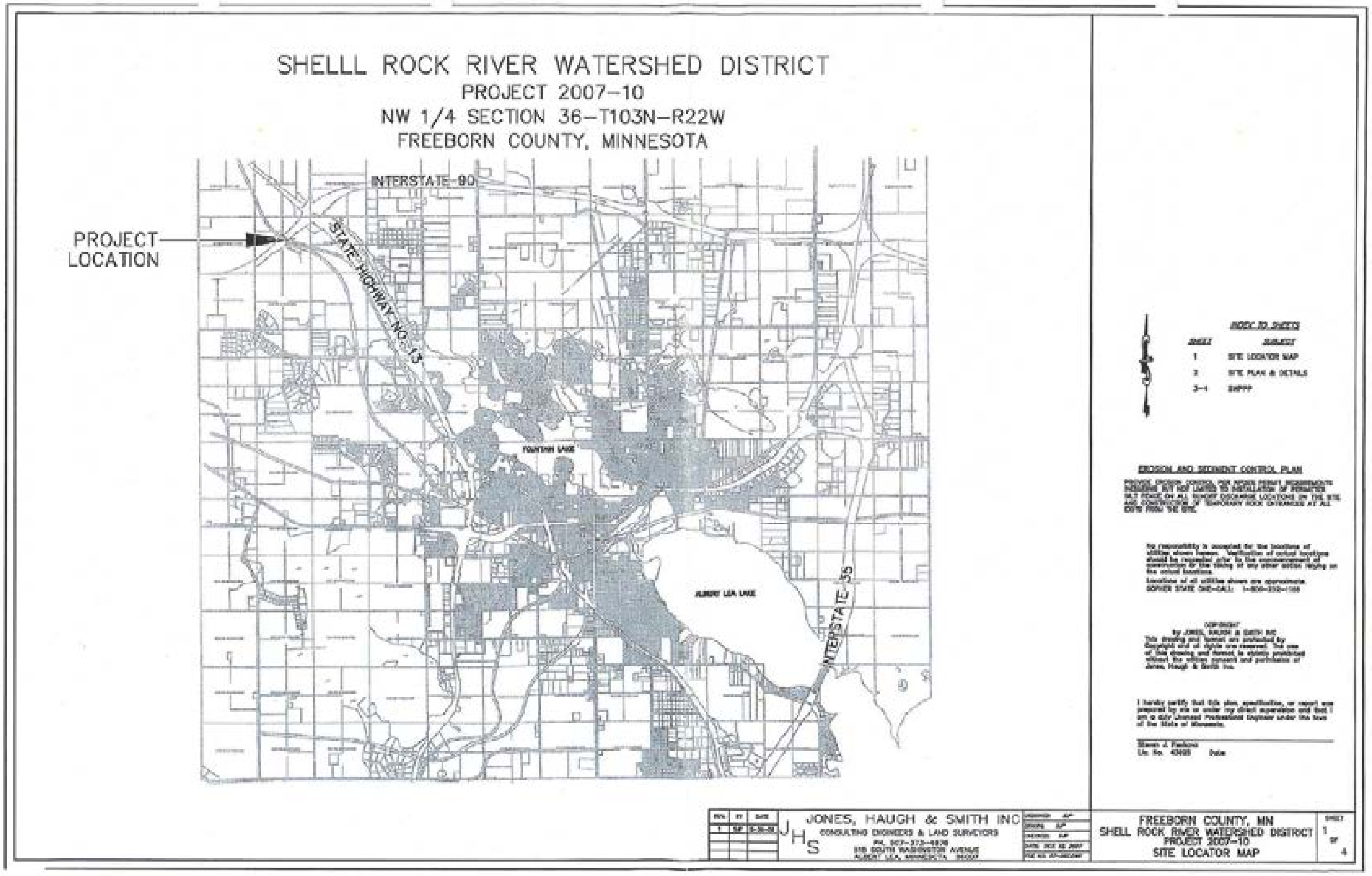


Figure 32-19 Wedge Creek Reach 6 culvert replacement construction project overview.

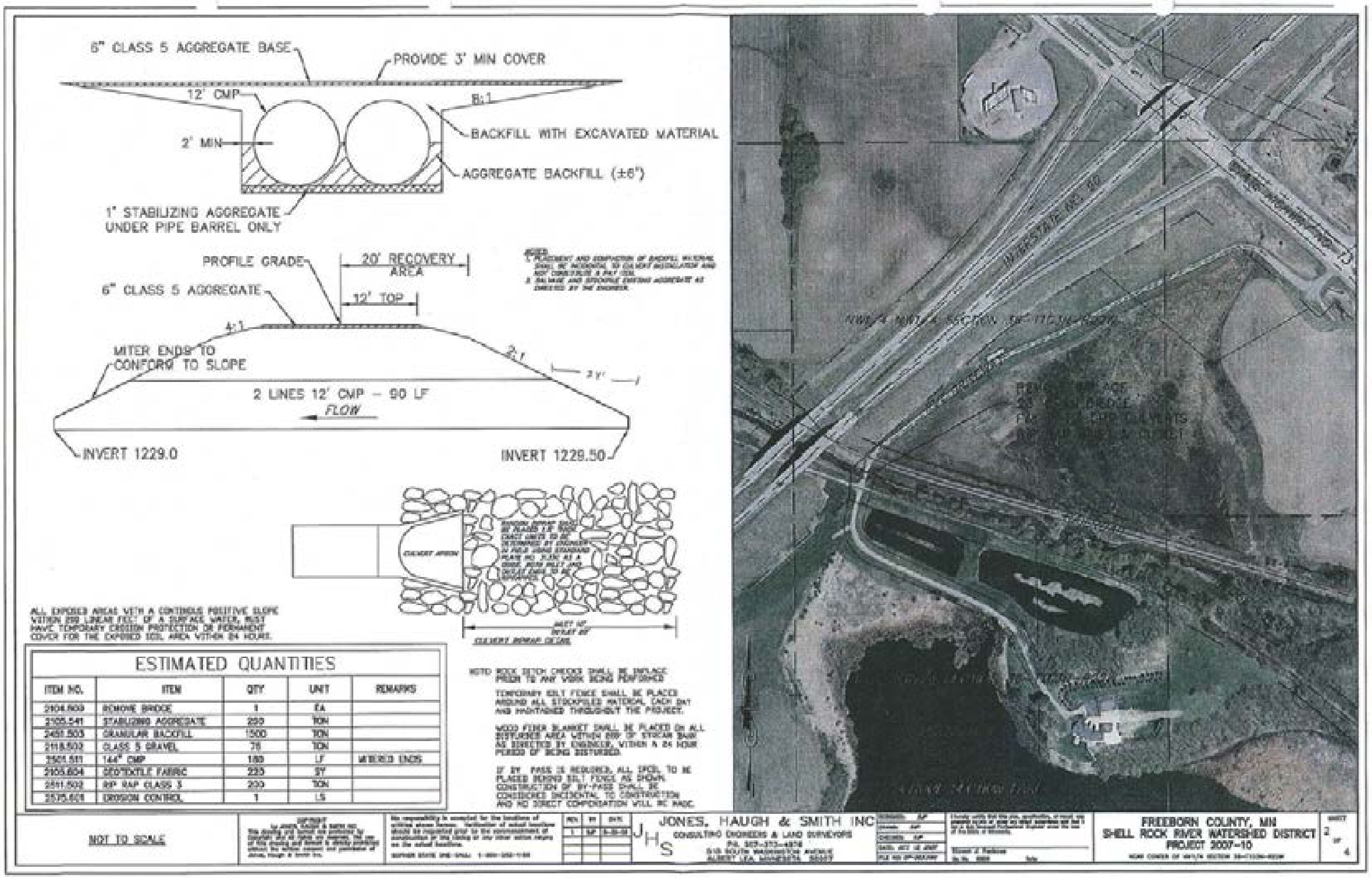


Figure 32-20 Wedge Creek Reach 6 culvert replacement construction plan and detail.

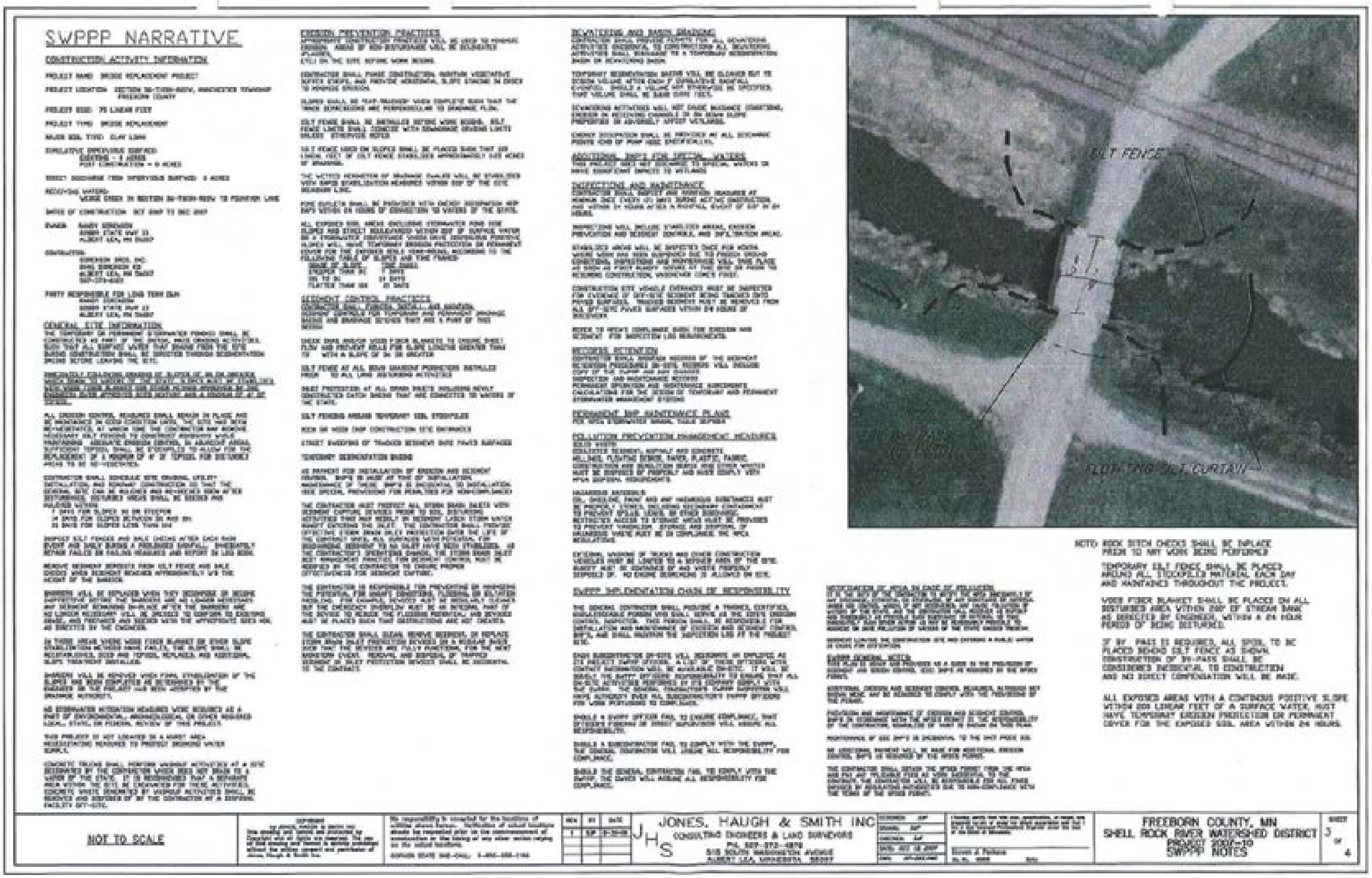


Figure 32-21 Wedge Creek Reach 6 culvert replacement construction Stormwater Pollution Prevention Plan.

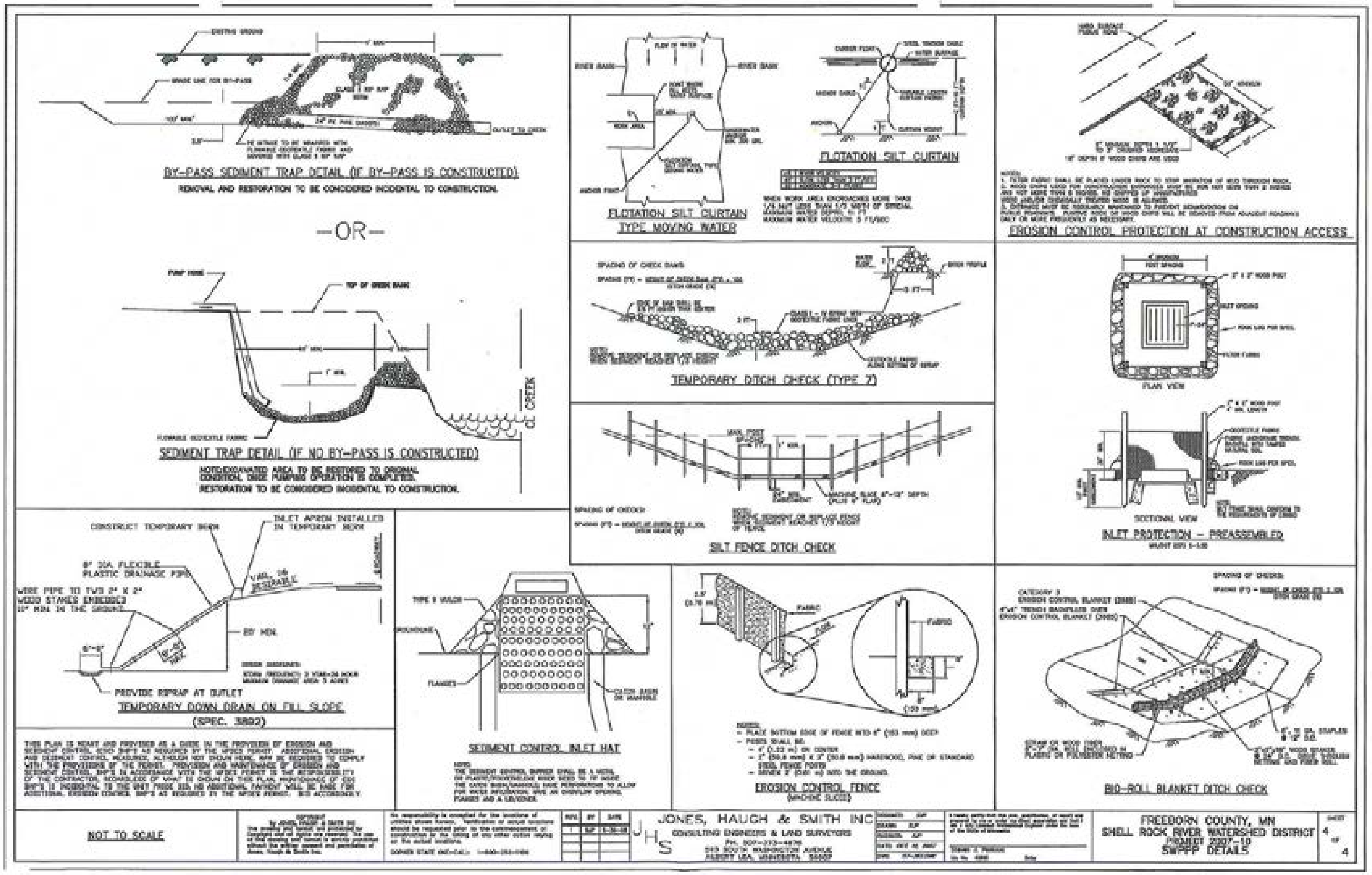


Figure 32-22 Wedge Creek Reach 6 culvert replacement construction details.

Table 32-1 Plants observed from field ID and photos taken during site visit on 9/20/19. Photos were taken along a meander survey route for plant ID. Seed mix(es) specified for restoration were native MN DOT 325 Wet Prairie Mix (Current Mix 34-262) along disturbed and restored streambank and wetland retention areas and non-native MN DOT 240 Sandy General Roadside Mix (Current Mix 25-121) on graded berms and tree staging areas.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Solidago gigantea	Giant goldenrod	5-10%		Native
Asclepias syriaca	Common milkweed	5-10%	Seeded	Native
Panicum virgatum	Switchgrass	5-10%		Native
Dalea purpurea	Purple prairie clover	5-10	Seeded	Native
Solidago canadensis	Canada goldenrod	5-25		Native
Bromis inermis	Smooth brome	10-75		Invasive
Elymus cf. virginicus	Virginia wildrye	<5		Native
Phalaris arundinacea	Reed canarygrass	10-75		Invasive
Zizia aurea	Golden alexanders	5-25	Seeded	Native
Phlox pilosa	Prairie phlox	1-10	Seeded	Native
Calystegia sepium	Hedge bindweed	1-10		Native, Weedy
Desmodium canadense	Canada tick trefoil	5-25	Seeded	Native
Melilotus sp.	Sweetclover	5-10		Invasive
Populus deltoides	Cottonwood	<5; Seedlings		Native
Ambrosia trifida	Giant ragweed	5-25		Weedy
Symphyotrichum cf. novae-angliae	New England aster	1-10	Seeded	Native
Andropogon gerardii	Big bluestem	5-10		Native
Liatris sp.	Blazing star	<5	Seeded	Native
cf. Heliopsis helianthoides	Smooth Oxeye	5-10		Native
Silphium perfoliatum	Cup Plant	<5	Seeded	Native
Euthamia graminifolia	Grass leaved Goldenrod	1-10	Seeded	Native
cf. Silene sp. (Silene cf. virginica or cultivar)	Catchfly, red-flowered	<5		-
cf. Helianthus tuberosus	Jerusalum artichoke	2-25		Native
Anemone sp.	Anemone, leaves only	<5		Native
Asclepias tuberosa	Butterfly-weed	<5	Seeded	Native
Cirsium arvense	Canada thistle	<5		Noxious
Verbena cf. urticifolia	White Vervain	<5		Native
Lactuca sp.	Lettuce	<5		-
Lotus corniculatus	Birdsfoot trefoil	1-10		Noxious
Sonchus arvensis	Field Sowthistle	1-10		Weedy
Monarda fistulosa	Wild bergamot	<5	Seeded	Native
Plantago sp.	Plantain	<5		Weedy
Rudbeckia hirta	Black-eyed susan	<5	Seeded	Native
Medicago lupulina	Black medick	<5		Weedy
Trifolium sp.	Clover	<5	Seeded	Weedy
Xanthium strumarium	Cocklebur	1-10		Weedy
Unknown Cyperaceae	Sedge family	<5		Native

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
cf. Echinochloa sp.	Barnyard grass	<5		-
Eleocharis sp.	Spikerush	<5		Native
Scirpus/Schoenoplectus sp.	Bulrush	<5		Native
Carex sp.	Sedge	<5		Native
Unknown shrub *(cf. Lonicera sp.)*	Honeysuckle sp.	<5		Invasive
Ratibida pinnata	Gray-headed Coneflower	<5	Seeded	Native
Asclepias incarnata	Swamp milkweed	<5	Seeded	Native
Verbena hastata	Blue Vervain	1-10		Native
Acer negundo	Boxelder, seedlings	1-10		Native

Appendix B: Site Photographs

Photo 32-1 These two 12’ culverts were installed on the upstream end of the project, on the upstream end of Reach 6, to replace an existing culvert that was undersized. Both culverts were incorrectly installed with an upstream invert 1.7’ higher than specified. Spring runoff and ice flow in 2019 pushed up and bent the upstream end of one culvert making it non-functional. (Wedge Creek – Reach 6, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-2 Photo looking upstream at the 12’ replacement culverts. Straightened channel is typical of what is found upstream in the agriculture landscape. (Wedge Creek – Reach 6, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-3 View of a lowered point bar to create a wetland terrace that is fully vegetated making it appear at almost the same elevation as the surrounding landcape. (Wedge Creek – Reach 6, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-4 Rock vane installed on the reach 6 project of Wedge Creek. Stream water is very turbid following 1.88” of rain the previous day and is assumed to be a result of agriculture drainage upstream. (Wedge Creek – Reach 6, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-5 Riprap toe installed on the reach 6 project of Wedge Creek. (Wedge Creek – Reach 6, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-6 Cross log installed on the Reach 5 project of Wedge Creek. Cross log was located based on landowner input to create and maintain a wet crossing upstream of the cross log. (Wedge Creek – Reach 5, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-7 Downstream view of the cross log depicted in the previous photo. Riprap toe is visible on the downsteam outside bend where flow is traveling from the cross log. (Wedge Creek – Reach 5, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-8 Looking upstream under a railroad bridge on the reach 4 project of Wedge Creek. Riprap was placed under bridge to control grade. Wedge creek turns 90 degrees to the left of the photo so riprap toe was installed to deflect the flow and prevent scour of the bank. State Highway 13 is immediately behind the viewer. (Wedge Creek – Reach 4, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-9 Looking downstream of the 90 degree bend shown in the previous photograph. (Wedge Creek – Reach 4, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-10 Reed canary grass, wet meadow surrounding reach 3 of the Wedge Creek project. (Wedge Creek – Reach 3, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-11 Reed canary grass, wet meadow surrounding reach 3 of the Wedge Creek project. (Wedge Creek – Reach 3, photo taken by Lucius Jonett during site visit 09/20/2019).

Photo 32-12 Looking downstream as Wedge Creek enters Fountain Lake. The winch and pulley with red bracket of the electric fish barrier is visible on the apron of the box culvert. (Wedge Creek – Reach 1, photo taken by Lucius Jonett during site visit 09/20/2019).

33) West Indian Creek Restoration/Enhancement (Revisit)

Legacy Fund Restoration Evaluations

See Appendix C for Project Background and Initial Project Evaluation

Project Name: West Indian Creek Habitat Improvement

Project Manager / Affiliated Organization: John Lenczewski/Trout Unlimited

Fund: OHF ***Fiscal Year Funds:*** 2011

County: Wabasha

Primary Activity: Stream/River Enhancement

Project Size: 4,250 linear feet

Project Completed: 2011

Revisit Site Assessment

Field Review Date: 10/21/2019

Field Visit Attendees: John Lenczewski (Trout Unlimited Executive Director), Wade Johnson (MN DNR Restoration Evaluations Program Coordinator), and Anna Varian (Stantec Site Assessor).

1. ***What are the stated goals of the project?***
   Reducing bank erosion, increasing overhead bank cover, increasing large trout and trout wintering cover, improving habitat for invertebrate species and other non-game species, reconnecting streams to their floodplain, adding native plant species whenever appropriate and possible, improving/increasing sunlight to streams by removing non-native and undesirable tree and shrub species, increasing trout angling opportunities.
2. ***What are the desired outcomes of achieving the stated goals of the project?***
   Improved trout angling and local economic impact by providing improved trout populations and habitat.
3. ***Please note any substantive changes to the site characteristics since last site assessment.***
   A major flood affected the project in the spring of 2013 that did damage the project area as well as areas outside the site.
4. ***Is the plan based on current science?*** Portions
   This project is eight years old, at this time fully engineered designs with plan sets were not common. The treatments and methods were common for the time when it was installed, if this project were

constructed today more pre-construction data would have been collected including reference reach data to guide the design and more wood used to help stabilize instead of rock. Skyhook structures for habitat and re-shaping banks to allow streams to access floodplains are still common practice today to improve habitat and reduce bank erosion

5. ***List indicators of project goals at this stage of the project.***

   The 2013 flood did damage the project area, but these areas were fixed and currently most banks are stable. Assessment of instream habitat was difficult due to high turbid water from morning rains. Fisheries surveys were completed pre and post construction, but trout populations are highly variable and assessing improvement can be difficult. Index of Biotic Integrity scores remained stable from pre to post construction in the "good" category. Minnesota Stream Habitat Assessment scores were collected pre and post construction, the initial score in 2010 was 67.8 (out of 100) and dropped to 51.2 in 2011 after a large flood impacted the site. Scores for the years immediately following construction were higher than the 2011 score but have not quite reached the 2010 score. Observations during fisheries surveys indicate that there are more and deeper pools, but a high sand bed load continues to exist within the reach due to watershed conditions. Photos of pre-construction condition show vertical exposed banks while current banks are sloped appropriately to allow floodplain access and vegetated. DNR fisheries had noticed an increased interest in angling in this area after project construction as stated in initial review.

6. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project outcomes?***

   Yes, bank erosion will be reduced by sloping banks to allow the stream to access its floodplain and adding skyhooks will add overhead cover. Deeper pools created by structures will improve overwintering habitat for trout. Invertebrate habitat would have been better improved with the use of more wood in the design.

7. ***Are corrections or modifications needed to meet proposed outcomes?***

   Yes, currently the campground area is being mowed all the way to the edge of the stream. If the landowner would agree to leave an un-mowed buffer of native vegetation the stream habitat and riparian habitat would improve. The initial evaluation stated that the campground owner will be notified about a mowing setback, this either was not done or the owner is disregarding. Additionally, horses are using some of the riparian area and a small portion of the riparian area is being negatively affected by this. Unfortunately, this improvement relies on landowner cooperation; landowner education may help the situation.

8. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

   The use of more woody debris in the design would help improve trout and invertebrate habitat but at the time this was constructed these practices where only just beginning. See previous answer for information on potential opportunities to improve outcomes and the potential challenges of this.

9. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***

   No.

10. ***Are follow-up assessments needed? Explain.***

    No, since fixes to the project after the 2013 flood it has been several years including several high flow events and no significant changes to the project have occurred.

11. ***Additional comments on the restoration project.***

    Remaining grant funds after initial construction were used in 2013 to fix erosion caused by the flood. Current vegetation through the project reach is primarily ruderal species and varies through the reach based on land management. The upper section bordered by unmanaged land is primarily Reed Canary Grass with scattered Box Elder. Common forbs in the upper section include Trailing Blackcap Raspberry, Canada Goldenrod, Giant Ragweed and Nettles. Near the middle of the project area there is horse pasture and a horse crossing. This section has patches of Sandbar Willow near the stream and open arears with patchy pasture grasses and primarily weedy forbs including Cow Parsnip, Curly dock, Bur Dock and Garlic Mustard. The lower half of the project reach is lined on the east by mowed turf grass extending from the adjacent campground. There is a buffer of 4 to fifteen feet of unmowed turf/pasture grass along the east side of the stream. The west side of the stream is a mixture of naturalized Box Elder, Reed Canary Grass and other naturalized streambank vegetation.

Revisit Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

12. ***The project has:***

    achieved the stated goals.
13. ***The project will:***

    Meet proposed outcomes

    Confidence of outcome determination:

    Medium
14. ***Provide explanation of reason(s) for determination.***

    High and turbid water during site review made it difficult to fully assess fish habitat, assessment relied on information from surveys and anecdotal information from the DNR. Goals of reducing bank erosion and reconnecting the stream to its floodplain were clearly met when comparing current banks conditions to photos taken pre-construction. DNR fisheries had noticed an increased interest in angling in this area after project construction as stated in initial review.
15. ***Site Assessor(s) Conducting Review:***

    Anna Varian, Stantec.

Appendix A: Revisit Site maps, Project plans or Vegetation tables

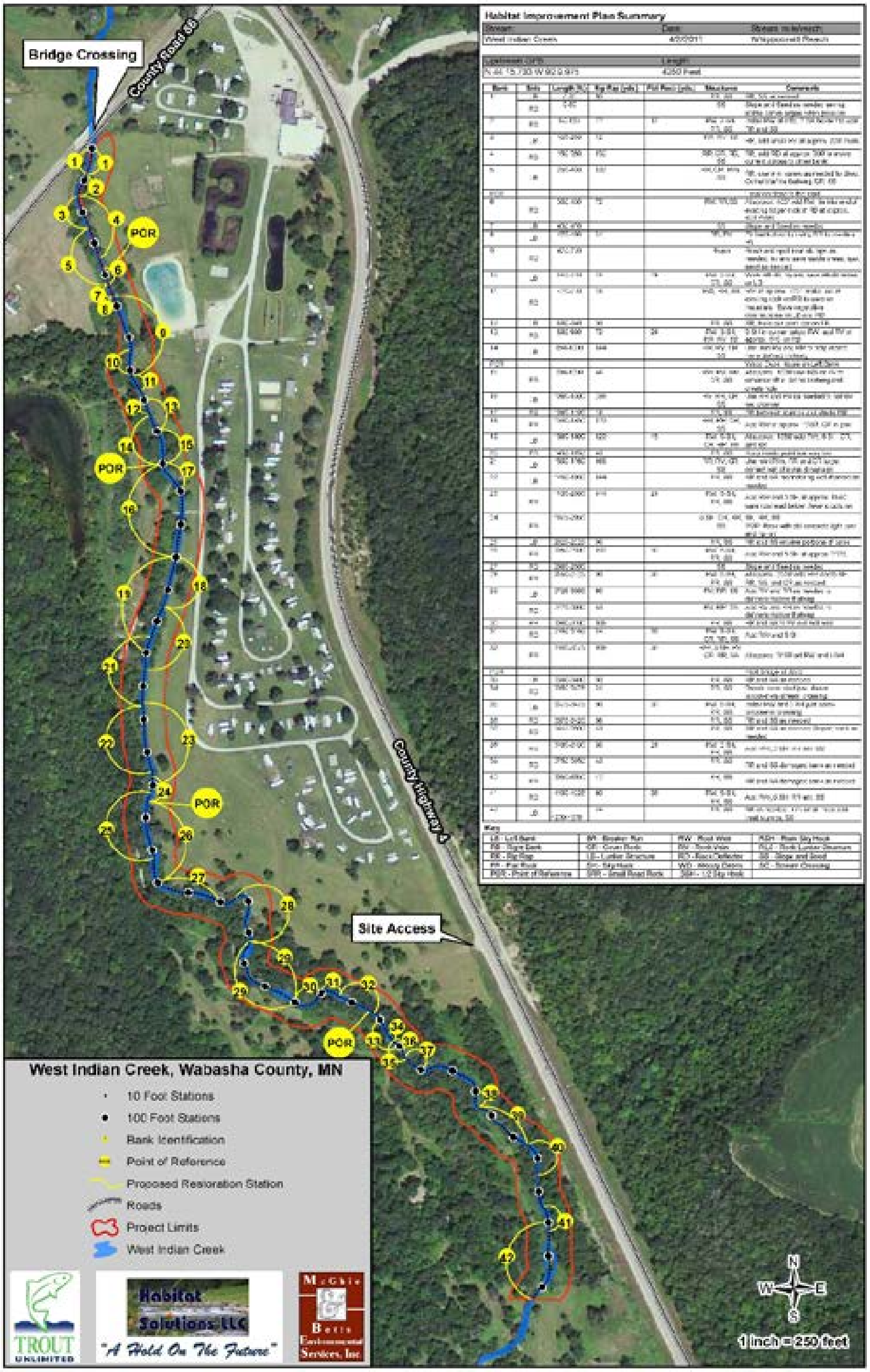


Figure 33-1 Construction plans.

Appendix B: Revisit Site Photographs

Photo 33-1 Stream conditions pre-construction. High vertical banks and overly wide stream with reduced instream habitat.

Photo 33-2 View of upstream reaches of habitat improvement project

Photo 33-3 Area of project that horses are impacting, stream bank has eroded and vegetation is clearly being disturbed by the activity.

Photo 33-4 View of downstream reaches of project area within campground.

Appendix C: Initial Project Evaluation

*Fields in original evaluation form may vary. Information was translated to newest version as applicable.

Project Background

Project Name: West Indian Creek Habitat Improvement

Project Location: West Indian Creek

Township/Range Section: Township 109N Range 11W Section 6

Project Manager / Affiliated Organization: John Lenczewski/Trout Unlimited

Fund: OHF ***Fiscal Year Funds:*** 2012

Project Start Date: 2012

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

16. ***What are the specific project components and treatments?***
    Click here to enter text.
17. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
    MN TU worked jointly with the Lanesboro and Lake City Fisheries offices in the project planning for this site. Most of the materials were included in the DOW permit application, which is available from the Lake City DNR office.
18. ***What are the stated goals of the project?***
    Reducing bank erosion, increasing overhead bank cover, increasing large trout and trout wintering cover, improving habitat for invertebrate species and other non-game species, reconnecting streams to their flood plain, adding native plant species whenever appropriate and possible, improving/increasing sunlight to streams by removing non-native and undesirable tree and shrub species, increasing trout angling opportunities and local economic impact by providing improved trout populations and habitat.
19. ***What are the desired outcomes of achieving the stated goals of the project?***
    Click here to enter text.
20. ***Were measures of restoration success identified in plans?*** *Choose an item.*
    If yes, list specific measurements.
    Click here to enter text.
21. ***Are plan Sets available?*** Choose an item. ***Have project maps been created?*** Choose an item.
    If yes, provide in Appendix A and list Maps provided:

Click here to enter text.

22. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
    Click here to enter text.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

23. ***Were alterations made to the plan during project implementation?***
    No
    Click here to enter text.
24. ***In what ways did alterations change the proposed project outcome?***
    Click here to enter text.

Site Assessment

Field Review Date: **9/18/2012**

Field Visit Attendees: Reviewers: Kevin Stauffer MNDNR Fisheries Lake City, Steve Klotz MNDNR Fisheries Lanesboro, Wade Johnson MNDNR - Project managers: John Lenczewski Trout Unlimited

25. ***Surrounding Landscape Characteristics:***
    Camper trailer park development along northeast section of project site. Hwy 4 along east edge of Valley bottom.
26. ***Site Characteristics:***
    u. ***Soils:***
    Floodplain fine sandy loam (Dunnbot-Scotah complex, 0-3% slopes, frequently flooded)
    v. ***Topography:***
    Valley Bottom, near level to moderate slope
    w. ***Hydrology:***
    Click here to enter text.
    x. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
    Regraded streambank slopes 50-80% (% varing site to site) second year establishment of native prairie and ripairian seed mixes, interspersed with annual and perenial ruderal veg. Developed northeast edge of project site mowed turf grass and individual flood plain trees: Box Elder, Green Ash, Cottonwood, Silver Maple. Southern end of project site mixed shrubs Dogwood, Willow; tall grasses and perenials (primarily ruderal) and patches of flood plain trees.
    y. ***Vegetation B: Meander Search Species List (as appropriate for site)***
    NA
27. ***Is the plan based on current science?*** Portions
    The type of habitat work done on the West Indian site has a long history of use in the Driftless Area of SE MN. The treatments used rely on significant quantities of rock to form and stabilize a stream channel that has habitat features (pools, overhead cover, etc.) for adult trout. These treatments are proven to enhance trout populations and angler success in SE MN. Prior to the project, the stream channel was overly wide and very shallow with high, eroded banks. The recent project created a narrower and

deeper channel that provides much improved habitat for brown trout.   Extensive bank sloping in the project will allow flood flows to pass through this stream reach without damaging stream banks and will allow for the establishment of high quality riparian vegetation.

While the treatments used on the West Indian site are deemed appropriate and effective in meeting the stated objectives, there is a growing expectation that this type of habitat restoration move away from the "hard armoring" approach and toward a "natural channel design" that allows the stream to adjust to its hydrology over time. The reason I mention this is that several other LSOHC funded projects in the Driftless Area will be implemented using natural channel design concepts. This may be an opportunity to compare methods over time to evaluate which approach is most successful in achieving goals and objectives for these projects.

28. ***List indicators of project goals at this stage of project:***

Physical habitat in the stream is much improved from original conditions, based on visual examination. Eroded banks have been sloped and stabilized, which will substantially reduce soil from entering the stream on this site. DNR Fisheries conducted a trout population assessment in September 2012. Those results will be compared to pre-project assessments, however it will likely take several years post-project to get an accurate assessment of population response to the habitat improvement work. Stream geomorpholgy data (longitudinal profiles, cross sections and pebble counts) were collected pre-project and will be repeated this fall. The geomorphological survey this fall will serve as the "as built" condition and allow monitoring for change in future years. While there has been no formal survey of anglers or property owner, it is very obvious that they are extremely pleased with the project and the stream reach has received considerably more angler activity that it would have without the project.

29. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***

    Yes.

30. ***Are corrections or modifications needed to achieve proposed goals?***

    Yes. Establishment of riparian vegetation may need some additional attention in places. There has only been one growing season since this project was completed, so the seeding/establishment should be monitored next season and addressed as needed. The campground operator will be notified about a mowing setback, which is currently to close to the stream.

31. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***

    I am not aware of any future steps that are proposed.

32. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***

    No.

33. ***Are follow-up assessments needed? Explain.***

    Yes. Ideally a project like this should be assessed again in 3 to 5 years. The initial "as completed" assessment is a good opportunity to see the finished product and compare it to the original conditions. However, the ecological functions take time to develop and monitoring progress over time will provide a more accurate assessment project. Additionally, one of the stated goals of the project is that it will be "long lasting and require minimal maintenance." I think this will likely be the case, but SE MN streams typically have a very flashy hydrology and the potential for some project failure is always a possibility that may require unforeseen maintenance and repair.

34. ***Additional comments on the restoration project.***

    Overall the project is very well done and has generated a great deal of interest from anglers and local residents. Nearby landowners have indicated their interest in potentially selling an angling easement to the DNR. The project was implemented as designed and agreed to with DNR Fisheries, but in hindsight, there was probably some additional habitat diversity that could have been included in the project. Specifically, pool habitats could have been improved by including submerged woody cover. Root wads or toe-wood/sod mats could have been used in some bank stabilization areas instead of rip rap. The use of artificial overhead cover (i.e. skyhooks) could have been reduced by 10-20% in several pools. DNR Fisheries has also collected pre-project data on fish population and stream geomorphology. Post-project surveys will be completed over the next few years. Reports on fish population assessments are available at the Lake City DNR Fisheries office.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

35. ***The project has:***

    Choose an item.

36. ***The project will:***

    Meet proposed outcomes

    Confidence of outcome determination:

    High

37. ***Provide explanation of reason(s) for determination.***

    There is a long history of this type of project in SE MN and based on prior projects success, this project will very likely meet the proposed outcomes.

38. ***Site Assessor(s) Conducting Review:***

    Kevin Stauffer MN DNR

Site Photographs

Photo 33-5 Regraded slope, Rock deflector and Rock weir. Site visit 09/18/2012.

Photo 33-6 Rock weir structure. Site visit 09/18/2012.

Photo 33-7 “Sky Hook” structure in stream bend. Site visit 09/18/2012.

Photo 33-8 Underwater support for Sky-hook structure shown in Photo 33-7. Site visit 09/18/2012.

Photo 33-9 Panoramic photo of reconstructed stream bend with rock weir and rip rap and sky hook on opposite streambank. Site visit 09/18/2012.

34) Zumbro River Channel Restoration

Project Background

Project Name: Zumbro River Restoration and Old Lake Shady Dam Removal

Project Site: Oronoco, Minnesota

Township/Range Section: Township 108N Range 14W Section 7, 8, 17, 18

Project Manager / Affiliated Organization: Luther Aadland, Amanda Hillman, MN DNR

Fund: OHF ***Fiscal Year Funds:*** FY 14

Project Start Date: Winter 2015

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Wetland , Prairie / Savana / Grassland

Project Status: Post Establishment Phase

County: Olmstead

Primary Activity: Stream/River Restoration

Project Size: 5,739 linear feet

Project Completed: Winter 2017

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Remove the remaining portion of the failed Lake Shady dam.
   Install a series of rock arch rapids through the old dam footprint and upstream to stabilize the former lake bed.
   Modify and restore the channel that formed after the Lake Shady dam failed to a stable pattern, profile, and dimension and restore riparian habitat and function. Constructed habitat features include:
   - Constructed riffles
   - Woody debris toe protection (toewood)
   - Boulder J-hook
   - Native vegetation seeding

   Work occurred on the Middle Fork of the Zumbro River and the South Branch of the Middle Fork of the Zumbro River, including downstream of the confluence of both streams.

2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***

A construction plan set that included detailed information on the existing site conditions, proposed conditions.
A completed Environmental Assessment Worksheet developed by Olmstead County as part of the environmental review of the project.

3. ***What are the stated goals of the project?***

   The purpose of this project is to remove the Lake Shady Dam, which is no longer serving its original purpose, and re-establish the Middle Fork and South Branch Middle Fork riverine system of the Zumbro River.

4. ***What are the desired outcomes of achieving the stated goals of the project?***
   The desired outcomes included improved fish passage through the former dam and lake basin. Improved water quality for the Zumbro River system by stabilizing the former lake bed sediments and preventing additional bank erosion. Improved fish habitat in the Middle Fork of the Zumbro River through the former lake basin.
5. ***Were measures of restoration success identified in plans?*** Yes
   If yes, list specific measurements.
   The restored channel will have a stable dimension, pattern, and profile.
   There will be improved fish passage for migrating fish through the former dam and restored channel.
6. ***Are plan Sets available?* Yes *Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   Olmstead County, Minnesota, City of Oronoco Zumbro River Restoration and Old Lake Shady Dam Removal. Olmstead County, Minnesota. 2015 64-sheet construction plan set that included detailed information for mass grading, storm sewer, final stabilization, dam removal and river restoration features for the removal of the failed Lake Shady Dam.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   <u>Dam Removal and Lake Bed Stabilization</u>
   The failed dam was demolished and the majority of the former footprint was completely removed. Sediment had accumulated behind the dam in the former bed of Lake Shady, creating an elevation difference between the lake bed and the stream channel downstream of the dam. Without any additional practices, the Middle Fork of the Zumbro River would continue to create its own channel through the former lake bed and a series of head-cuts in the stream bed would likely form as the river attempted to reduce the elevation difference between the downstream channel and the lake bed. Head-cuts would result in significant bank erosion and downstream sediment transport. The accumulated sediment in the former lake bed was stabilized through a series of rock arch rapids through and upstream of the former dam footprint. The rock arch rapids allow for grade control at the former lake bed elevation and as a means to step-down the elevation differences between the former lake bed and downstream channel. The rock arch rapids also allow for aquatic organism passage and safe recreational boat use such as kayaks and canoes.
   Rock arch rapids are commonly used in dam removal projects to mitigate the elevation differences between the former lake bed and the downstream channel. In addition, they are also installed downstream of existing dams to reduce the impacts to aquatic organism passage and boater/river user safety created by dangerous, circulating currents caused by water flowing over a dam's spillway. In this project, the use of rock arch rapids was the best current science to balance multiple needs/issues

related to the removal of the Lake Shady dam while promoting the restoration of aquatic processes such as aquatic organism passage and river-riparian connection in the former lake bed.

Channel Restoration

After the dam failed, the Middle Fork of the Zumbro River carved a flow path through the former lake bed. Although both the pattern and the dimension of the resulting channel were naturally created, they were likely unstable, especially if the rock arch rapids portion of the project was not completed. Creating a channel with the appropriate dimensions to transport sediment at a bankfull stage and access the floodplain during high flows helps to speed up natural processes. Additionally, modifying the channel pattern to increase sinuosity also helps to promote stream stability and geomorphic processes. Adding features such as constructed riffles and toewood add habitat value to the stream reaches and also promote geomorphic processes that maintain a stable stream. The techniques used to stabilize the channel are the best current science and appropriate for river restoration of this nature.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No
   No significant changes were made during the implementation of this project.
9. ***In what ways did alterations change the proposed project outcome?***
   N/A.

Site Assessment

Field Review Date: 9/16/2019

Field Visit Attendees: Wade Johnson, MN DNR; Amanda Hillman, MN DNR; Mark Pranckus, Cardno (Contracted Assessor)

10. ***Surrounding Landscape Characteristics:***
    The project area is within a city park. The surrounding landscape is a mix of light-density resident housing, open and forested natural spaces, and agriculture (row crop and hay/pasture fields).
11. ***Site Characteristics:***
    a. ***Soil Series:***
       Waubeek silt loam – Well-drained
       Kalmarville silt loam – Poorly-drained
       Waukee loam – Well-drained
    b. ***Topography:***
       Relatively flat through the former lake basin
    c. ***Hydrology:***
       Perennial stream with relatively flashy hydrology during storm events.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***

The plant community is primarily composed of grass species along with a few forb species. Woody vegetation is minimal with little to no saplings or older age classes due to a combination of construction, competition from invasive grass species, and no planting of larger tree material. Reed canary grass is the dominant species and makes up the majority of the cover adjacent to the stream, indicative of a seed source upstream. Total vegetative cover of all species, both native and non-native, throughout the site appears to be nearly 100%.

e. Vegetation B: Meander Search Species List (as appropriate for site)

See Table 34-1 in Appendix A for species observed during the site visit.

12. ***Is the plan based on current science?*** Yes

The use of rock arch rapids when removing a dam considers the impact of accumulated sediment behind the dam and the potential for significant erosion and subsequent downstream transport. The spacing and height of each arch in the series of rapids considers the elevation change between the former lake bed and the downstream stream channel in relation to aquatic organism passage and boater safety. Although the EAW and construction plan set do not explicitly mention Natural Channel Design (NCD), designing a stream based on bankfull parameters with a stable pattern, profile, and dimension are consistent with NCD. The use of constructed riffles and toewood are standard practices in NCD and have been used to successfully restore streams.

13. List indicators of project goals at this stage of project:

Based on an aerial photo review and on-site observations, the stream channel appears to be stable. MN DNR is completing geomorphic assessments through the project area on a regular basis to monitor for changes in channel dimension, pattern, and profile.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals? Yes.

The overall project goal was to re-establish the project area as a functioning riverine system for both the Middle Fork of the Zumbro River and the South Branch of the Zumbro River. Removing the dam, installing the rock arch rapids and creating an appropriate-size channel with both stability and aquatic habitat elements helps to restore or re-establish a free-flowing stream with a connection to its floodplain. Maintaining the adjacent riparian area as natural land cover also helps to re-establish a functioning riverine system.

Removing the dam and installing rock arch rapids promotes the desired objectives of fish passage and improved water quality. A stable channel with constructed riffles and toewood supports the desired objectives of improved water quality through the reduction of bank erosion and increased fish habitat quality by providing a diversity of riffle and pool habitats with overhead cover.

15. Are corrections or modifications needed to achieving proposed goals?

None at this point.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

Proposed future and long term management appear practical and reasonable for maintaining the project goals and desired outcomes. The City of Oronoco along with MN DNR are managing the former lake basin as a natural area. The City of Oronoco has a master plan for the park that integrates public use elements such as trails and canoe landings while maintaining the natural feel of the area.

During the assessment visit, it was mentioned tree planting was planned following construction, but funds were not available because other elements of the construction ended up costing more. The site is primarily composed of herbaceous vegetation. It's reasonable to think that there will be some natural tree and shrub recruitment to the site over time; however, the species that do colonize will likely be of less than ideal quality such as boxelders. The opportunity for improvement would have been to plant a diverse mix of native trees and shrubs to further promote the development of a high-functioning riverine system.

Increased frequency, duration, and intensity of flooding is a potential challenge to maintaining a functioning riverine system. Flooding may cause the stream channel to adjust beyond the existing dimensions. The connection between the stream and the floodplain is an important process; however, flooding will likely contribute a constant supply of plant invasive species that may invade in disturbed areas. It will be important to maintain the integrity of the vegetation to avoid being completely dominated by invasive species, especially adjacent to the stream channel.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No.
18. ***Are follow-up assessments needed? Explain.***
    None other than those already being conducted such as the geomorphic assessment and any planned fish or aquatic organism surveys.
19. ***Additional comments on the restoration project.***
    There was approximately 5 years between when the dam failed and construction began. This allowed for the former lake bed sediments to consolidate and make constructability easier.
    This project area is fairly large (200+ acres with 5,000+ feet of stream). The use of drones to capture photos pre-, during, and post-project would provide an additional amount of information and value in understanding how the system is functioning.
    Project planning and scoping should consider adding a year to the project timeline in the event of bad weather and to consider post-project maintenance during the initial adjustment and establishment phase.
    If left untouched, the stream would naturally attempt to find a stable dimension, pattern, and profile through the former lake bed. In the process of doing so, a large amount of accumulated sediment would have impacted the downstream portions of the Zumbro River. This project helps to speed up the stability component while mitigating the accumulated sediment transport component.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    High

22. ***Provide explanation of reason(s) for determination.***

This project has achieved its stated goal of re-establishing riverine function on through this area of the Middle Fork of the Zumbro River. Rock arch rapid spacing and slope considered the flashy nature of the watershed to make sure they remain stable, which in turn helps to maintain the stream-floodplain connection through the former lake basin. Constructed riffles and toewood provide for long term channel stability while providing fish habitat.

Site Assessor(s) Conducting Review:

Mark Pranckus, Cardno

Appendix A: Site maps, Project plans or Vegetation tables

Figure 34-1 Aerial view of the restored stream channel and rock arch rapids from 2018. Stream flow is from the left to right in the photo. Aerial imagery is provided by https://www.digitalglobe.com/.

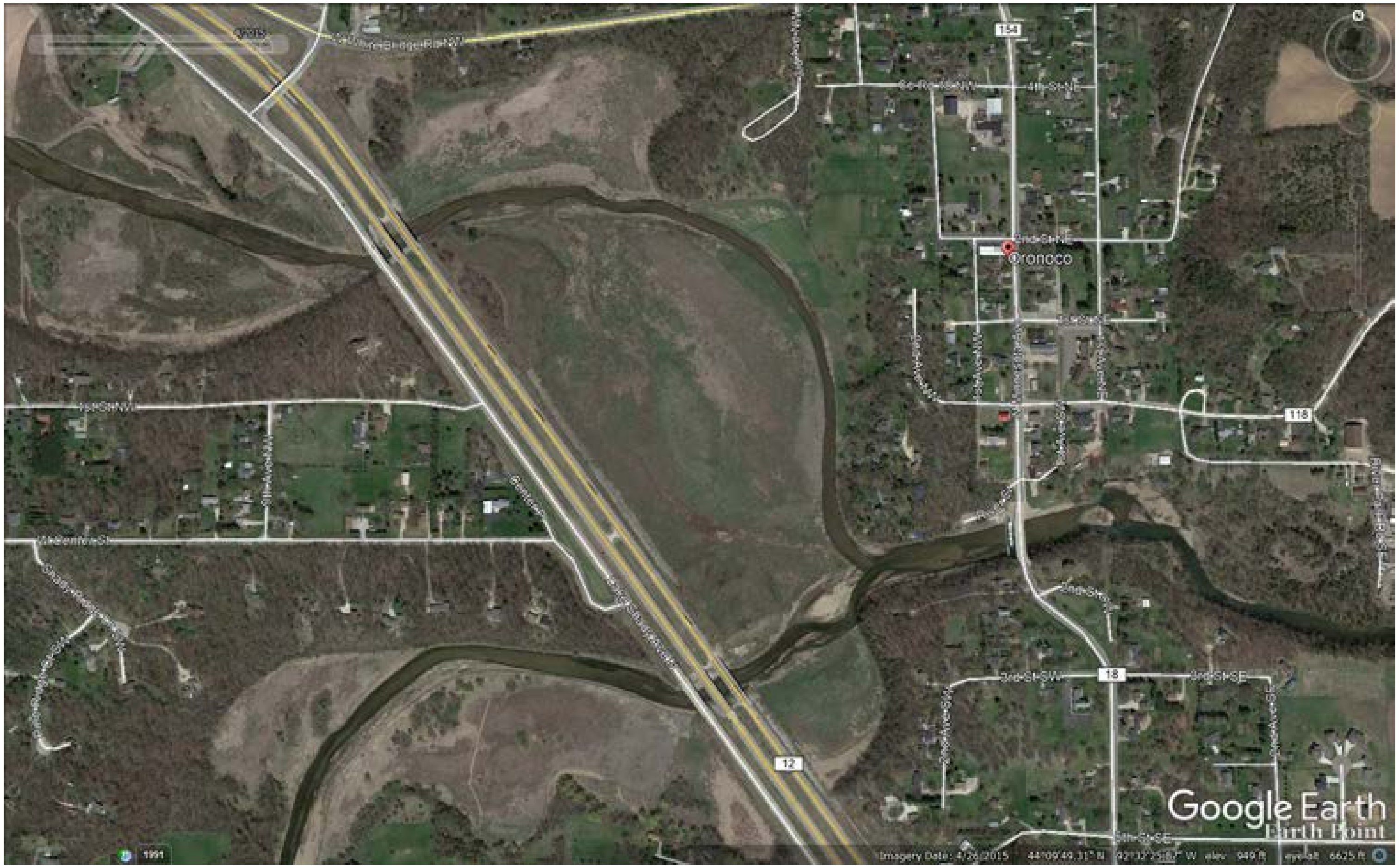


Figure 34-2 Aerial image of the former Lake Shady in 2015 prior to work. The channel through the former lake bed formed after the dam failed. Aerial photography is from April 2015 and provided by Google Earth.

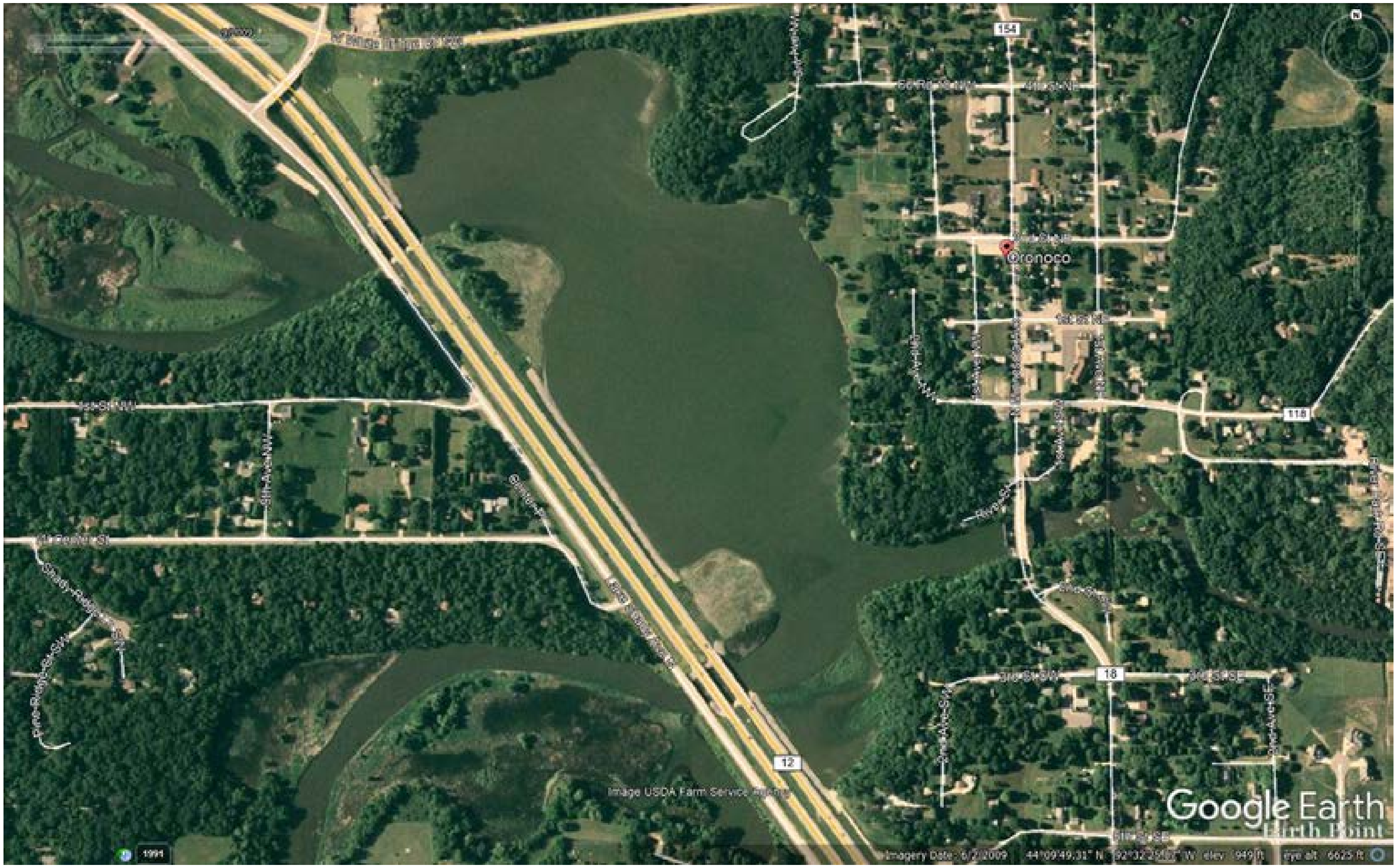


Figure 34-3 Aerial photo from 2009 prior to the dam failure showing the extent of open water of Lake Shady. Approximately one year later the day would fail. Aerial photography is from September 2009 and provided by Google Earth.

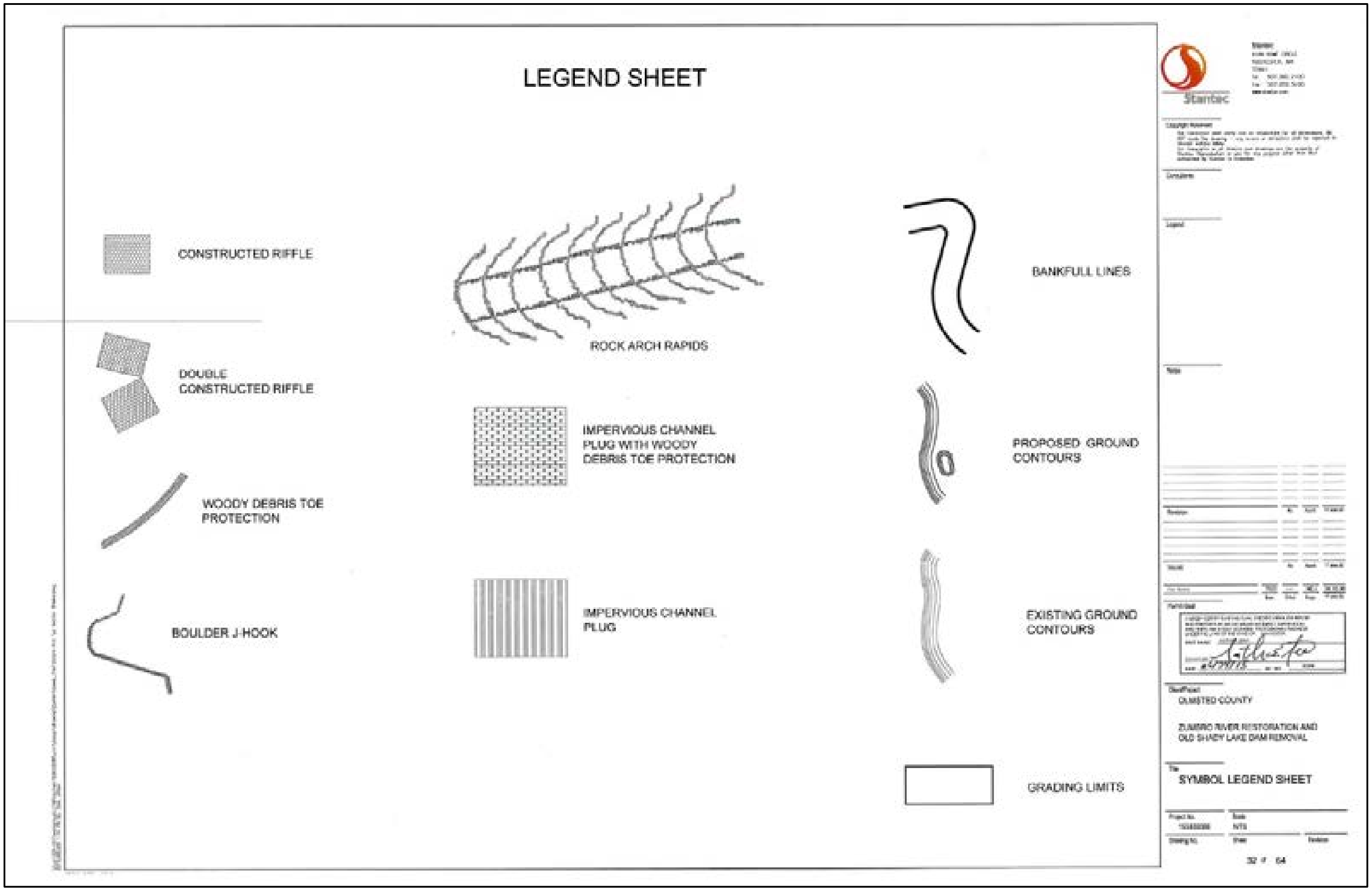


Figure 34-4 Sheet from construction plan set showing legend for channel features and grading.

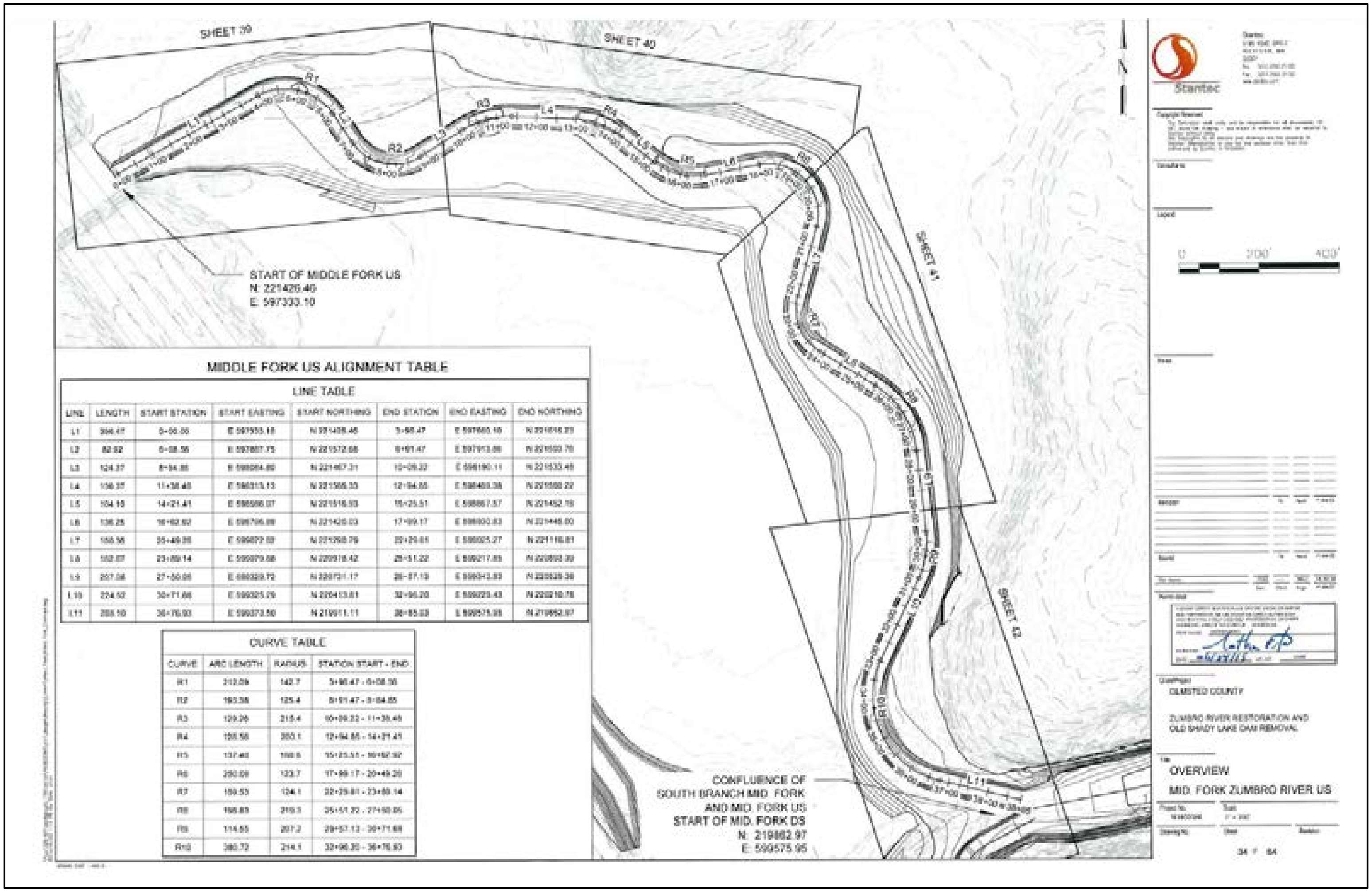


Figure 34-5 Sheet from construction plan set showing overview of the Middle Fork of the Zumbro River construction.

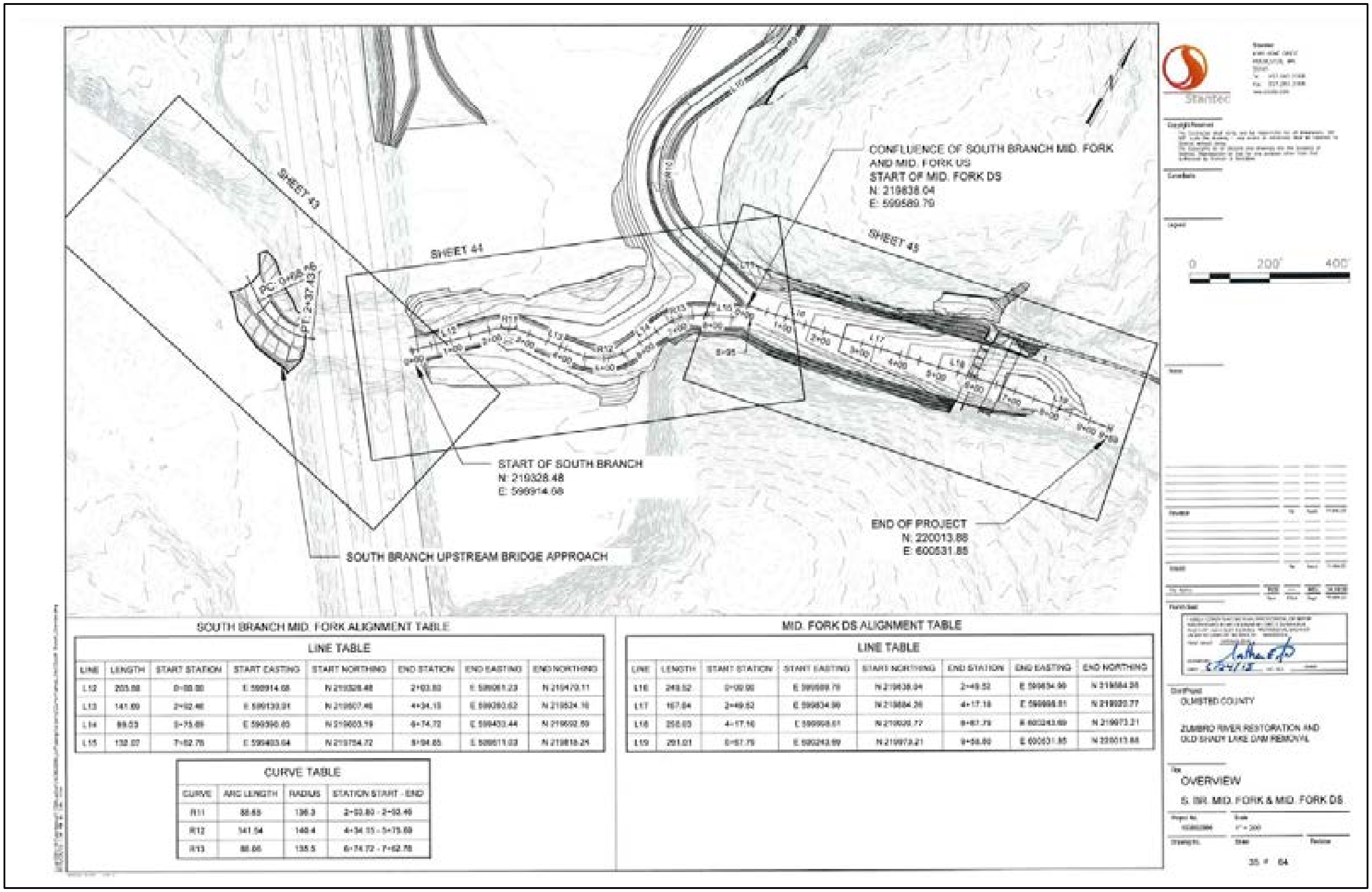


Figure 34-6 Sheet from construction plan set showing overview of the South Branch of the Zumbro River and downstream of the confluence with the Middle Fork of the Zumbro River construction.

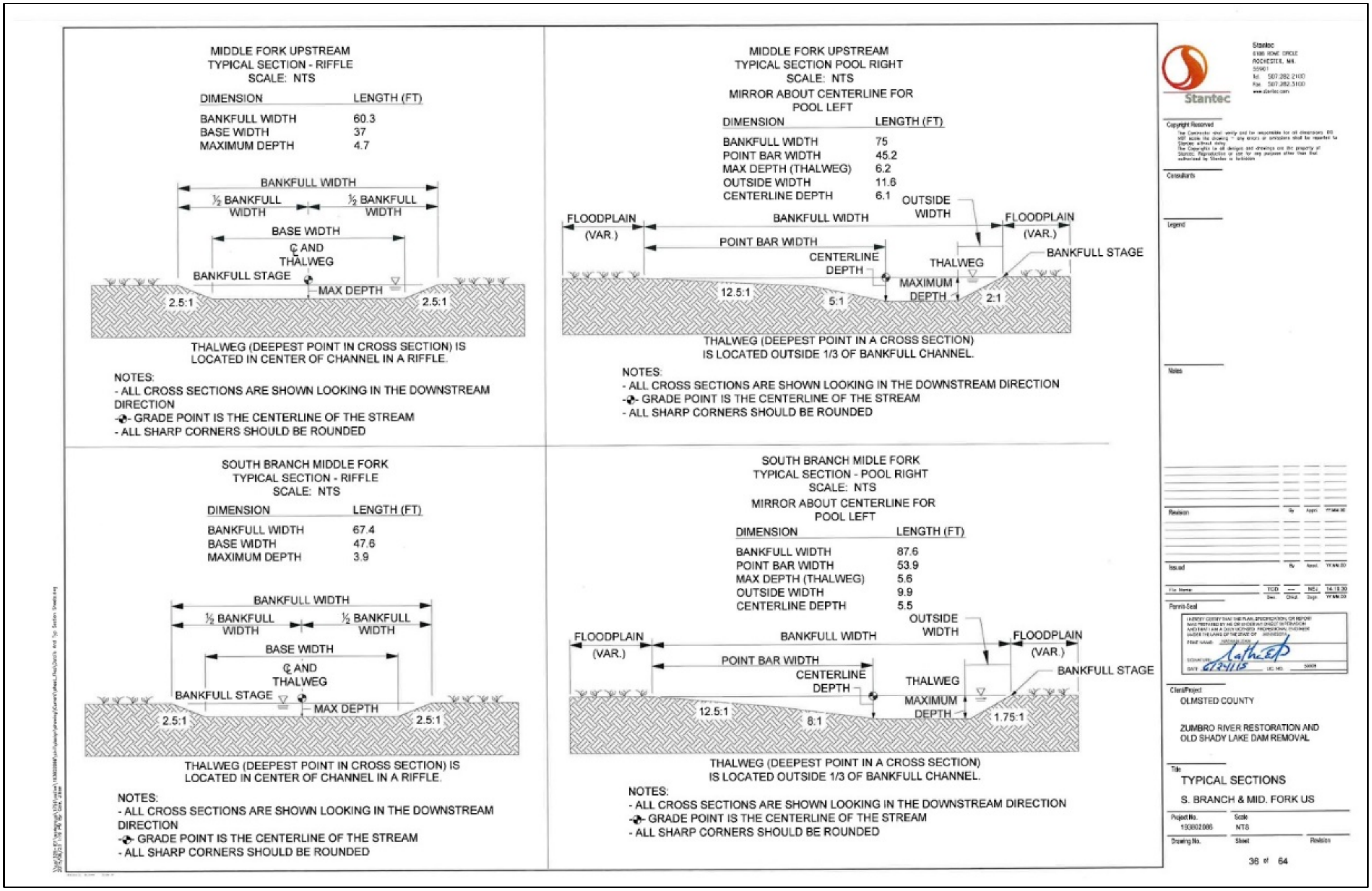


Figure 34-7 Sheet from construction plan set showing typical cross section dimensions for riffles and pools.

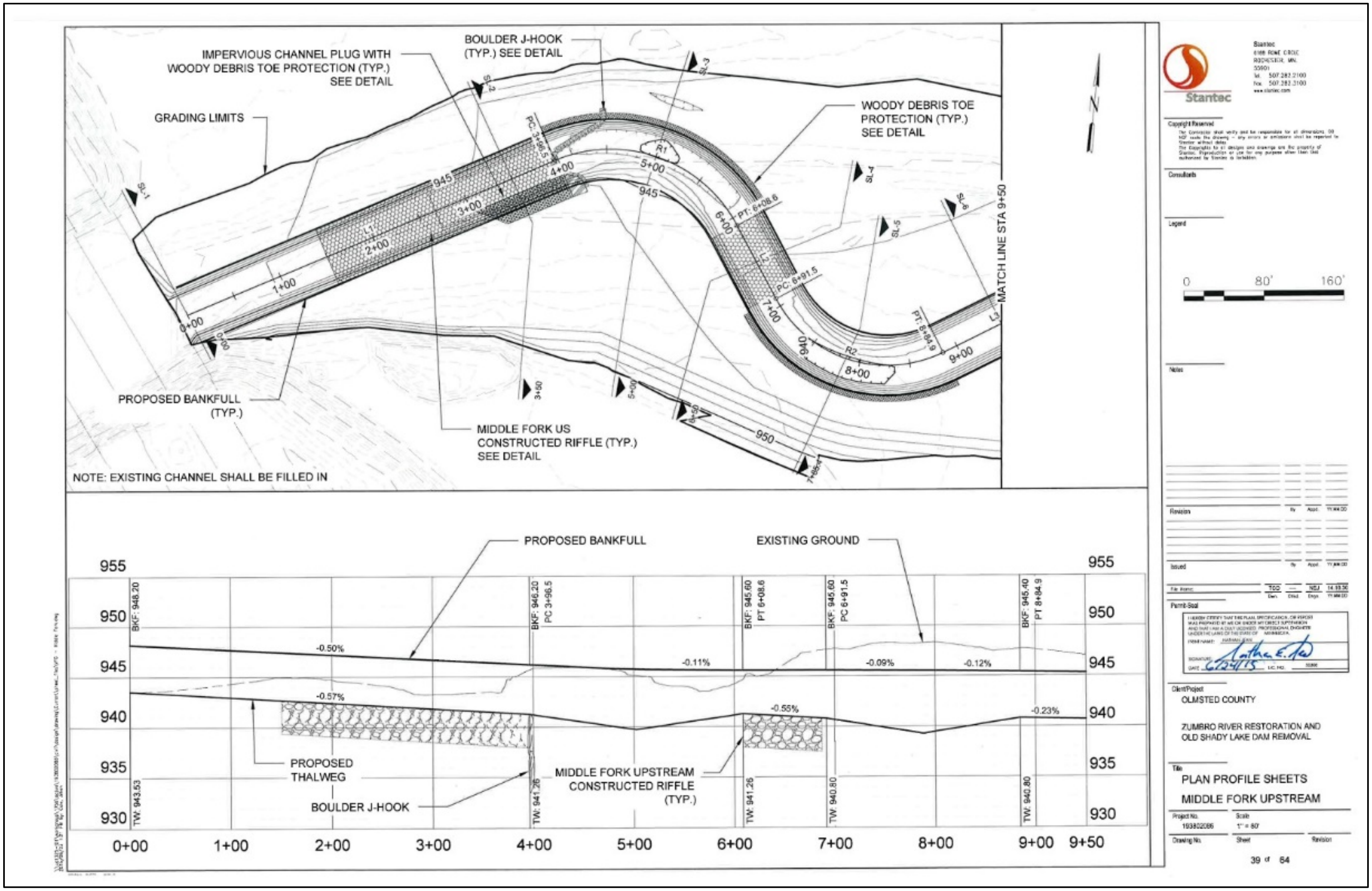


Figure 34-8 Sheet from construction plan set showing proposed channel features and longitudinal profile of the Middle Fork of the Zumbro River from Station 0+00 to Station 9+50.

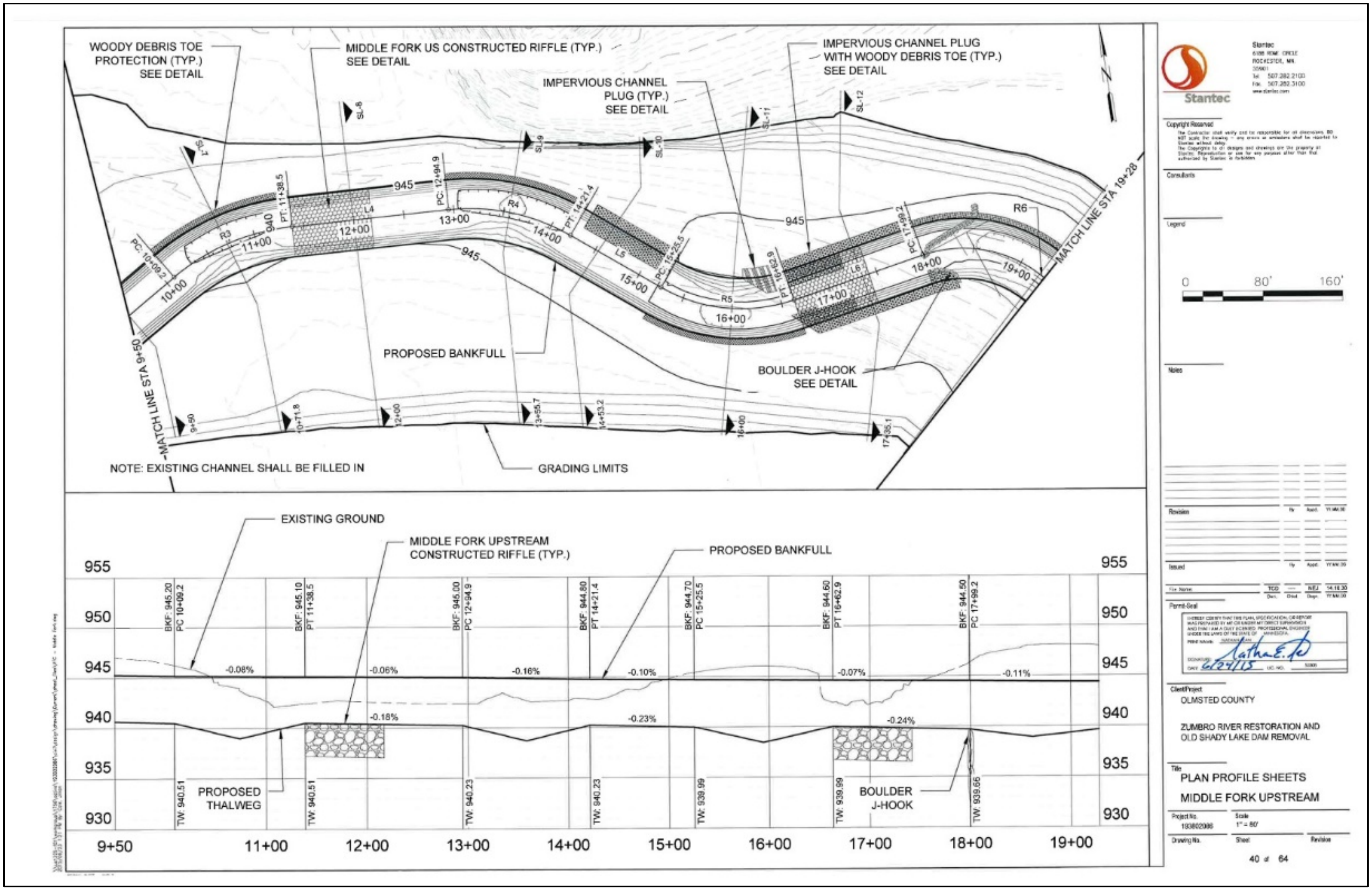


Figure 34-9 Sheet from construction plan set showing proposed channel features and longitudinal profile of the Middle Fork of the Zumbro River from Station 9+50 to Station 19+00.

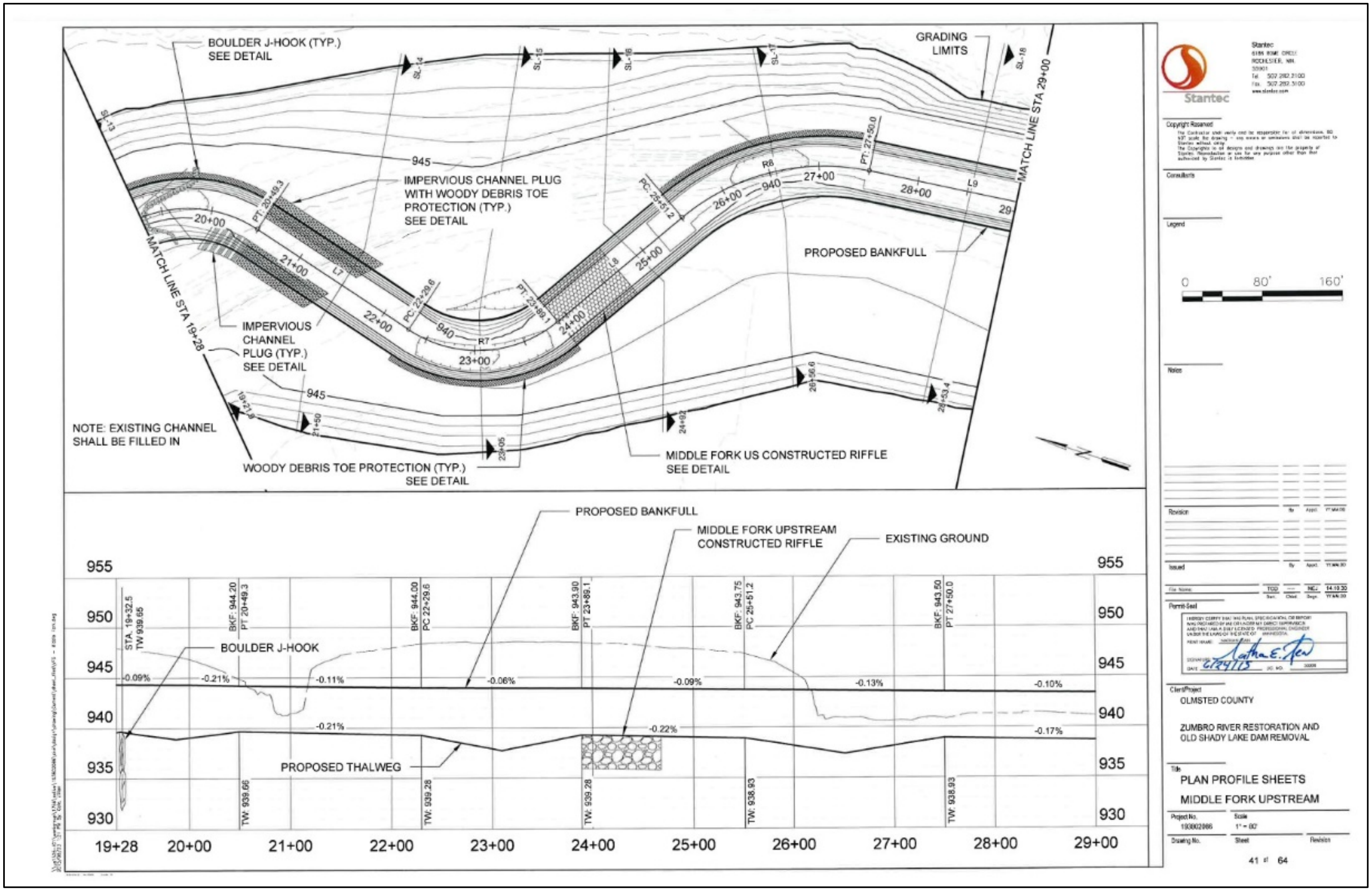


Figure 34-10 Sheet from construction plan set showing proposed channel features and longitudinal profile of the Middle Fork of the Zumbro River from Station 19+28 to Station 29+00.

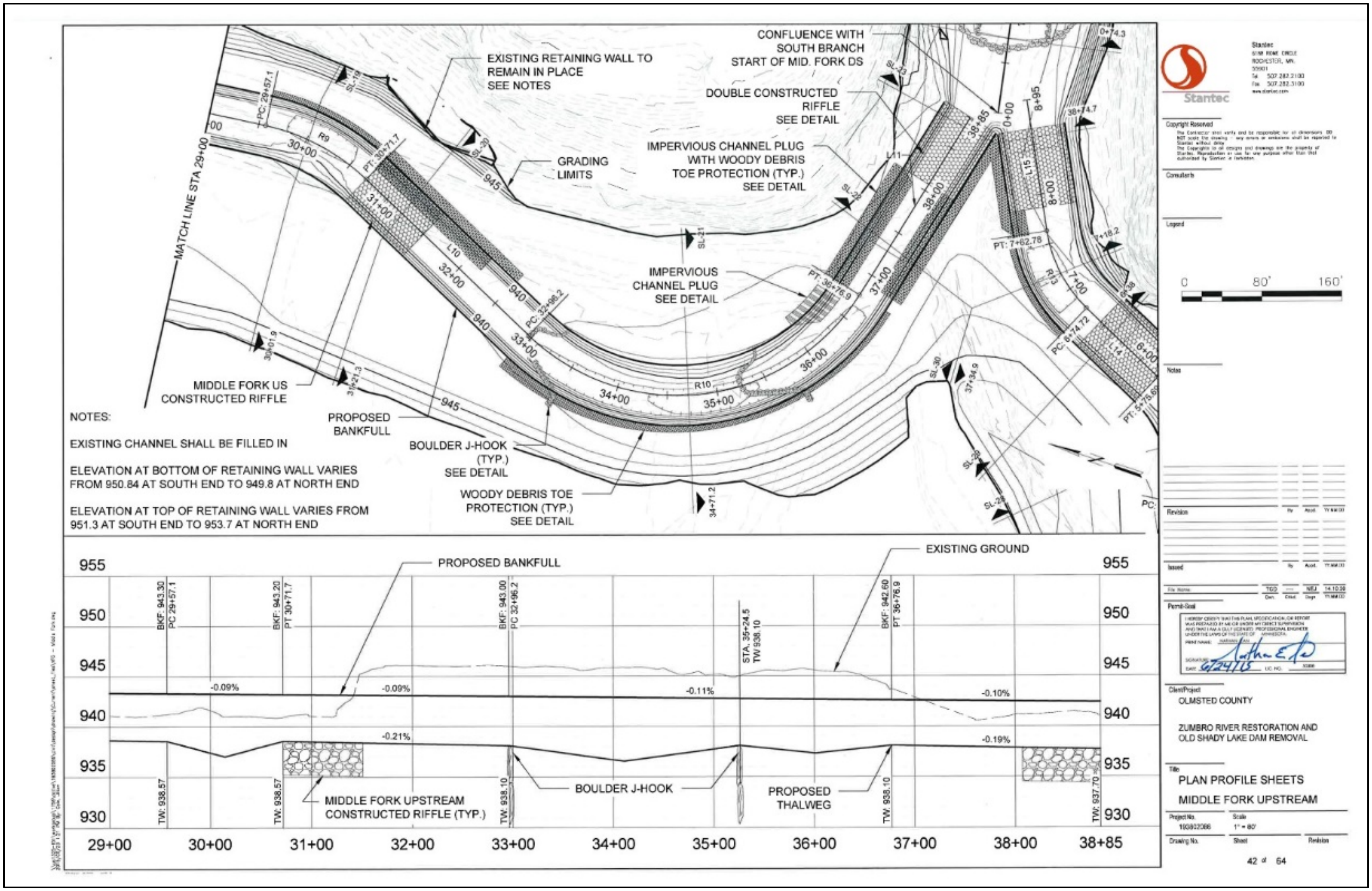


Figure 34-11 Sheet from construction plan set showing proposed channel features and longitudinal profile of the Middle Fork of the Zumbro River from Station 29+00 to Station 38+85.

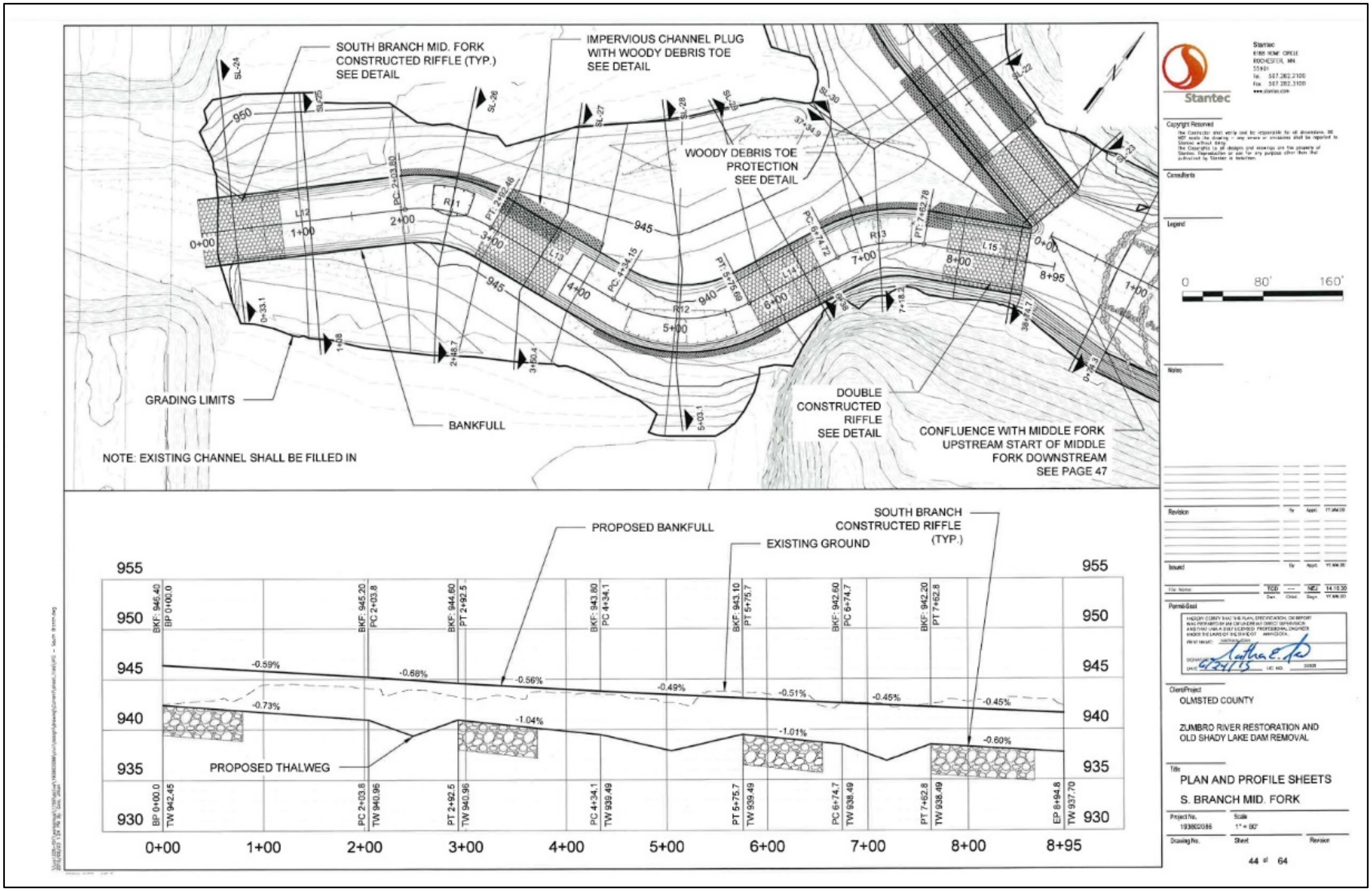


Figure 34-12 Sheet from construction plan set showing proposed channel features and longitudinal profile of the South Branch of Zumbro River from Station 0+00 to Station 8+95.

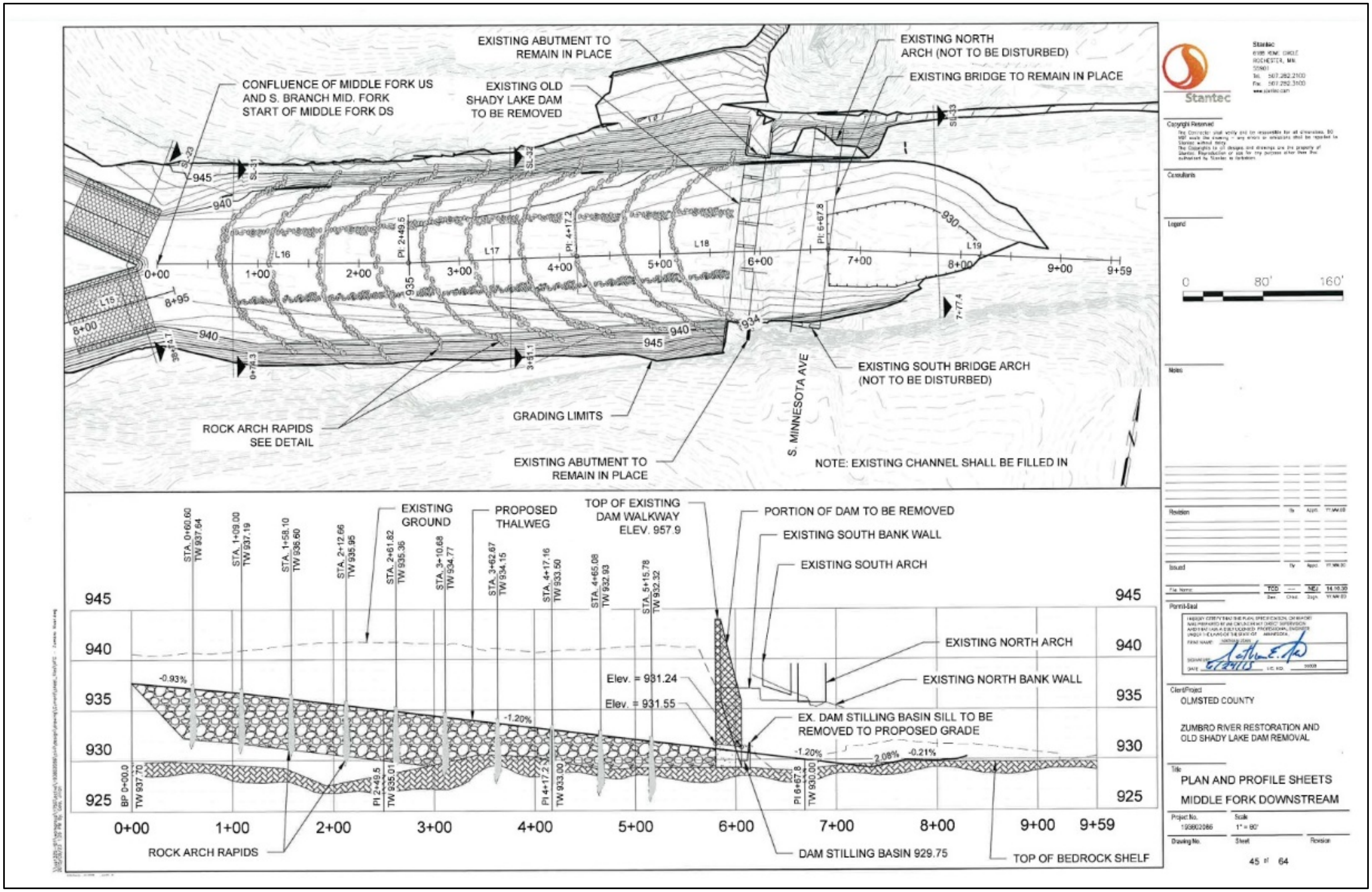


Figure 34-13 Sheet from construction plan set showing proposed channel features and longitudinal profile of the Middle Fork of the Zumbro River downstream from the confluence with South Branch of the Zumbro River from Station 0+00 to Station 9+59.

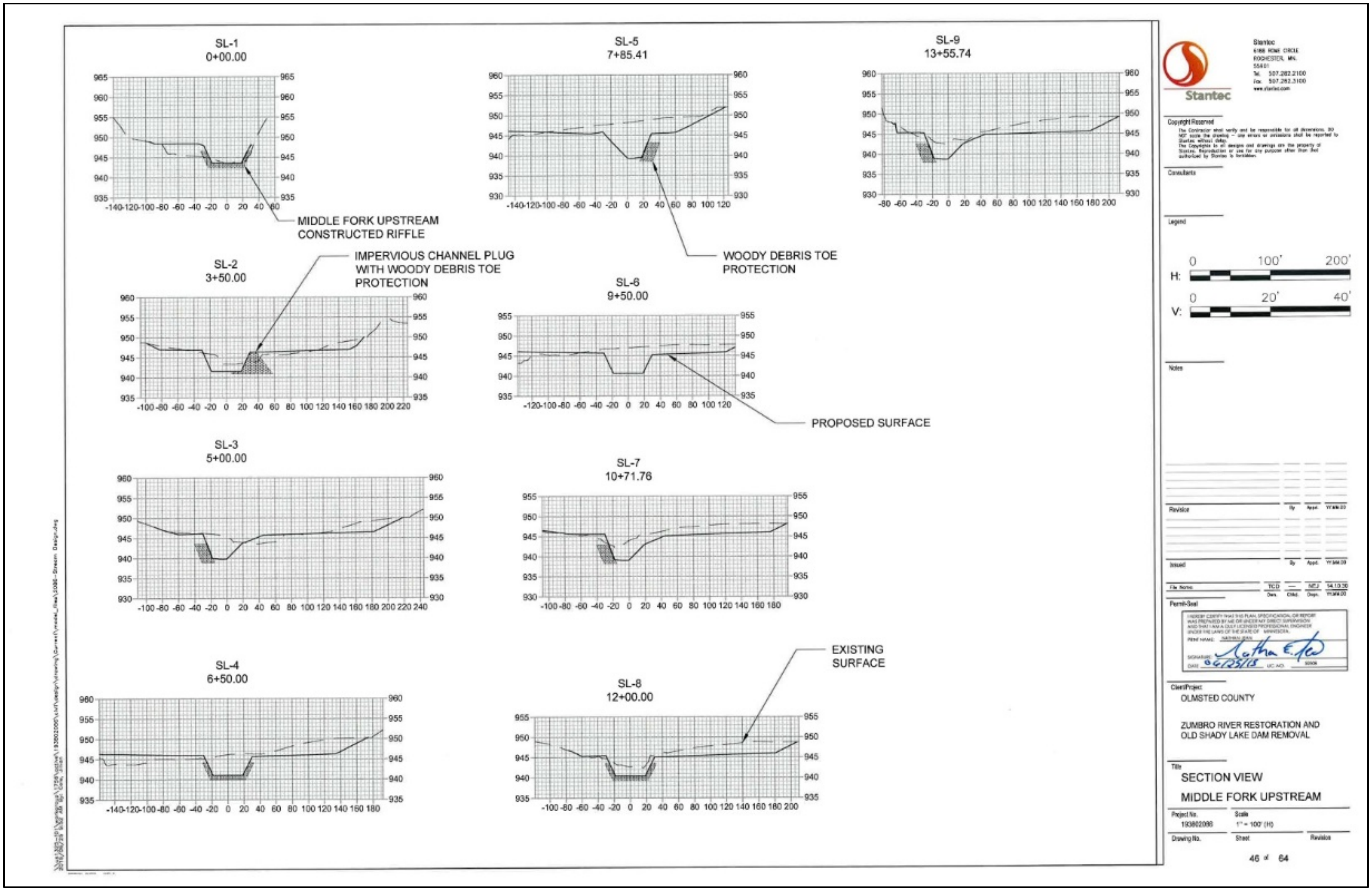


Figure 34-14 Sheet from construction plan set showing an example of the existing and proposed cross sections for the Middle Fork of Zumbro River construction.

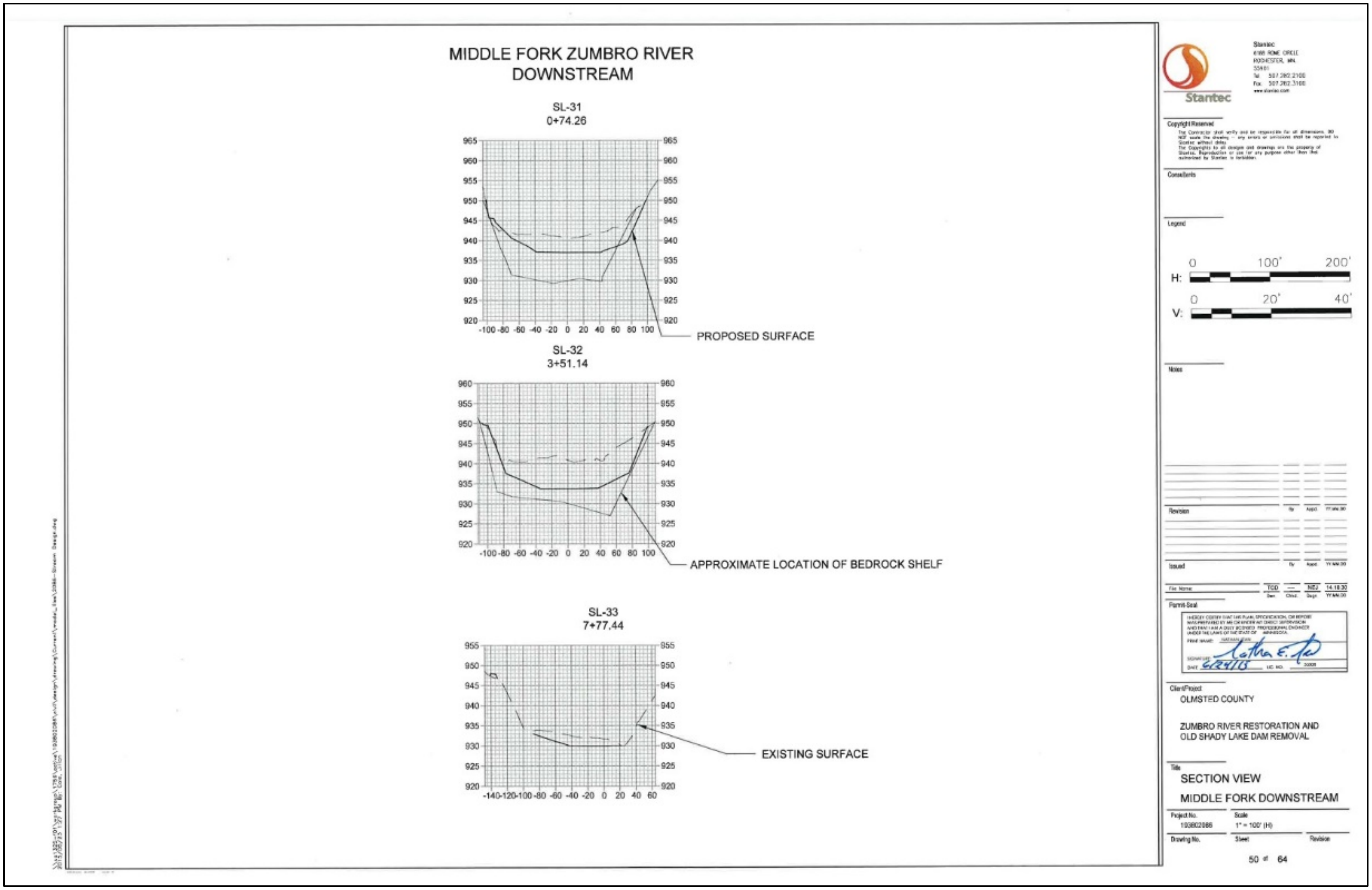


Figure 34-15 Sheet from construction plan set showing an example of the existing and proposed cross sections for the Middle Fork of Zumbro River construction downstream of the confluence with South Branch of the Zumbro River.

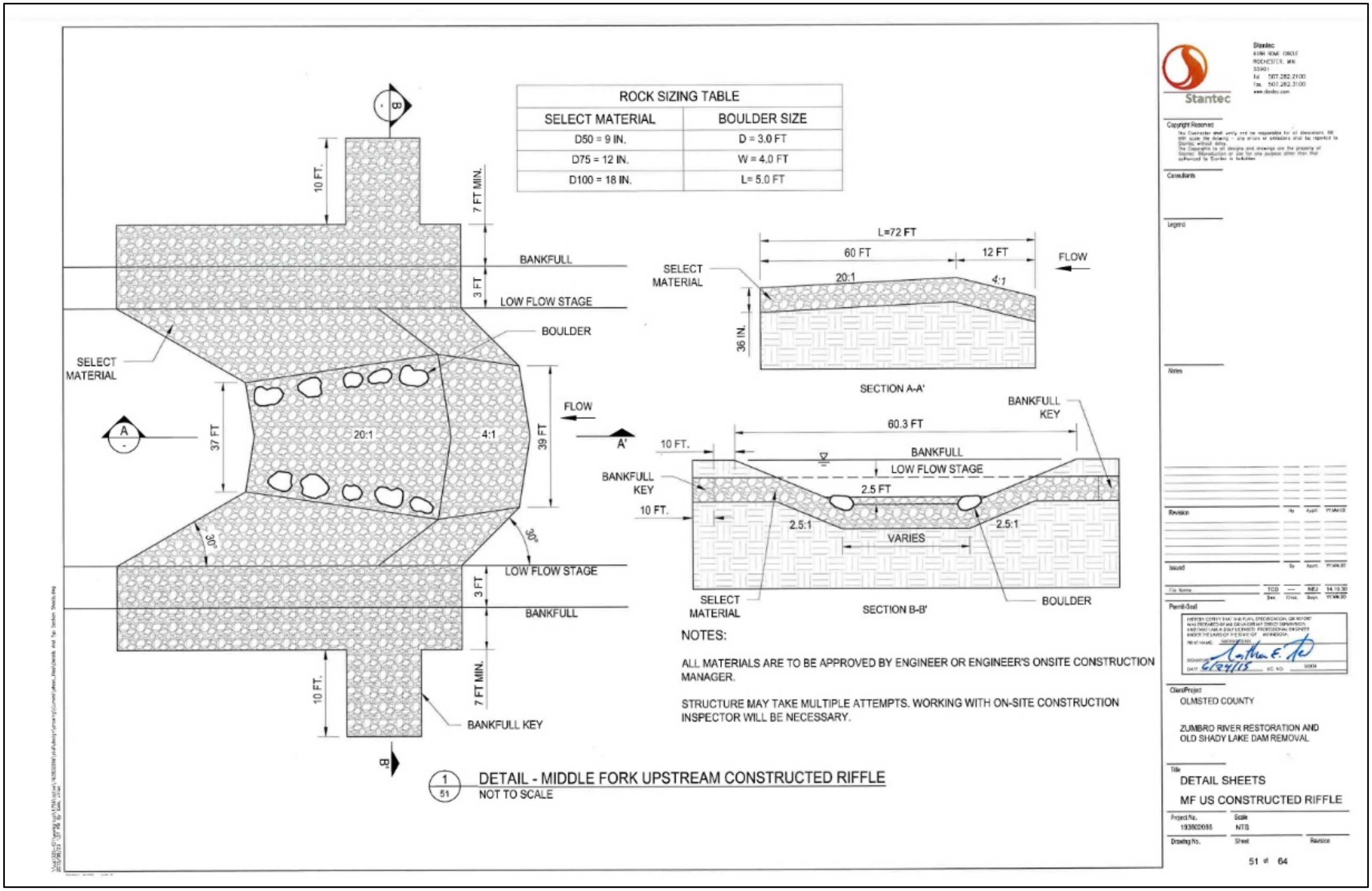


Figure 34-16 Sheet from the construction plan set detailing the constructed riffle.

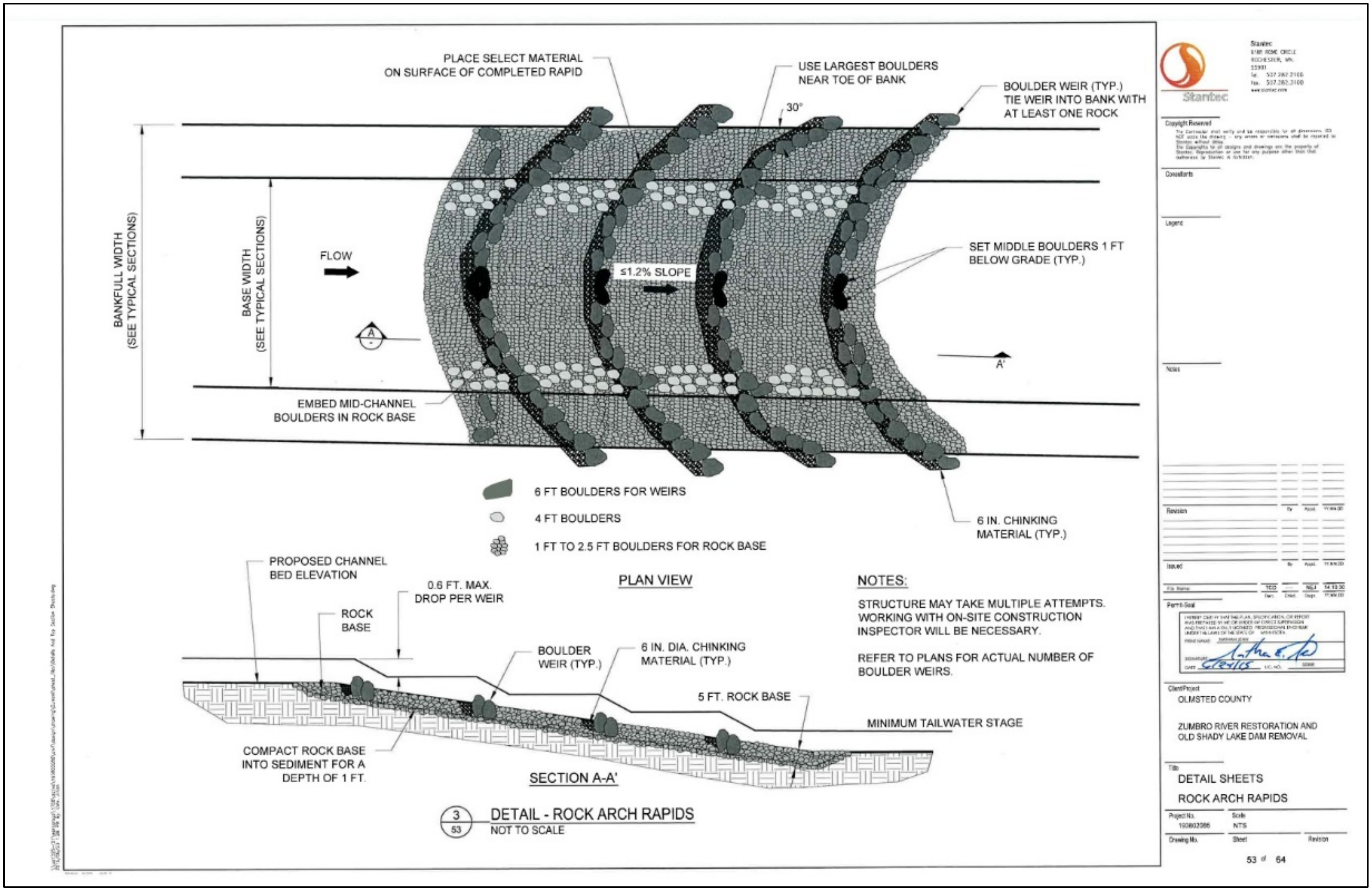


Figure 34-17 Sheet from the construction plan set detailing the rock arch rapids.

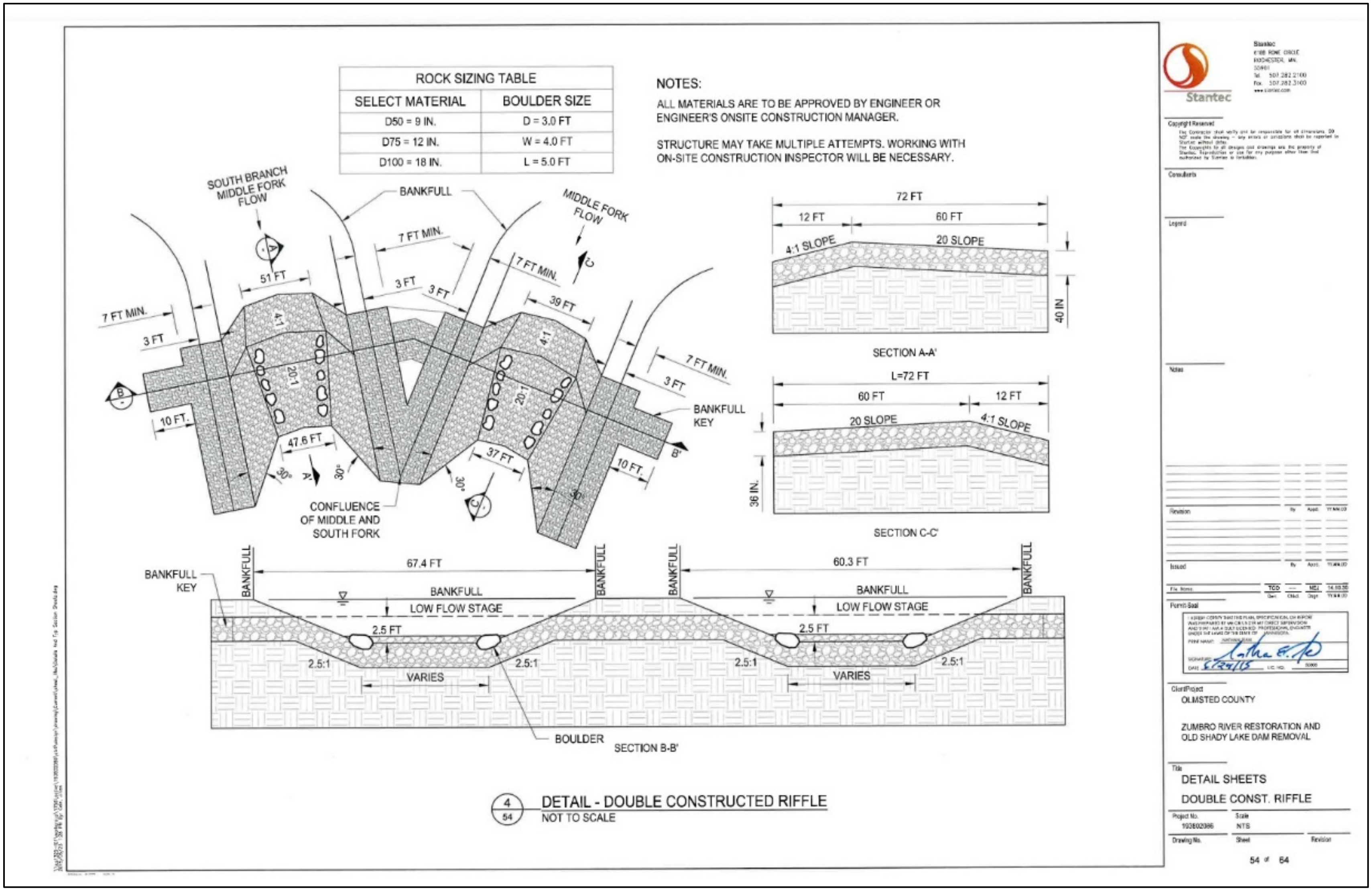


Figure 34-18 Sheet from the construction plan set detailing the double constructed riffle.

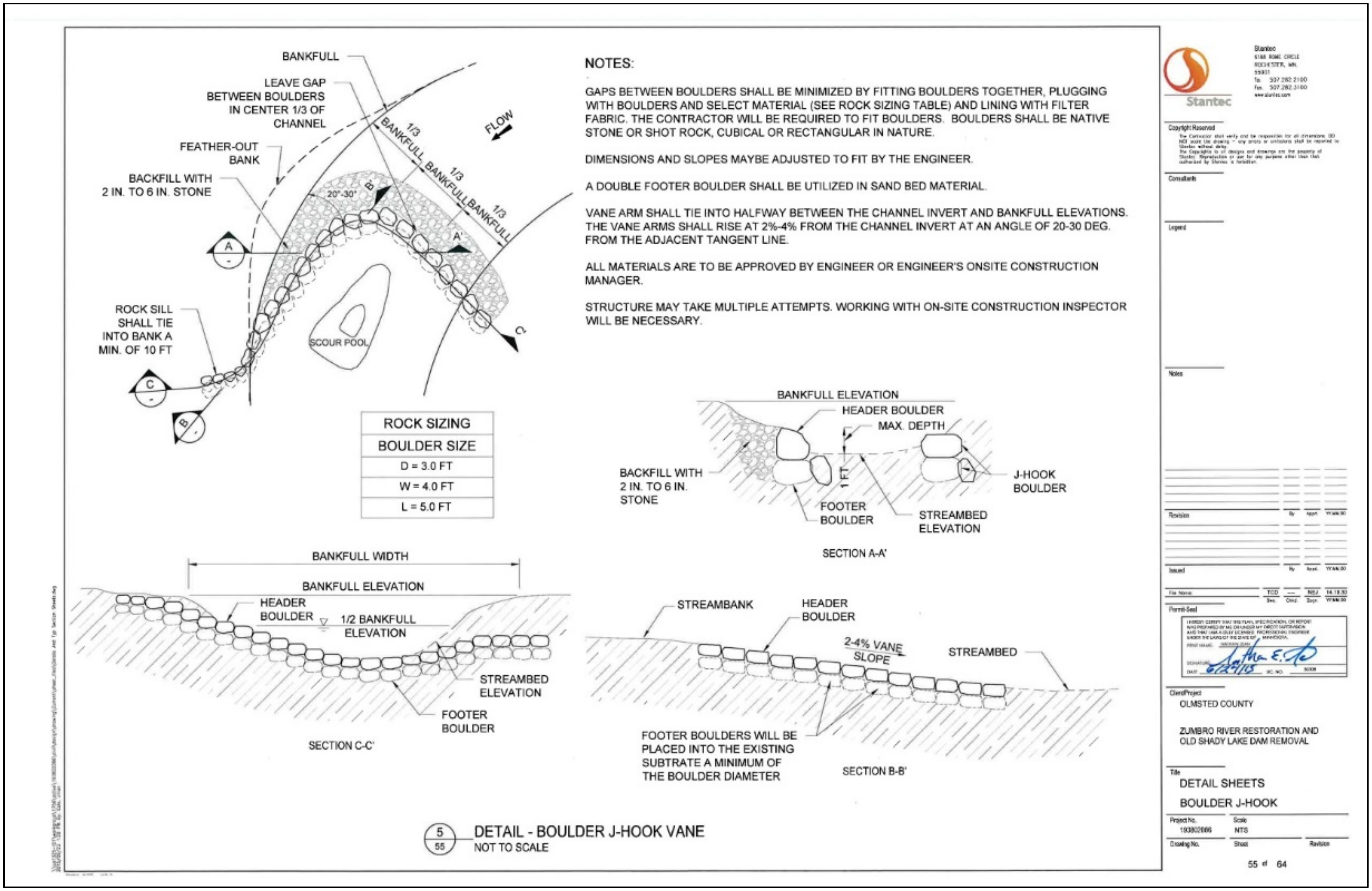


Figure 34-19 Sheet from the construction plan set detailing the boulder J-hook vane.

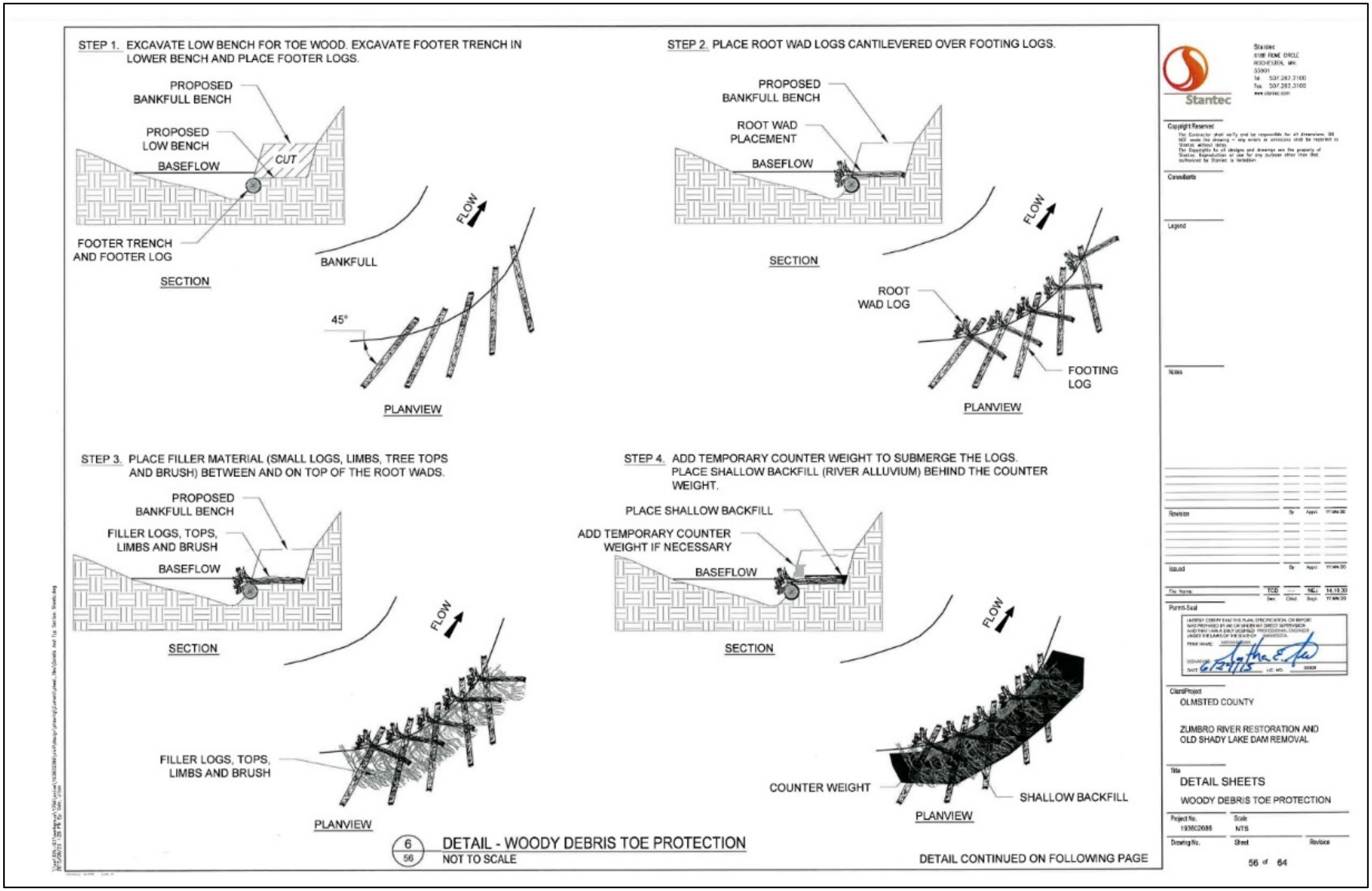


Figure 34-20 Sheet from the construction plan set detailing the woody debris toe protection (toewood).

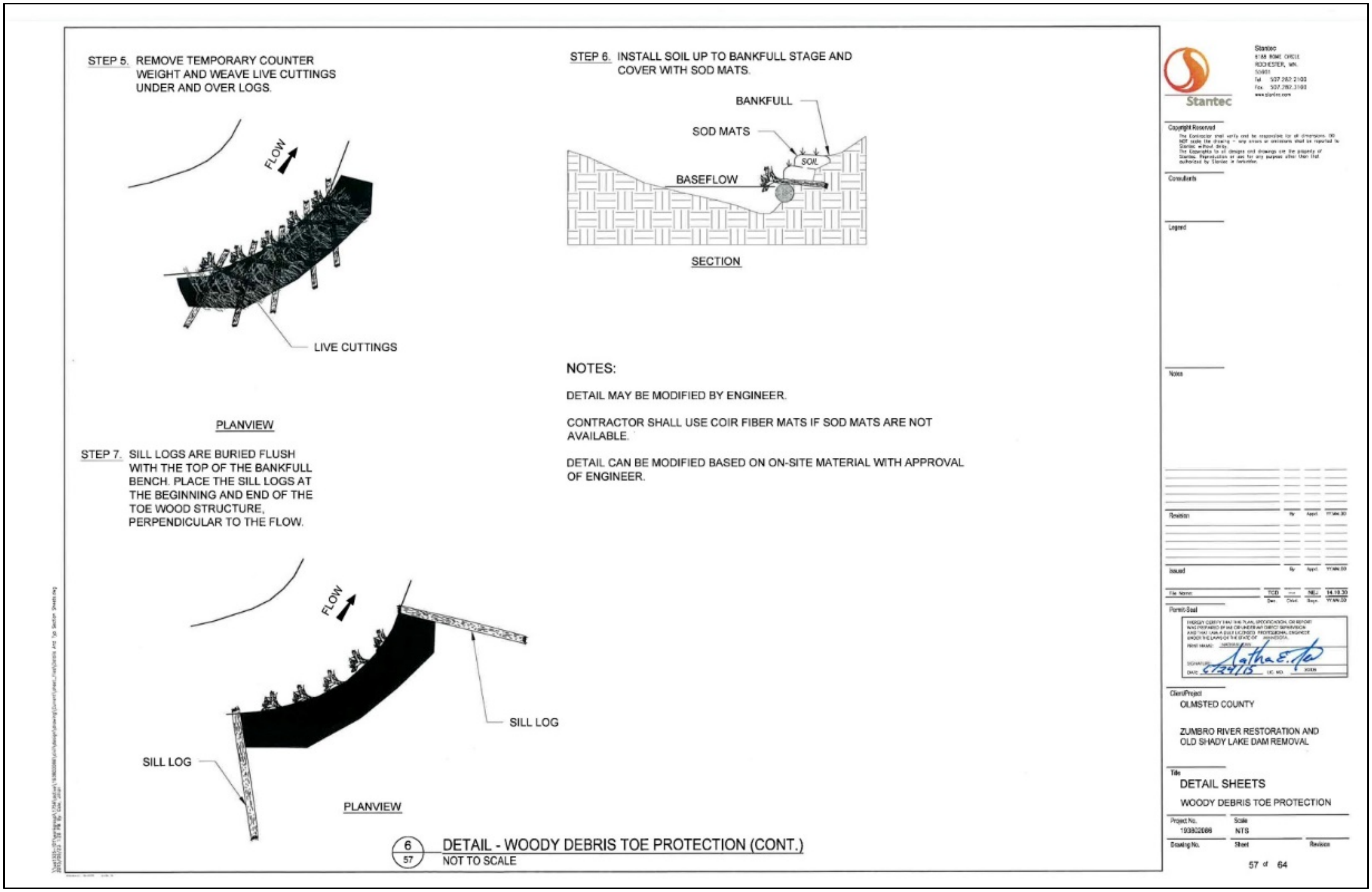


Figure 34-21 Sheet from the construction plan set detailing the woody debris toe protection (toewood).

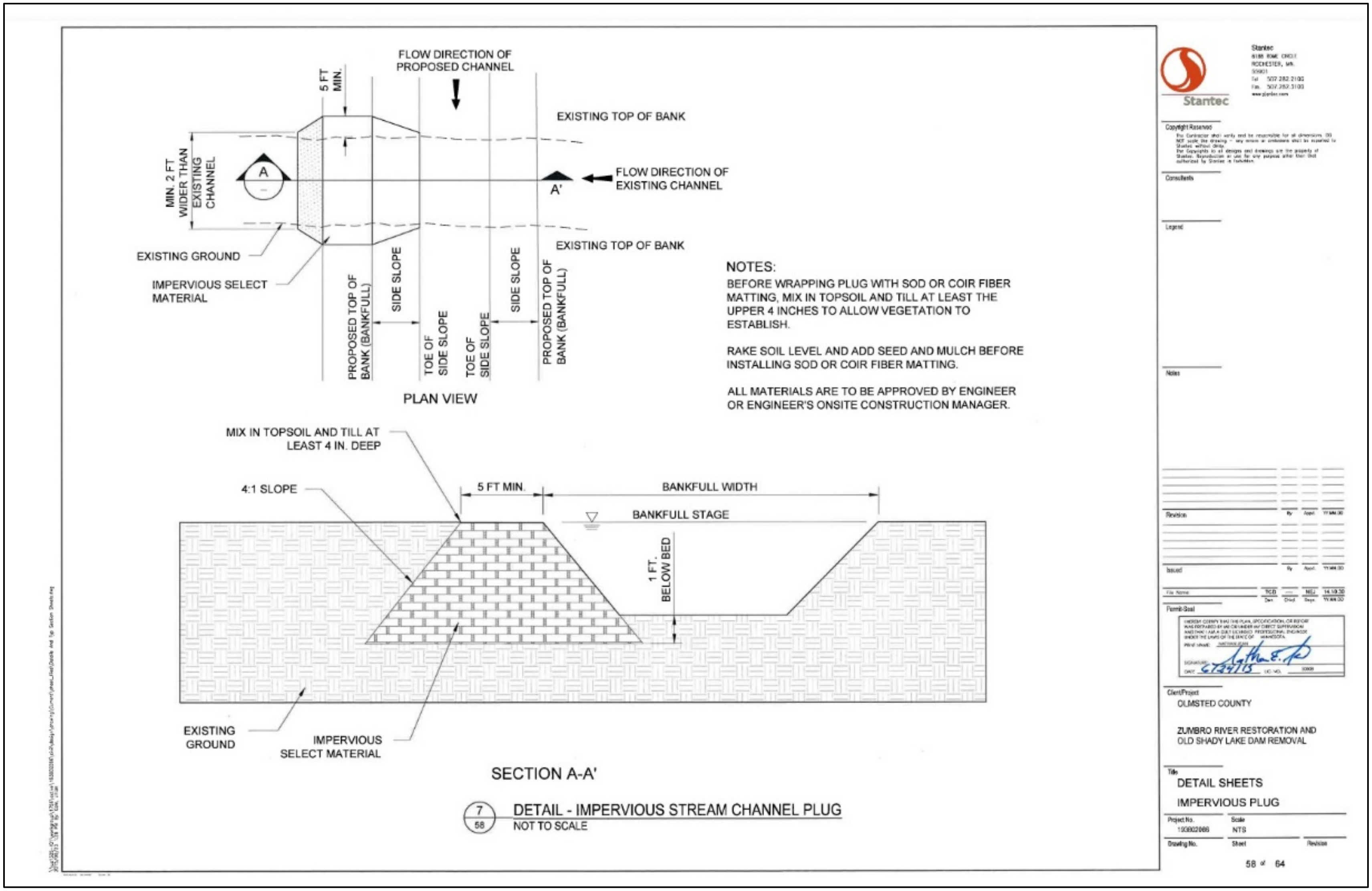


Figure 34-22 Sheet from the construction plan set detailing the stream channel plug used to prevent the new channel from eroding into the old channel.

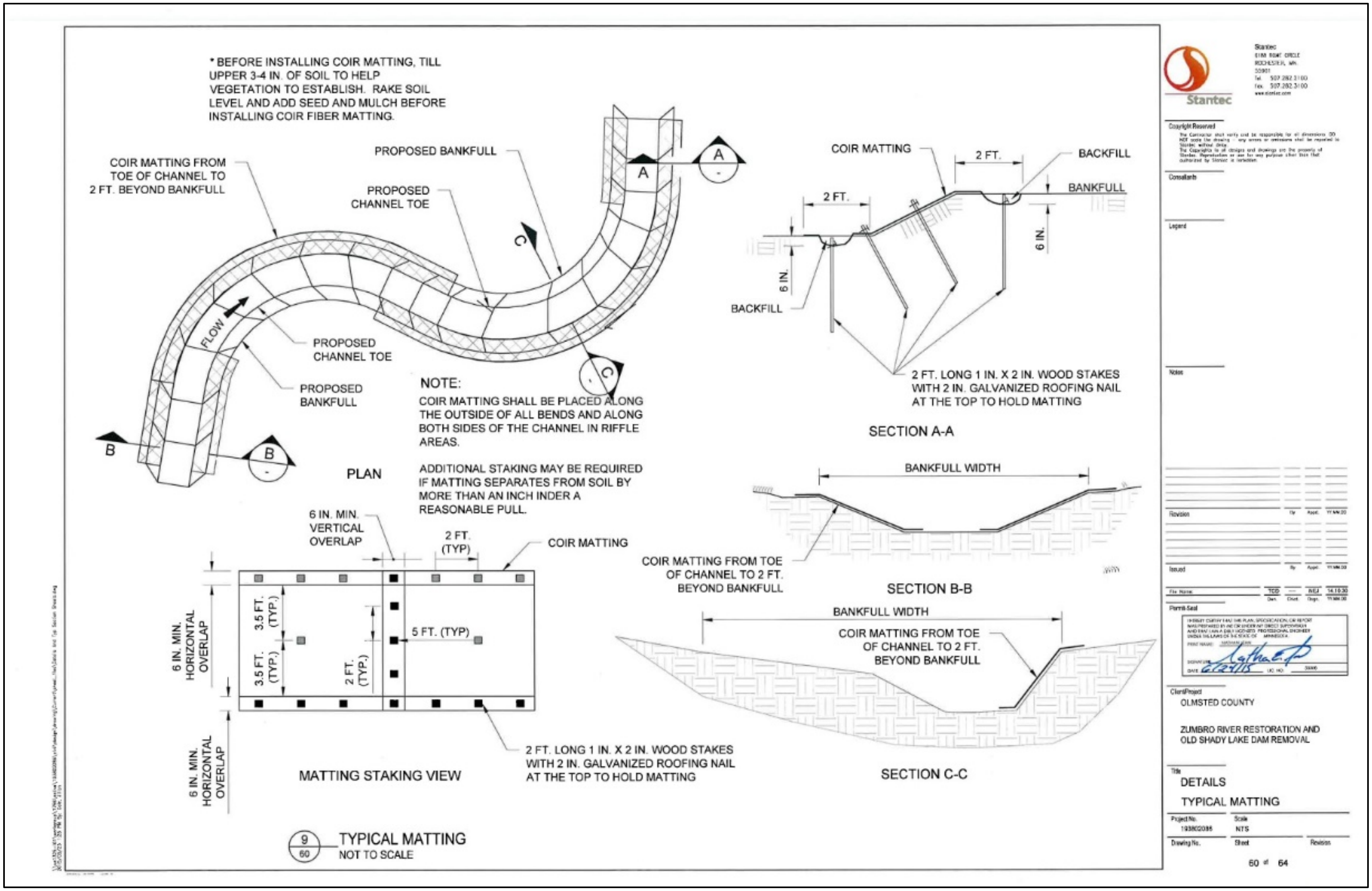
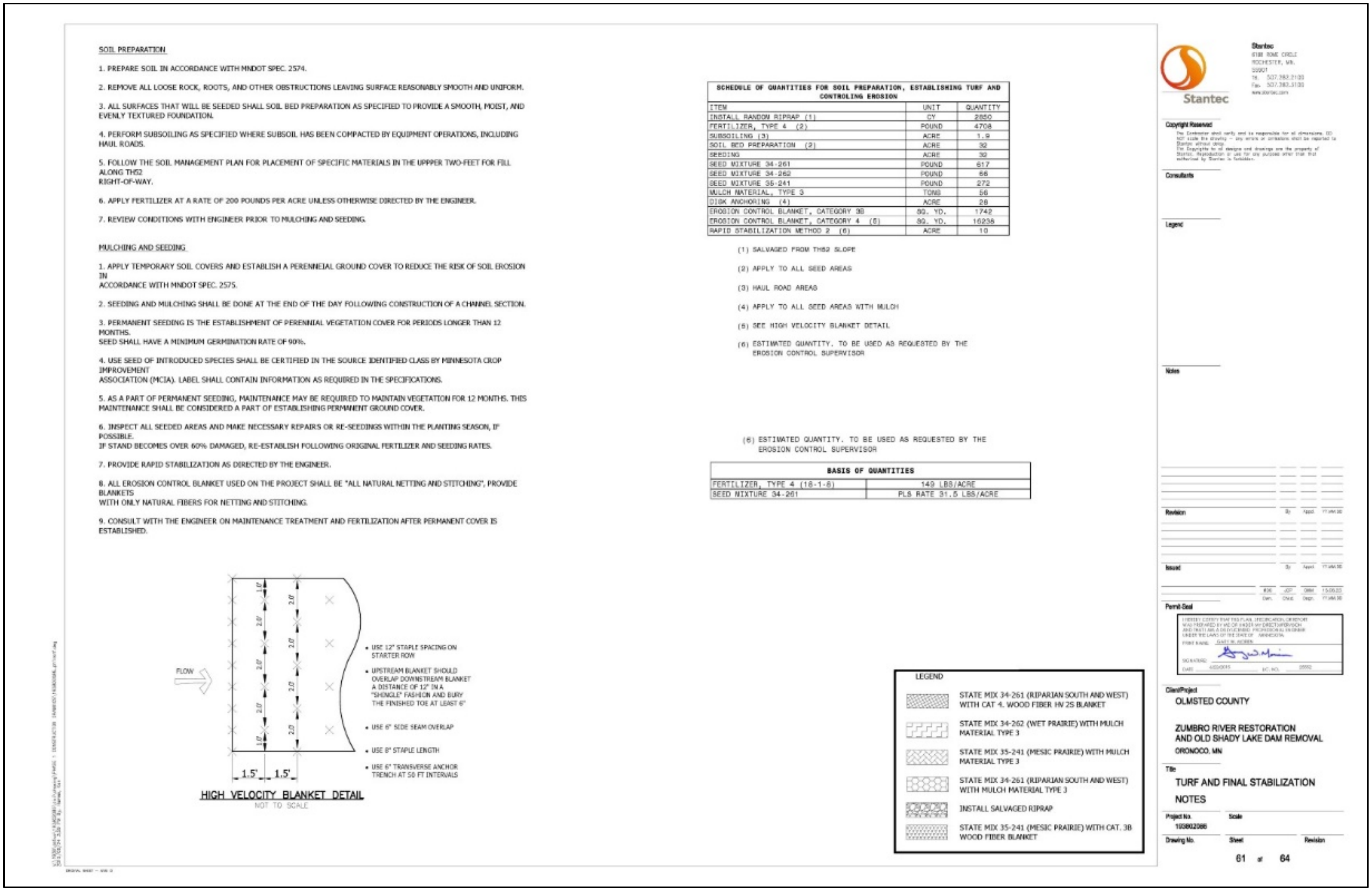


Figure 34-23 Sheet from the construction plan set detailing erosion control matting.



SOIL PREPARATION

1. PREPARE SOIL IN ACCORDANCE WITH MNDOT SPEC. 2574.

2. REMOVE ALL LOOSE ROCK, ROOTS, AND OTHER OBSTRUCTIONS LEAVING SURFACE REASONABLY SMOOTH AND UNIFORM.

3. ALL SURFACES THAT WILL BE SEEDED SHALL SOIL BED PREPARATION AS SPECIFIED TO PROVIDE A SMOOTH, MOIST, AND EVENLY TEXTURED FOUNDATION.

4. PERFORM SUBSOILING AS SPECIFIED WHERE SUBSOIL HAS BEEN COMPACTED BY EQUIPMENT OPERATIONS, INCLUDING HAUL ROADS.

5. FOLLOW THE SOIL MANAGEMENT PLAN FOR PLACEMENT OF SPECIFIC MATERIALS IN THE UPPPER TWO-FEET FOR FILL ALONG TH52
RIGHT-OF-WAY.

6. APPLY FERTILIZER AT A RATE OF 200 POUNDS PER ACRE UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

7. REVIEW CONDITIONS WITH ENGINEER PRIOR TO MULCHING AND SEEDING.

MULCHING AND SEEDING

1. APPLY TEMPORARY SOIL COVERS AND ESTABLISH A PERENNEIAL GROUND COVER TO REDUCE THE RISK OF SOIL EROSION IN
ACCORDANCE WITH MNDOT SPEC. 2575.

2. SEEDING AND MULCHING SHALL BE DONE AT THE END OF THE DAY FOLLOWING CONSTRUCTION OF A CHANNEL SECTION.

3. PERMANENT SEEDING IS THE ESTABLISHMENT OF PERENNIAL VEGETATION COVER FOR PERIODS LONGER THAN 12 MONTHS.
SEED SHALL HAVE A MINIMUM GERMINATION RATE OF 90%.

4. USE SEED OF INTRODUCED SPECIES SHALL BE CERTIFIED IN THE SOURCE IDENTIFIED CLASS BY MINNESOTA CROP IMPROVEMENT
ASSOCIATION (MCIA). LABEL SHALL CONTAIN INFORMATION AS REQUIRED IN THE SPECIFICATIONS.

5. AS A PART OF PERMANENT SEEDING, MAINTENANCE MAY BE REQUIRED TO MAINTAIN VEGETATION FOR 12 MONTHS. THIS MAINTENANCE SHALL BE CONSIDERED A PART OF ESTABLISHING PERMANENT GROUND COVER.

6. INSPECT ALL SEEDED AREAS AND MAKE NECESSARY REPAIRS OR RE-SEEDINGS WITHIN THE PLANTING SEASON, IF POSSIBLE.
IF STAND BECOMES OVER 60% DAMAGED, RE-ESTABLISH FOLLOWING ORIGINAL FERTILIZER AND SEEDING RATES.

7. PROVIDE RAPID STABILIZATION AS DIRECTED BY THE ENGINEER.

8. ALL EROSION CONTROL BLANKET USED ON THE PROJECT SHALL BE "ALL NATURAL NETTING AND STITCHING", PROVIDE BLANKETS
WITH ONLY NATURAL FIBERS FOR NETTING AND STITCHING.

9. CONSULT WITH THE ENGINEER ON MAINTENANCE TREATMENT AND FERTILIZATION AFTER PERMANENT COVER IS ESTABLISHED.

HIGH VELOCITY BLANKET DETAIL
NOT TO SCALE

SCHEDULE OF QUANTITIES FOR SOIL PREPARATION, ESTABLISHING TURF AND CONTROLING EROSION		
ITEM	UNIT	QUANTITY
INSTALL RANDOM RIPRAP (1)	CY	2850
FERTILIZER, TYPE 4 (2)	POUND	4708
SUBSOILING (3)	ACRE	1.9
SOIL BED PREPARATION (2)	ACRE	32
SEEDING	ACRE	32
SEED MIXTURE 34-261	POUND	617
SEED MIXTURE 34-262	POUND	66
SEED MIXTURE 35-241	POUND	272
MULCH MATERIAL, TYPE 3	TONS	56
DISK ANCHORING (4)	ACRE	28
EROSION CONTROL BLANKET, CATEGORY 3B	SQ. YD.	1742
EROSION CONTROL BLANKET, CATEGORY 4 (5)	SQ. YD.	16238
RAPID STABILIZATION METHOD 2 (6)	ACRE	10

(1) SALVAGED FROM TH52 SLOPE

(2) APPLY TO ALL SEED AREAS

(3) HAUL ROAD AREAS

(4) APPLY TO ALL SEED AREAS WITH MULCH

(5) SEE HIGH VELOCITY BLANKET DETAIL

(6) ESTIMATED QUANTITY. TO BE USED AS REQUESTED BY THE EROSION CONTROL SUPERVISOR

(6) ESTIMATED QUANTITY. TO BE USED AS REQUESTED BY THE EROSION CONTROL SUPERVISOR

BASIS OF QUANTITIES	
FERTILIZER, TYPE 4 (18-1-8)	149 LBS/ACRE
SEED MIXTURE 34-261	PLS RATE 31.5 LBS/ACRE

LEGEND

- STATE MIX 34-261 (RIPARIAN SOUTH AND WEST) WITH CAT 4. WOOD FIBER HV 2S BLANKET
- STATE MIX 34-262 (WET PRAIRIE) WITH MULCH MATERIAL TYPE 3
- STATE MIX 35-241 (MESIC PRAIRIE) WITH MULCH MATERIAL TYPE 3
- STATE MIX 34-261 (RIPARIAN SOUTH AND WEST) WITH MULCH MATERIAL TYPE 3
- INSTALL SALVAGED RIPRAP
- STATE MIX 35-241 (MESIC PRAIRIE) WITH CAT. 3B WOOD FIBER BLANKET

Stantec

Copyright Reserved

Consultants

Legend

Notes

Revision

Issued

Permit-Seal

Client/Project
OLMSTED COUNTY

ZUMBRO RIVER RESTORATION
AND OLD SHADY LAKE DAM REMOVAL
ORONOCO, MN

Title
TURF AND FINAL STABILIZATION
NOTES

Project No. 193802086
Scale
Drawing No.
Sheet 61 of 64
Revision

Figure 34-24 Sheet from the construction plan set detailing stabilization and seed mix information.

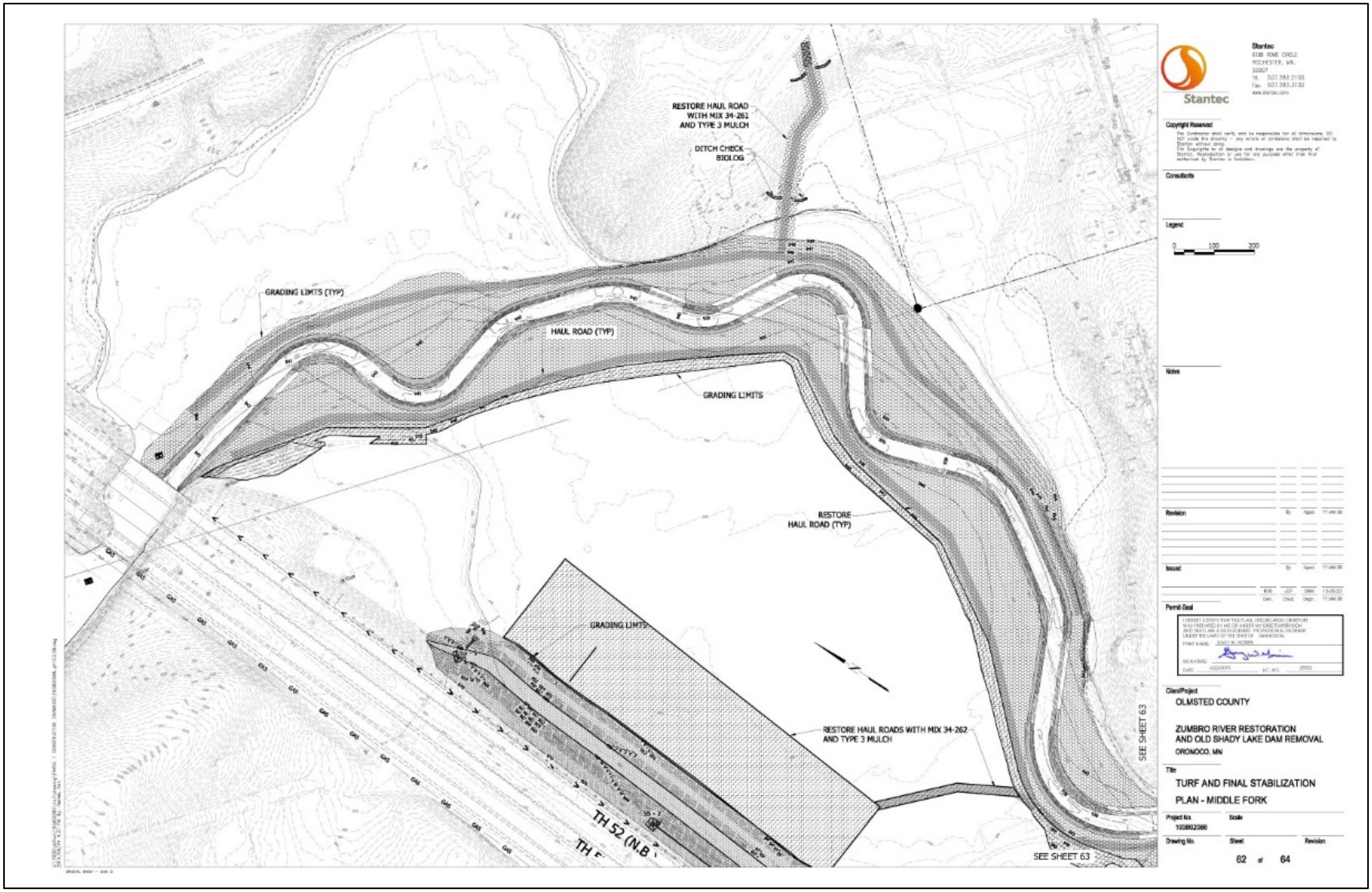


Figure 34-25 Sheet from the construction plan set detailing where seed mixes are used within the project area.

Table 34-1 Results of meander survey through project area. Cover ranges were estimated visually. Meander survey occurred 9/16/19 by Mark Pranckus, Cardno. Meander times were 8:45 – 9:30.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Phalaris arundinacea	Reed Canary Grass	50-75%	No	Native/Non-Native
Setaria pumila	Yellow Foxtail	10-25%	No	Non-Native
Andropogon gerardii	Big Bluestem	5-10%	No	Native
Panicum virgatum	Switchgrass	5-10%	No	Native
Elymus riparius	Riverbank Wildrye	5-10%	Yes	Native
Echinocholoa crus-galli	Barnyard Grass	1-5%	No	Non-Native
Carex vulpinoidea	Fox Sedge	1-5%	Yes	Native
Asclepias incarnata	Swamp Milkweed	1-5%	Yes	Native
Ambrosia trifida	Great Ragweed	1-5%	No	Native
Bidens sp	Beggerticks	1-5%	No	Native
Helenium autumnale	Sneezeweed	1-5%	Yes	Native
Helianthus giganteus	Giant Sunflower	1-5%	Yes	Native
Monarda fistulosa	Wild Bergamot	1-5%	No	Native
Persicaria hydropiper	Marshpepper Knotweed	1-5%	No	Native
Persicaria lapathifolia	Curlytop Knotweed	1-5%	No	Native
Plantago lanceolata	Narrowleaf Plantain	1-5%	No	Non-Native
Pycnanthemum virginianum	Virginia Mountain Mint	0-1%	Yes	Native
Rudbeckia laciniata	Tall Coneflower	1-5%	Yes	Native
Rumex crispus	Curly Dock	1-5%	No	Non-Native
Salix exigua	Narrowleaf Willow	1-5%	No	Native
Silphium perfoliatum	Cup Plant	1-5%	No	Native
Solidago spp.	Goldenrod species	5-10%	No	Native
Solanum ptychanthum	Nightshade	1-5%	No	Native
Symphyotrichum ericoides	Heath Aster	1-5%	No	Native
Verbena hastata	Blue Vervain	1-5%	Yes	Native
Trifolium campestre	Field Clover	1-5%	No	Non-Native
Symphyotrichum firmum	Purplestem Aster	1-5%	No	Native
Xanthium strumarium	Rough Cocklebur	1-5%	No	Native

Appendix B: Site Photographs

Photo 34-1 Example of a boulder J-hook near the upper third of the channel through the former Lake Shady bed. Water levels were elevated during the site assessment. Photo taken 9/16/19 by Mark Pranckus, Cardno.

Photo 34-2 Example of a meander bend through the former Lake Shady bed. The bank on the left has toewood, which is currently underwater. Photo taken 9/16/19 by Mark Pranckus, Cardno.

Photo 34-3 View looking upstream at the rock arch rapids from the Highway 52 bridge. The dam was formerly near the bottom of this photo. Photo taken 9/16/19 by Mark Pranckus, Cardno.

Photo 34-4 View looking upstream from streamside of the rock arch rapids. The structures are installed in an arch facing upstream and also in elongated "U" shaped in the cross section to keep turning flows into the center of the channel as water elevation increases, which reduces bank erosion potential. Photo taken 9/16/19 by Mark Pranckus, Cardno.

35) Middle Branch Whitewater River Restoration/Enhancement

Project Background

Project Name: Middle Branch Whitewater River

Project Site: Middle Branch Whitewater River and Crow Springs

Township/Range Section: Township 107N Range 11W Section 26

Project Manager / Affiliated Organization: John Lenczewski/ Trout Unlimited

Fund: OHF ***Fiscal Year Funds:*** 2010

Project Start Date: 2010

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Post Establishment Phase

County: Olmsted

Primary Activity: Stream/River Enhancement

Project Size: 16,300

Project Completed: 2010

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   This project involved the installation of rock, lunker structures, sky hooks, cover rocks, breaker runs, rock weirs, rock veins, rock deflector, woody debris and re-shaping banks and adjusting stream width in some areas.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   MBWW Habitat Enhancement Plan.
3. ***What are the stated goals of the project?***
   Overall goals for a number of different projects were stated in the Lessard-Sams Outdoor Heritage Council 2009 Final Report as: reconnect streams to their floodplains, increase natural reproduction of trout and other aquatic organisms, maintain or increase adult trout abundance, increase biodiversity for both in-stream and non-game species, be long lasting with minimal maintenance required and improve angler access.
4. ***What are the desired outcomes of achieving the stated goals of the project?***

Increases in trout population and large trout abundance are expected. Additionally, the expected outcome of reconnecting streams to their floodplains as stated in the Lessard-Sams Outdoor Heritage Council 2009 Final Report was to reduce negative impacts from severe flooding

5. ***Were measures of restoration success identified in plans? Yes***
   If yes, list specific measurements.
   Increases in trout population/size over time.
6. ***Are plan Sets available?*** **No** ***Have project maps been created?*** **No**
   If yes, provide in Appendix A and list Maps provided:
   Click here to enter text.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   Lunker structures are a standard practice for improving overhead cover for brown trout populations. Reshaping banks is a standard practice for allowing the stream to access its floodplain and reduce erosion on the banks thus improving habitat. Adjusting stream width reduces sedimentation within a reach and helps improve bed features. Rock was used along the stream banks, this is common in SE Minnesota and helps stabilize banks in areas with cattle grazing.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No
   Click here to enter text.
9. ***In what ways did alterations change the proposed project outcome?***
   Click here to enter text.

Site Assessment

Field Review Date: 10/21/2019

Field Visit Attendees: John Lenczewski (Trout Unlimited Executive Director), Wade Johnson (MN DNR Restoration Evaluations Program Coordinator), and Anna Varian (Stantec Site Assessor).

10. ***Surrounding Landscape Characteristics:***
    The project area is within cattle pasture, some areas are actively being grazed other areas are not. There is an angling easement throughout the project allowing anglers to access and fish the stream.
11. ***Site Characteristics:***
    a. ***Soil Series:***
    The dominant soil type within the project area is Arenzville silt loam, 0 to 3 percent slopes, occasionally flooded (USDA).
    b. ***Topography:***
    The Middle Branch of Whitewater and Crow Springs flows through a wide valley dominated by agriculture.

c. Hydrology:

The drainage area of Crow Springs at the project site is 9.1 square miles and is dominated by agriculture. Within the project site Crow Springs flows into the Middle Branch Whitewater River, the downstream portion of the project is on the Middle Branch Whitewater River with a drainage area of 30 square miles.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

The project site was seeded with a pasture mix with wildflowers included. No trees or shrubs were planted. The greater than 2 mile stream reach where project work took place is almost entirely actively grazed cattle pasture. Grazed areas can be described as a cool season pasture with a limited native species influence. Low floodplain areas are dominated by Reed Canary Grass, with a mix forbs including Cow Parsnip, Nettles and Spotted Jewelweed. Patches of degraded Oak-Basswood forest exist in the areas with steep slopes. Box Elder is common near the stream and Buckthorn is common throughout in these forested patches.

e. Vegetation B: Meander Search Species List (as appropriate for site)

NA. Vegetation in the 2 mile reach walked during the evaluation is described above in 11.d.

12. ***Is the plan based on current science?*** Portions

This project is almost ten years old, at this time fully engineered designs with plan sets were not common. The treatments and methods were common for the time when it was installed, if this project were constructed today more pre-construction data would have been collected including reference reach data to guide the design and more wood used to help stabilize instead of rock. Lunker structures for habitat and re-shaping banks to allow streams to access floodplains are still common practice today to improve habitat and reduce bank erosion.

13. List indicators of project goals at this stage of project:

Banks have been reshaped to allow the stream to access its floodplain, stream banks are stable and holding up to cattle grazing. With the stream slopes graded to allow access to the floodplain angler access is also improved. Another goal was minimal maintenance, the project was constructed 9 years ago with little to no additional work needed. Fisheries surveys have been conducted within the project area but several years of data are needed to determine improvements.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes, reshaping stream banks to allow access to the floodplain helps reduce erosion. Using rock along the stream banks helps reduce damage from cattle. Given that this area is grazed by cattle, a full restoration with undisturbed native vegetation along the riparian corridor would not be possible without cooperation with the landowner so the habitat enhancement goals are treatments used are reasonable for the conditions.

15. Are corrections or modifications needed to achieving proposed goals?

No.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

Given the site conditions the project goals and outcomes are reasonable. The watershed is primarily agriculture, these upstream conditions and cattle within the site will be the biggest challenge to maintaining quality habitat at this site without further maintenance.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No.
18. ***Are follow-up assessments needed? Explain.***
    No. The project has remained stable since construction over several years of high-water events.
19. ***Additional comments on the restoration project.***
    This project was designed and constructed before it was common to have fully engineered designs based on reference reaches and before natural channel design was fully embraced by the state. The project is within cattle pasture and portions are currently grazed while others are not. Excluding cattle from the stream corridor was not an option and the approach taken with this project was the best available option given the landscape conditions. No significant erosion was visible during the site visit. Visual assessment of habitat improvements was difficult during the site visit due to high and turbid water. Comparison to pre-construction photos does show an improvement in banks and anecdotal information from DNR employees indicate habitat has improved in this reach.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium
22. ***Provide explanation of reason(s) for determination.***
    The project site appears stable and anecdotal information from the DNR is that instream habitat has improved at the site; however, during the site visit water level was high and turbid making assessment of instream habitat conditions difficult. Pre-construction photos show vertical banks that have been improved by the project. Without several years of pre and post project surveys assessing changes in trout populations would be difficult.
23. ***Site Assessor(s) Conducting Review:***
    Anna Varian, Stantec

Appendix A: Site maps, Project plans

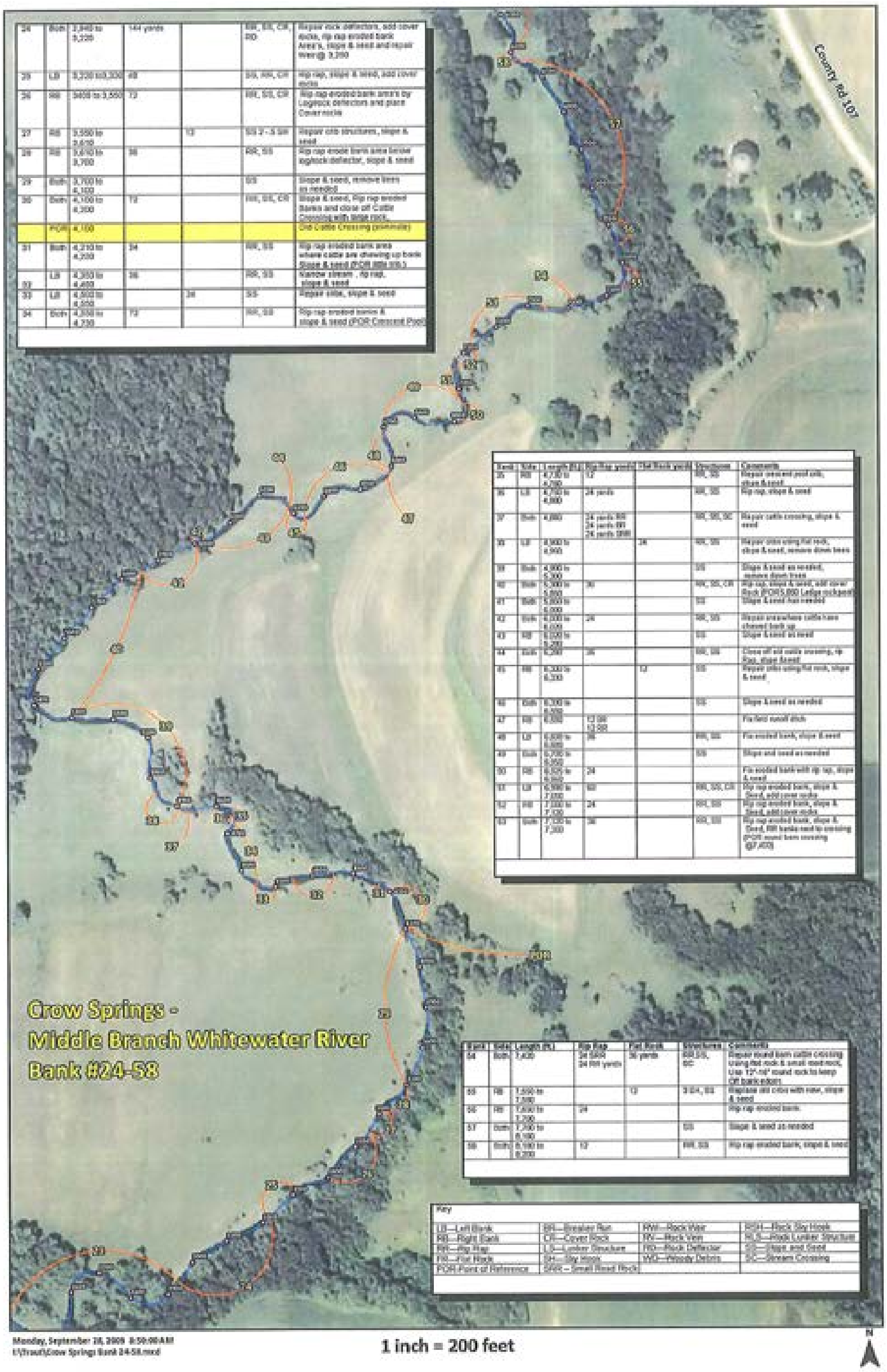


Figure 35-1 One portion of the construction plans showing locations of treatments used.

Appendix B: Site Photographs

Photo 35-1 Pre-construction photo of Crow Springs showing eroding banks. Photo taken on 7/15/2009.

Photo 35-2 Crow Springs project area where stream bank slopes were re-shaped, and rock added. Photo taken 10/21/2019 by Anna Varian.

Photo 35-3 Middle Branch Whitewater River, area where stream width was reduced, banks were re-shaped and rock added to banks. Photo taken 10/21/2019 by Anna Varian.

Photo 35-4 Middle Branch Whitewater River looking downstream from County Road 107 at area where banks were re-shaped and rock added. Photo taken 10/21/2019 by Anna Varian.

36) Middle Fork Whitewater River Restoration

Project Background

Project Name: Whitewater State Park – River Restoration

Project Site: Middle Fork Whitewater River

Township/Range Section: Township 107N Range 10W Section 20

Project Manager / Affiliated Organization: Ian Chisholm/ MN DNR

Fund: OHF ***Fiscal Year Funds:*** 2014

Project Start Date: 2018

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Choose an item. , Choose an item.

Project Status: Establishment Phase

County: Winona

Primary Activity: Stream/River Restoration

Project Size: 2,000 linear feet

Project Completed: June 2019

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   This project involves installation of rock riffles, removal of deposited sediment, reconstruction of existing boulder vanes, addition of boulder clusters for habitat, and toe wood.
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Construction Plans for Whitewater State Park River Restoration, Minnesota Department of Natural Resources, 2018 Altura, MN - prepared by Barr Engineering. Whitewater River EAW, 2015 – prepared by MN DNR. Whitewater State Park – River Restoration Basis of Design Report, prepared for MN DNR, October 2018 Minneapolis, MN – prepared by Barr Engineering.
3. ***What are the stated goals of the project?***
   Goals stated in the River Restoration Basis of Design Report are to restore the stream's natural processes, habitat and water quality as well as protect infrastructure and maintain safety for park users.
4. ***What are the desired outcomes of achieving the stated goals of the project?***
   The DNR's intention is to be able to use this project as a showcase of natural channel design methods and to serve as a future training resource.
5. ***Were measures of restoration success identified in plans? No***

If yes, list specific measurements.
Click here to enter text.

6. ***Are plan Sets available?*** **Yes** ***Have project maps been created?*** **No**
   If yes, provide in Appendix A and list Maps provided:
   Construction Plans for Whitewater State Park River Restoration, Minnesota Department of Natural Resources, 2018 Altura, MN - prepared by Barr Engineering. Document includes project location, SWPPP, erosion control plan, existing conditions, stream plan and profile, typical riffle and pool sections, boulder cross vane and toe wood detail, and restoration plans.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   A number of surveys and analysis prior to design occurred including extensive geomorphic surveys in the watershed, a complete watershed assessment of River Stability and Sediment Supply (WARSSS), multiple geomorphic assessments in the project reach, sediment transport analysis, hydrologic analysis, hydraulic modeling, and reference reach surveys. This level of data collection and documentation is based on current science. The treatments used (boulder vanes, toe wood, boulder clusters) are all based on current science and are industry standards.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No
   Click here to enter text.
9. ***In what ways did alterations change the proposed project outcome?***
   Click here to enter text.

Site Assessment

Field Review Date: **9/16/2019**

Field Visit Attendees: Ian Chisholm (MN DNR Natural Resources Program Supervisor, River Ecology Unit), Amanda Hillman (MN DNR Restoration Coordinator), Ronald Benjamin (MN DNR Fisheries), Wade Johnson (MN DNR Restoration Evaluations Program Coordinator), and Anna Varian (Stantec Site Assessor)

10. ***Surrounding Landscape Characteristics:***
    The project site is within Whitewater State Park, there is a campground directly to the north and cart in sites south of the project. No designated trails line the project area but anglers commonly us the stream banks for access. The state park is primarily forested. There is a pedestrian bridge and State Highway 74 bridge within the project area.
11. ***Site Characteristics:***
    a. ***Soil Series:***
    The soil type found across the whole project area is Beavercreek silt loam, 1 to 8 percent slopes, stony. The profile is described as very cobbly sand to very cobbly silt loam. This is not a hydric soil.

b. Topography:

The stream flows through a wide valley with a gentle slope and well-developed floodplain.

c. Hydrology:

The Middle Fork Whitewater River drainage area at the project location is 47.8 square miles and is 76% cultivated crops. There are multiple springs that enter the project area in the downstream portion of the project, the design incorporated a method to capture these springs and provide a stable outlet into the stream.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

The native seeding at the Middle Fork Whitewater River restoration is in the very early stages of development process, having been seeded in May of 2019. Although the seeding appears to be developing at an appropriate pace in some areas, many areas have limited vegetative cover due to site-specific conditions. The greatest single issue with the lack of development of native seeding is due to the lack soil. Many areas are comprised of stream-deposited material that ranges in size from small gravel to cobble-sized rocks. Where sufficient soil occurs to enable vegetation establishment, plants are still relatively young with few plants mature enough to flower.

Positive identification of graminoids was challenging due to their small size. Total vegetation cover in areas with some soil varied from about 10 to 50 percent. Native plants observed on site that are components of the native seed mix installed include: the native grass Virginia wildrye (*Elymus virginicus*) was the most readily identifiable native graminoid. Native forbs from the seed mix that were observed included: giant sunflower (*Helianthus giganteus*), blue vervain (*Verbena hastata*), and giant goldenrod (*Solidago canadensis*). Other natives that were observed volunteering into the site include: white vervain (*Verbena urticifolia*), climbing false buckwheat (*Polygonum scandens*), Virginia stickseed (*Hackelia virginiana*), daisy fleabane (*Erigeron strigosus*) and three-seeded mercury (*cf. Acalypha rhomboidea*). Cover crop was not readily observable. Nonnative plants are common across the site, and mostly comprised of yellow foxtail (*Seteria pumila*) and clover (*Trifolium sp*.). A small amount of the invasive, nonnative wild parsnip was observed as rosettes across the site. Willow stakes and cuttings were present and those closest to the stream were doing well, higher up on the banks they were not as successful. Installation of the stakes was difficult due to the rocky soil and some have been washed away from high water. Sugar maple, hackberry and swamp white oak were planted and there are plans to plant more trees and shrubs in the spring of 2020.

e. Vegetation B: Meander Search Species List (as appropriate for site)

Click here to enter text.

12. *Is the plan based on current science?* Yes

A number of surveys and analysis prior to design occurred including extensive geomorphic surveys in the watershed, a complete watershed assessment of River Stability and Sediment Supply (WARSSS), multiple geomorphic assessments in the project reach, sediment transport analysis, hydrologic analysis, hydraulic modeling, and reference reach surveys. This level of data collection and documentation is based on current science. The treatments used (boulder vanes, toe wood, boulder clusters) are all based on current science and are industry standards.

13. List indicators of project goals at this stage of project:

There is no significant erosion or sedimentation within the reach. Construction was completed in May of this year and thus it is difficult to fully assess measures of success at this time.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes, correcting mistakes made during the previous project such as eliminating failing riprap, properly installing boulder vanes, adding rock riffles and toe wood, and removing deposited sediment will improve habitat and water quality.

15. ***Are corrections or modifications needed to achieving proposed goals?***
    Vegetation establishment will need to be monitored closely.
16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    There will be geomorphological surveys on this project to monitor stability as well as drone flights to assess progress as the project matures. Geomorphological surveys post construction are rare and this information should help inform future projects. There are plans to plant more trees and shrubs but no major additions to herbaceous cover other than minor repairs or possibly a cover crop on the banks. The rocky soil will be a challenge for establishing vegetation and it should be monitored yearly and additional seeding if necessary.
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No.
18. ***Are follow-up assessments needed? Explain.***
    Yes, project construction was only completed this spring and stream restoration projects should be assessed after the project experiences multiple bankfull events and vegetation has had a chance to establish.
19. ***Additional comments on the restoration project.***
    This project area has a long history of issues, multiple stabilization projects have occurred in this area throughout the years. Most recently in 2016 the DNR’s River Ecology Unit collected data and developed a plan to restore the channel through the current project area. This plan included re-alignment of the stream and natural channel design treatments; however, the engineer would not agree to using all of the natural channel design treatments and instead created a design with riprap to hard armor the channel. The riprap failed catastrophically along with failure of an improperly installed boulder vane the first spring flows it experienced. The current project is aimed at correcting the errors of the previous project. The re-alignment that was implemented in 2016 held its position and so correcting errors in construction of a boulder vane, removing remnants of the failed riprap, adding constructed riffles and toe wood were the remaining treatments to be installed.
    During construction of the current project members of the DNR’s River Ecology unit along with Barr Engineering were on site every day to monitor construction, this is an important aspect of stream restoration construction.
    There is some erosion occurring on the upper bank just below rock riffle 2, this area was constructed higher than indicated in the design documents and the current bank height and angle resulting from the erosion more closely align with the designed bank.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***

    achieved the stated goals.

21. ***The project will:***

    Meet proposed outcomes

    Confidence of outcome determination:

    Medium

22. ***Provide explanation of reason(s) for determination.***

    Construction on this project only finished earlier this summer and the project has yet to experience several bankfull flow events and time for vegetation establishment. Stream restoration projects need time for riparian vegetation to establish and time for any natural adjustment that may happen to take place in order to determine if the designed stream is stable. Knowing that someone was on site every day during construction instils confidence that treatments were installed correctly. The project has experienced high flows already during its first summer and no significant erosion or other signs of instability were present.

23. ***Site Assessor(s) Conducting Review:***

    Anna Varian, Stantec Consulting.

Appendix A: Site maps, Project plans or Vegetation tables

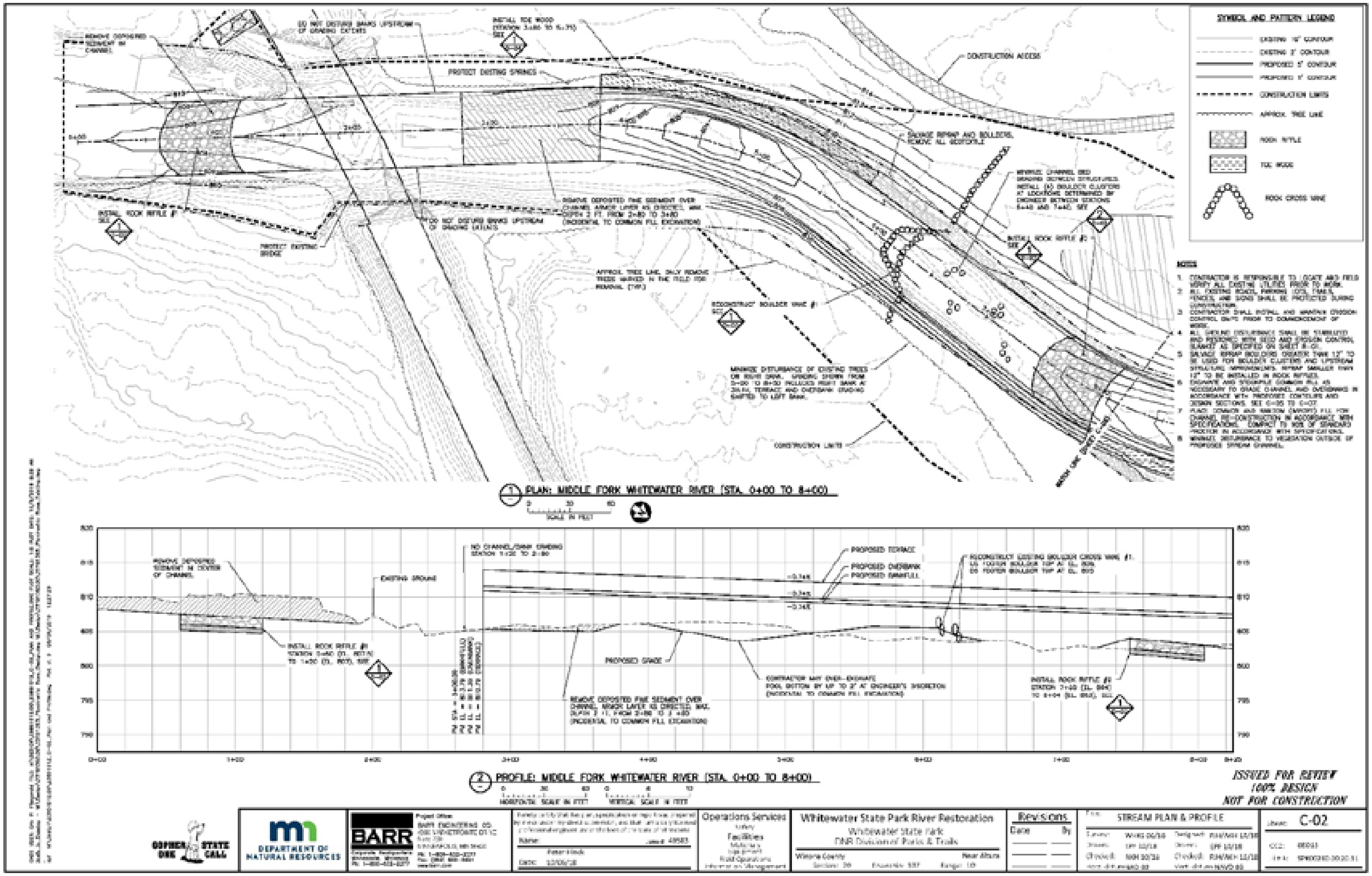


Figure 36-1 Stream plan and profile from construction plans.

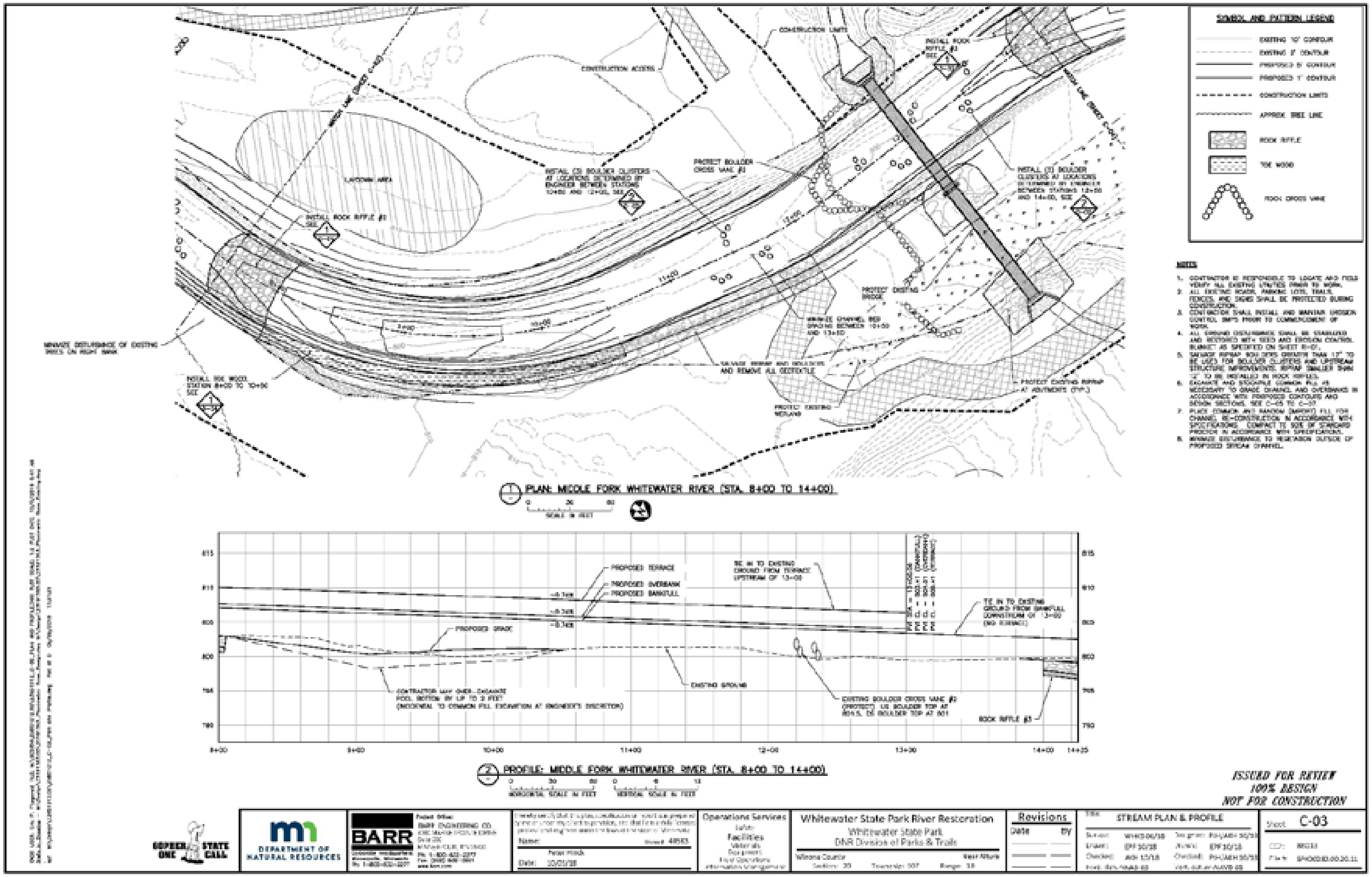


Figure 36-2 Stream plan and profile from construction plans.

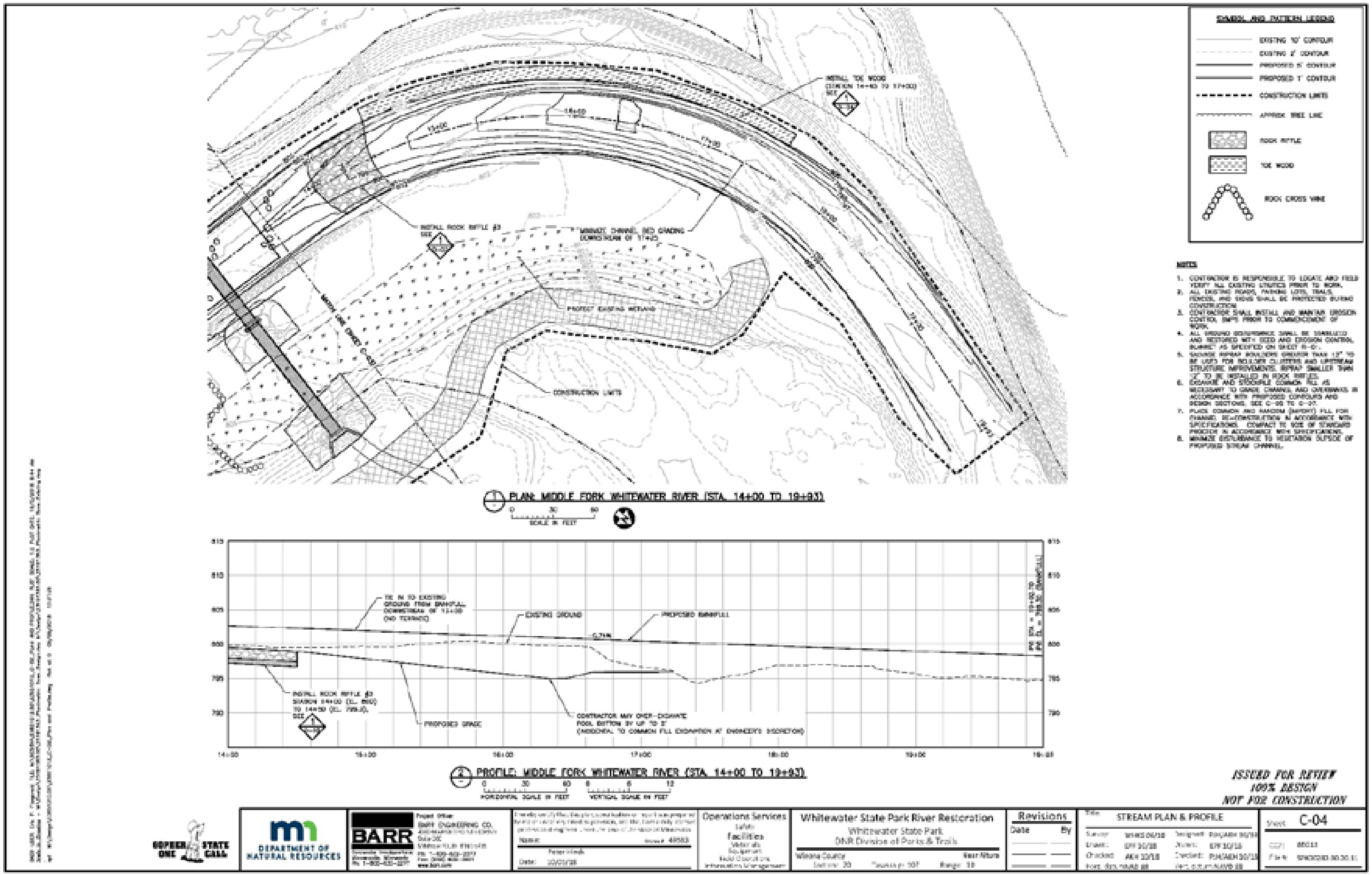


Figure 36-3 Stream plan and profile from construction plans.

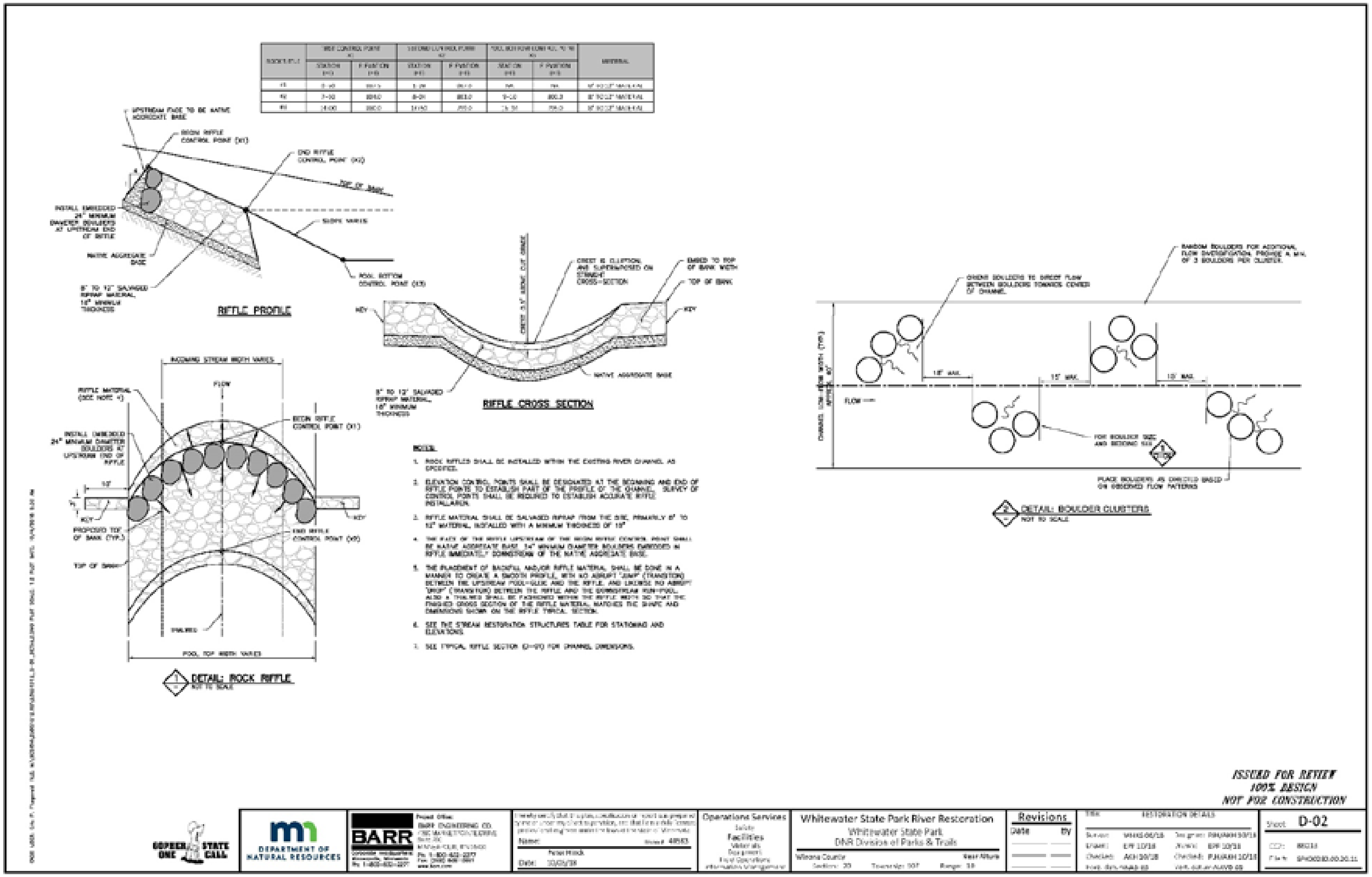


Figure 36-4 Rock riffle and boulder clusters detail from construction plans.

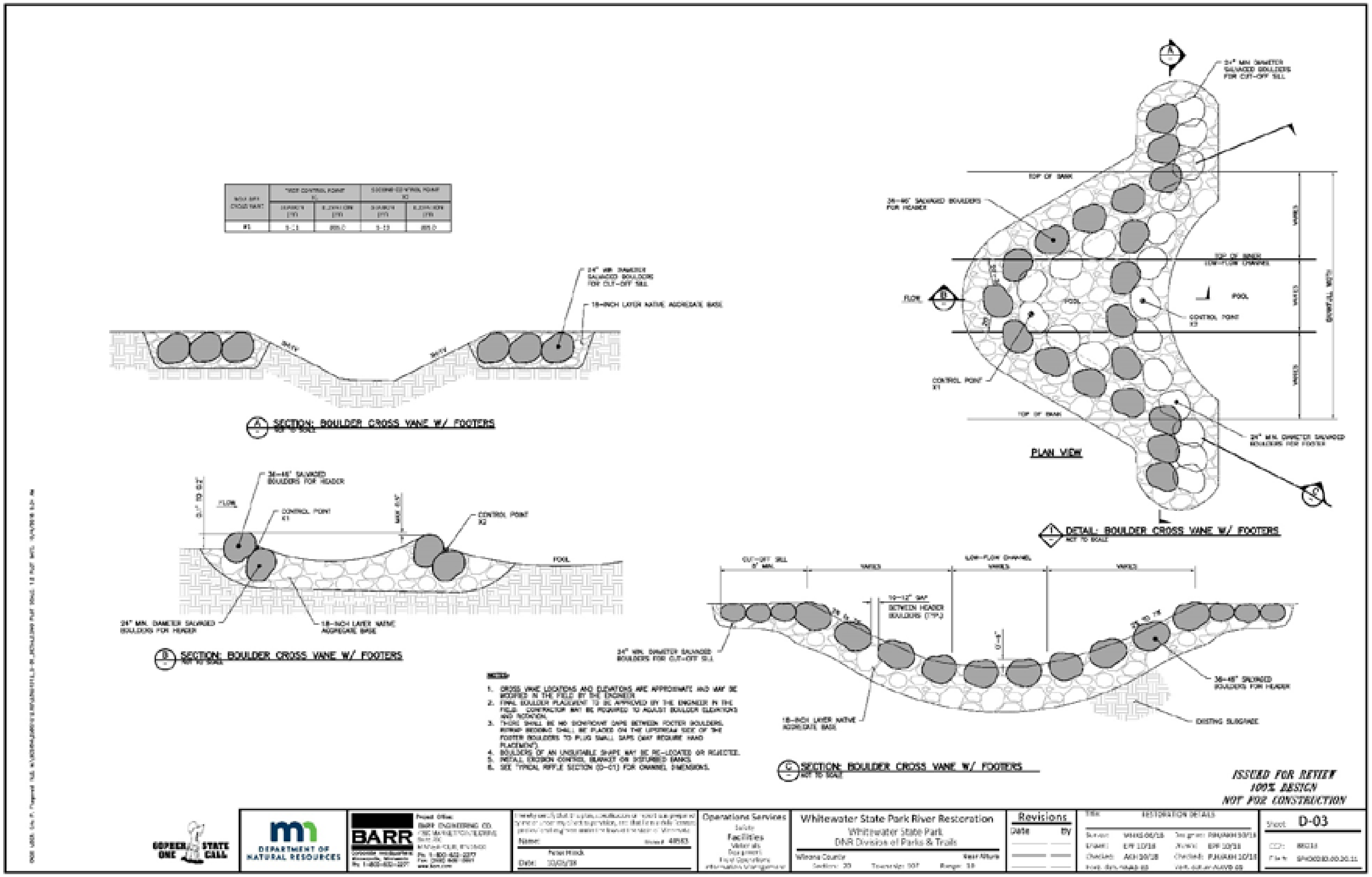


Figure 36-5 Boulder cross vane details from construction plans.

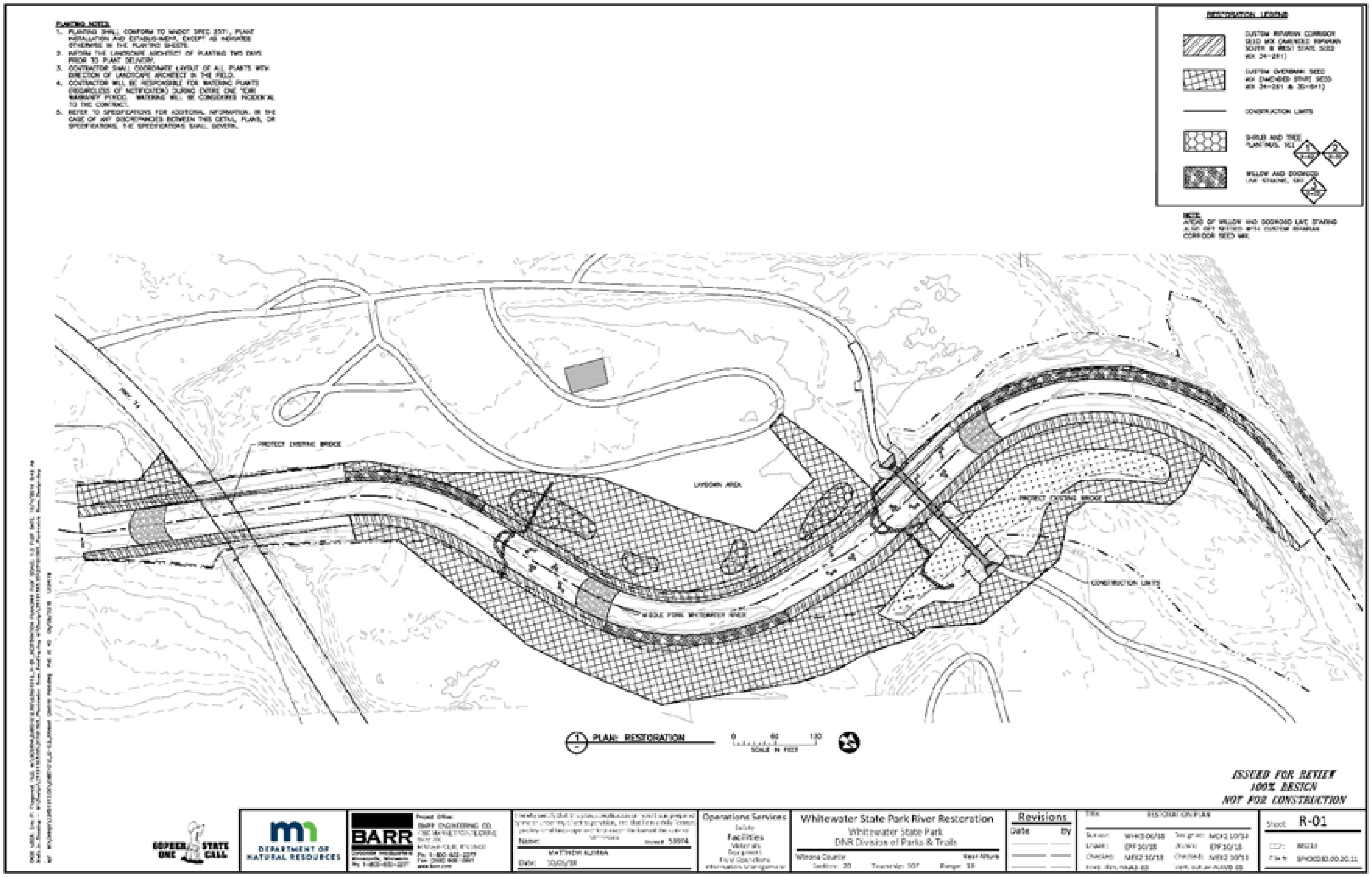


Figure 36-6 Restoration plans from construction plans.

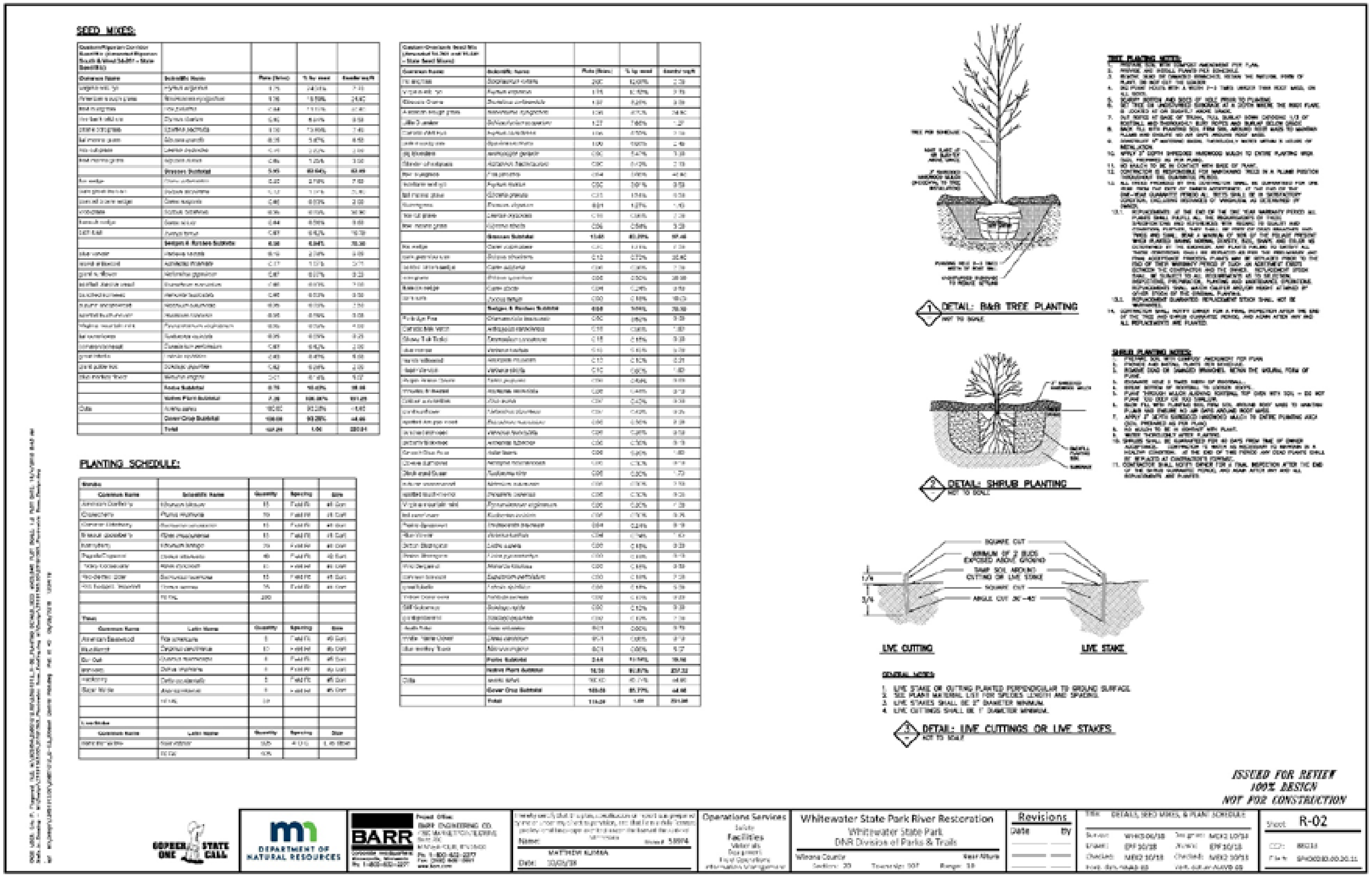


Figure 36-7 Seeding and plantings details.

Table 36-1. Plants observed from photos taken during site visit on 9/17/19.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Abutilon theophrasti	Velvetleaf	Rare	No	Non-native
Acalypha rhomboidea	three-seeded mercury	Common	No	Native
Asclepias incarnata	Swamp Milkweed	Rare	Yes	Native
Ambrosia trifida	Giant Ragweed	Rare	No	Native
Avena sativa	Oats	Common	Yes	Non-native (cover crop)
Bidens sp.	Beggerticks	Common	No	Na
Elymus virginicus	Virginia wildrye	Common	Yes	Native
Erigeron strigosus	daisy fleabane	Common	No	Native
Eupatorium perfoliatum	Common Bonset	Rare	Yes	Native
Helianthus giganteus	giant sunflower	Rare	Yes	Native
Hackelia virginiana	Virginia stickseed	Common	No	Native
Oxalis stricta	Wood Sorrel	Common	No	Native
Pastinaca sativa	wild parsnip	Rare	No	Invasive
Plantago major	Plantain	Rare	No	Non-native
Polygonum scandens	climbing false buckwheat	Rare	No	Native
Populus deltoides	Cottonwood	Rare	No	Native
Prunella vulgaris	Self Heal	Common	No	Native
Rudbeckia hirta	Common Black-eyed Susan	Rare	Yes	Native
Rudbeckia laciniata	Tall Coneflower	Rare	Yes	Native
Seteria pumila	yellow foxtail	Abundant	No	Non-native
Solidago canadensis	giant goldenrod	Rare	No	Native
Solidago gigantea	giant goldenrod	Rare	Yes	Native
Sonchus arvensis	Sowthistle	Rare	No	Non-native
Symphyotrichum leave	Smooth Blue Aster	Common	Yes	Native
Trifolium hybridum	Alsike Clover	Abundant	No	Non-native
Verbena hastata	blue vervain	Rare	Yes	Native
Verbena urticifolia	white vervain	Common	No	Native

Appendix B: Site Photographs

Photo 36-1 View of project looking upstream from pedestrian bridge. Photo taken during site visit 9/16/19 by Anna Varian.

Photo 36-2 Looking upstream at reconstructed boulder vane 1. Photo taken during site visit 9/16/19 by Anna Varian

Photo 36-3 View of toe wood looking downstream toward end of project area. Photo taken during site visit 9/16/19 by Anna Varian.

Photo 36-4 Aerial view of project site taken after project construction in early summer 2019.

37) Whitewater State Park Enhancement

Project Background

Project Name: Whitewater River - Restoration of riparian corridor

Project Site: Riparian zone adjacent to the Whitewater River adjacent to State Park footbridge

Township/Range Section: Township 107N Range 10W Section 20

Project Manager / Affiliated Organization: Shawn Fritcher, Resource Specialist, MN DNR Parks and Trails

Fund: PTF ***Fiscal Year Funds:*** FY14

Project Start Date: October 2016

Predominant Habitat type: Prairie / Savanna / Grassland

Additional Habitat types: Aquatic , Choose an item.

Project Status: *Establishment Phase*

County: Winona

Primary Activity: Stream/River Restoration

Project Size: 0.5 acres

Project Completed: October 2016

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Native seeding in riparian area disturbed by stream restoration construction
2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Vegetation management within the State Park is guided by the Whitewater State Park Resource Management Plan. This seeding project was planned in conjunction with a stream channel reconstruction project completed in 2016. MNDOT native seed mixes were specified in the stream project plan in consultation with MN DNR Parks resource staff. Additional, hand harvested riparian seed from within the park was also used. MN DNR Parks resource staff maintain plans and records of implemented activities including activities, dates, materials and seed tags.
3. ***What are the stated goals of the project?***
   Establish native plant cover on disturbed construction soils to provide 1. vegetative stabilization and 2. Native plant habitat

4. ***What are the desired outcomes of achieving the stated goals of the project?***
   Habitat connectivity between surrounding native forest and stream.
5. ***Were measures of restoration success identified in plans?*** *No*
   If yes, list specific measurements.
   Click here to enter text.
6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** No
   If yes, provide in Appendix A and list Maps provided:
   Click here to enter text.
7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   - Site prep: cleared and graded with appropriate substrate for seeding
   - Fall seeding in 2016 using broadcast seeder
   - Mowing during the summer following seeding to control weeds
   - Second-year mowing and spot spraying to control weeds

   These practices are consistent with prairie reconstruction best management practices.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Additional local native seed was added. This seed was hand harvested from riparian areas within the Park.
9. ***In what ways did alterations change the proposed project outcome?***
   Addition of the local harvested seed increased the potential species richness

Site Assessment

Field Review Date: 8/16/2019

Field Visit Attendees: Anna Varian, Stantec, Wade Johnson, MN DNR

10. ***Surrounding Landscape Characteristics:***
    The project site is within Whitewater State Park, there is a campground directly to the north and cart in sites south of the project. No designated trails line the project area, but anglers commonly use the stream banks for access. The state park is primarily forested. There is a pedestrian bridge within the project area.
11. ***Site Characteristics:***
    a. ***Soil Series:***
    The soil type found across the whole project area is Beavercreek silt loam, 1 to 8 percent slopes, stony. The profile is described as very cobbly sand to very cobbly silt loam. This is not a hydric soil.
    b. ***Topography:***

The adjacent Whitewater River flows through a wide valley with a gentle slope and well-developed floodplain.

c. Hydrology:

The seeding project site is a predominantly dry over bank floodplain. The site is inundated by the Middle Fork Whitewater River during high flow events, typically on 1.5 year intervals.

d. Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:

Within the area assessed from the 2016 seeding Indian Grass (Sorgastrum nutans) and Canada Goldenrod (Solidago canadensis) appear to be the most prevalent species, each with approximately 30-40% cover. There is a dense cover of native seeded species and native species not know to be seeded (see Table 37-3). Patches of Cottonwood seedlings (20% cover) can be seen emerging in the grass/forbs.

e. Vegetation B: Meander Search Species List (as appropriate for site)

See Appendix A, Table 37-3

12. ***Is the plan based on current science?*** Yes

The sequence of site preparation, seeding, mowing and spot spraying used on this site is consistent with current riparian restoration practices. These practices encourage the establishment of native grasses and forbs while controlling for non-native and weedy species.

13. List indicators of project goals at this stage of project:

The dominant cover in seeded areas consists primarily of the native seeded species. Future management activities that MN DNR Parks regularly enlists; such as mowing, spot herbicide treatment and prescribed burning; should reduce the cover of undesirable species and encourage native seeded species.

14. Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?

Yes. Current management of the surrounding Park natural areas and ongoing monitoring and vegetation management of 2019 post construction plantings should enable this site to develop into a successful native plant community restoration.

15. Are corrections or modifications needed to achieving proposed goals?

Continued vegetation management will be needed to ensure integration between the remaining 2016 seeding and the recent 2019 construction seeding and planting.

16. Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?

Yes. DNR Parks resource managers are monitoring this site regularly and plan to continue regular maintenance.

17. Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.

No. All activities involved in this project improve overbank floodplain stability and habitat on the site.

18. Are follow-up assessments needed? Explain.

Follow up assessment of establishment of vegetation at this specific site and surrounding 2019 vegetation inputs along the stream corridor is advised.

19. Additional comments on the restoration project.

Overall the seeding appears to be successful. Canada Goldenrod appears to be becoming more prevalent and may crowd out other forb species. Cottonwood seedlings present may shift the site to a forested condition over time. If the grass forb community is to be maintained, Cottonwood will likely need to be managed.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***
    Meet proposed outcomes
    Confidence of outcome determination:
    Medium
22. ***Provide explanation of reason(s) for determination.***
    The establishment phase of the 2016 seeding was well implemented, with good establishment of native seeded grasses and forbs. The majority of this seeded area was also disturbed during construction in 2019, as such continued monitoring and management will be required to achieve long term outcomes. MN DNR Parks resource managers have established plans to continue this monitoring and maintenance.
23. ***Site Assessor(s) Conducting Review:***
    Paul Bockenstedt, Stantec; Wade Johnson, MN DNR

Appendix A: Site maps, Project plans or Vegetation tables

Table 37-1 Seed tag MNDOT 34-261 Riparian South and West. Mix used along streambank. 1.5 Acre. 47.25 Pounds Pure Live Seed (PLS). 51.11 Bulk Pounds.

Common Name	Scientific Name	Origin	Mix Percent	Pure Live Seed pounds	Bulk pounds
American Slough Grass	*Beckmannia syzigadia*	MN	7.49%	0.90	1.13
Riverbank Wild Rye	*Elymus riparius*	MN	1.58%	0.75	0.80
Blue Joint Grass	*Calamagrostis Canadensis*	MN	0.42%	0.21	0.28
Virginia Wild Rye	*Elymus virginicus*	MN	5.56%	2.63	2.85
American Manna Grass	*Glyceria grandis*	MN	0.80%	0.38	0.73
Fowl Manna Grass	*Glyceria grandis*	IA	0.29%	0.14	0.18
Rice Cut Grass	*Leersia oryzoides*	MN	0.51%	0.24	0.26
Fowl Bluegrass	*Poa paulustris*	Canada	2.66%	1.26	1.36
Prairie Cord Grass	*Spartina pectinata*	IA	0.96%	0.45	0.82
Tussock Sedge	Carex stricta	MN	0.13%	0.06	0.07
Pointed Broom Sedge	*Carex scoparia*	MN	0.21%	0.10	0.13
Brown Fox Sedge	*Carex vulpinoidea*	MN	0.65%	0.31	0.33
Inland Rush	*Juncus interior*	MN	0.09%	0.04	0.05
Green Bulrush	*Scirpus atrovirens*	MN	0.38%	0.18	0.20
Woolgrass	*Scirpus cyperinus*	MN	0.15%	0.07	0.08
Swamp Milkweed	*Asclepias incarnata*	MN	0.38%	0.18	0.22
Boneset	*Eutrochium perfoliatum*	MN	0.11%	0.05	0.10
Joe Pye Weed	*Eutrochium maculatum*	MN	0.18%	0.09	0.11
Sneezeweed	*Helenium autumnale*	MN	0.25%	0.13	0.15
Giant Sunflower	*Helianthus gigantius*	MN	0.22%	0.10	0.12
Spotted Touch me Not	Impatiens capensis	MN	0.17%	0.08	0.09
Great Blue Lobilia	Lobielia siphilitica	MN	0.09%	0.01	0.01
Monkey Flower	*Mimulus ringens*	MN	0.02%	0.01	0.01
Mountain Mint	Pycnanthemum virginianum	MN	0.16%	0.08	0.08
Wild Golden Glow	Rudebeckia laciniata	WI	0.15%	0.07	0.07
Cup Plant	Silphium perfoliatum	MN	0.07%	0.03	0.05
Blue Vervain	*Verbena hastata*	MN	0.46%	0.22	0.24
Ironweed	*Vernonia fasciculata*	MN	0.18%	0.09	0.10
Oats	*Avena sativa*	SD	79.37%	37.50	39.52

Table 37-2 MNDOT Standard Mix 35-641 Mesic Prairie Southeast. Mix used in "overbank" area. 1 Acre. 12 Pounds Pure Live Seed (PLS). 13.62 Bulk Pounds.

Common Name	Scientific Name	Origin	Percent of Mix	Pure Live Seed pounds	Bulk pounds
Big Bluestem	Andropogon gerardii	MN	7.50%	0.90	1.13
Sideoats Grama	Bouteloua curtipendula	MN	11.40%	1.37	1.63
Canada Wild Rye	Elymus canadensis	MN	8.74%	1.05	1.19
Slender Wheatgrass	Agropyron trachycaulum	WI	7.50%	0.90	0.93
Switchgrass	Panicum virgatum	MN	1.75%	0.21	0.29
Little Bluestem	Schizachyrium scoparium	MN	10.57%	1.27	1.68
Indiangrass	Sorghastrum nutans	MN	16.64%	2.00	2.20
Butterfly Milkweed	Asclepias tuberosa	MN	0.50%	0.06	0.07
Whorled Milkweed	Asclepias verticillata	MN	0.08%	0.01	0.01
Heath Aster	Aster ericoides	MN	0.08%	0.01	0.01
Smooth Blue Aster	Aster laevis	MN	0.42%	0.05	0.06
Canada Milk Vetch	Astragalus canadensis	MN	1.33%	0.16	0.16
Partridge Pea	Chamaecrista fasciculata	MN	4.99%	0.06	0.63
White Prairie Clover	Dalea candidum	MN	0.08%	0.01	0.01
Purple Prairie Clover	Dalea purpurea	MN	0.75%	0.09	0.10
Showy Tick Trefoil	Desmodium canadense	MN	1.25%	0.15	0.16
Ox-eye Sunflower	Heliopsis helianthoides	MN	0.42%	0.05	0.06
Button Blazingstar	Liatris aspera	MN	0.25%	0.03	0.04
Prairie Blazingstar	Liatris pycnostachya	MN	0.25%	0.03	0.04
Wild Bergamot	Monarda fistulosa	MN	0.25%	0.01	0.01
Yellow Coneflower	Ratibida pinnata	MN	0.17%	0.02	0.02

Common Name	Scientific Name	Origin	Percent of Mix	Pure Live Seed pounds	Bulk pounds
Black-eyed Susan	Rudbeckia hirta	MN	0.42%	0.05	0.05
Stiff Goldenrod	Solidago rigida	MN	0.17%	0.02	0.02
Prairie Spiderwort	Tradescantia bracteata	MN	0.33%	0.04	0.05
Blue Vervain	Verbena hastata	MN	0.33%	0.04	0.05
Hoary Vervain	Verbena stricta	MN	0.83%	0.10	0.11
Golden Alexanders	Zizia aurea	MN	0.58%	0.07	0.08
Oats	Avena sativa	SD	22.46%	2.70	2.84

Table 37-3 Results of meander survey through project area. Cover ranges were estimated visually. Meander survey occurred between 1:00–1:30 PM, 08/16/19 by Wade Johnson, MN DNR and Anna Varian, Stantec.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Populus deltoides	Cottonwood	5-10%	No	Native
Sorgastrum nutans	Indian Grass	25-50%	Yes	Native
Andropogon gerardii	Big Bluestem	25-50%	Yes	Native
Elymus canadensis	Canada Wild Rye	10-25%	Yes	Native
Avena sativa	Oats	5-10%	Yes	Non-native (cover crop)
Setaria pumila	Yellow Foxtail	5-10%	No	Non-Native
Panicum capillare	Witchgrass	1-5%	No	Native
Carex vulpinoidea	Fox Sedge	1-5%	Yes	Native
Scirpus atrovirens	Green Bulrush	1-5%	Yes	Native
Solidago Canadensis	Canada Goldenrod	5-10%	No	Native
Verbena hastata	Blue Vervain	5-10%	Yes	Native
Rudbeckia hirta	Common Black-eyed Susan	5-10%	Yes	Native
Heliopsis helianthoides	Common Ox Eye	5-10%	Yes	Native
Solidago speciosa	Showy Goldenrod	1-5%	Yes	Native
Solidago nemoralis	Oldfield Goldenrod	1-5%	No	Native
Solidago rigida	Stiff Goldenrod	1-5%	Yes	Native
Eupatorium altissimum	Tall Boneset	1-5%	No	Native
Symphyotrichum leave	Smooth Blue Aster	1-5%	Yes	Native
Bidens sp	Beggerticks	1-5%	No	Native
Trifolium hybridum	Alsike Clover	1-5%	No	Non-native
Rubus occidenalis	Trailing Blackcap Raspberry	1-5%	No	Native
Lobilia siphilitica	Great Blue Lobelia	1-5%	Yes	Native
Helenium autumnale	Sneezeweed	1-5%	Yes	Native
Monarda fistulosa	Wild Bergamot	1-5%	Yes	Native
Ambrosia artimisifolia	Common Ragweed	1-5%	No	Native
Chamaerista fasciculate	Partridge Pea	1-5%	Yes	Native
Ratibida pinnata	Yellow Coneflower	1-5%	Yes	Native
Rudbeckia laciniata	Green Coneflower	1-5%	Yes	Native
Silphium perfoliatum	Cup plant	1-5%	No	Native
Plantago major	Plantain	1-5%	No	Non-native
Persicaria pensylvanica	Smartweed	0-1%	No	Native

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Verbascum thapsus	Mullein	0-1%	No	Non-native

Table 37-4 Species included in 23 pounds of unprocessed local native riparian seed. Individual species seed quantity unknown.

Scientific Name	Common Name
Elymus villosus	Silky Rye
Spartina pectinata	Cordgrass
Scirpus atrovirens	Green Bulrush
Scirpus cyperinus	Woolgrass
Agastache foeniculum	Giant Hyssop
Angelica atropurpurea	Angelica
Eutrochium maculatum	Spotted Joe Pye Weed
Heracleum maximum	Cow Parsnip
Rudbeckia laciniata	Green Coneflower
Thalictrum dasycarpum	Tall Meadow Rue
Vitis riparia	River Bank Grape

Appendix B: Site Photographs

Photo 37-1. Aerial view of project site taken after new construction in early summer 2019. Areas impacted by 2019 construction work is evidenced by bare soil. Unimpacted areas of the 2016 seeding project is the green herbaceous cover near the center of the photo.

Photo 37-2 Established area of 2016 seeding. Cottonwood seedlings can be seen beginning to establish, 08/16/2019.

Photo 37-3 Veiw from upland area of 2016 seeded area looking towards Whitewater River, 08/16/2019.

38) Sucker Channel Restoration

Project Background

Project Name: Vadnais-Snail Lake Regional Park Channel Restoration

Project Site: Vadnais-Snail Lake Regional Park

Township/Range Section: Township 30 Range 22 Section 19

Project Manager / Affiliated Organization: Ann WhiteEagle / Ramsey County Parks and Recreation Department

Fund: PTF ***Fiscal Year Funds:*** 2018

Project Start Date: 2018

Predominant Habitat type: Prairie / Savanna / Grassland

Additional Habitat types: Aquatic, Wetland

Project Status: Establishment Phase

County: Ramsey County

Primary Activity: Lake Shore Enhancement

Project Size: 550 linear ft, 0.25 acres

Project Completed: 2018

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***
   Project components associated with 2018 PFT funding include conversion of turf grass and rock/debris along stream/channel to native plant buffer. Related project components not associated with 2018 PFT funding include fishing access nodes, ADA accessible trails, signage, utilities and landscaping.

2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***
   Sucker Channel Fishing Node Implementation Construction Plan Set, 15-Sheets. Ramsey County Parks & Recreation Department. Vadnais-Snail Lakes Regional Park. July 7, 2017.
   Sucker Lake Channel – Planting Plan, 6-Sheets. Ramsey Conservation District. Vadnais Heights, MN. October 12, 2017 revision.

3. ***What are the stated goals of the project?***
   The Ramsey Conservation District (RCD) [currently a part of Ramsey County] partnered with the Vadnais Lake Area Water Management Organization (VLAWMO), St. Paul Regional Water Service (SPRWS), and

Ramsey County Parks and Recreation (RCPR) to restore and stabilize approximately 550 linear feet of streambank along the Sucker Lake Channel in northeastern Ramsey County. The Sucker Lake Channel is part of the Vadnais chain of lakes, which is the drinking supply for over 400,000 people, including the city of St. Paul and thirteen additional municipalities. The stated goals of the project are as follows:

- Protect drinking water
- Improve surface water quality
- Create habitat

4. ***What are the desired outcomes of achieving the stated goals of the project?***

   The following stated outcomes are the bases to achieving the state goals:

   - Reduce Total Phosphorus (TP)
   - Reduce Total Suspended Solids (TSS)
   - Reduce Stormwater Runoff

5. ***Were measures of restoration success identified in plans? No***
   If yes, list specific measurements.
   The following stated outcomes were excerpted from the BWSR grant application:

   - Decrease TP loading by 8.21 pounds per year
   - Reduce TSS loading by 4.60 tons per year
   - Reduce stormwater runoff into the Sucker Lake Channel by 13%, specifically 1,702 cu/ft annually
   - Native planting will act as a deterrent for waterfowl in accessing the shoreline of the channel and reduce the risk of a bacterial contamination

6. ***Are plan Sets available?*** Yes ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   Sheets BD 1.0 & BD 3.0 and Sheet L1.1 of the aforementioned plans (see response to Question #2) are included for reference in Appendix A.

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   This project is primarily a planting of native forbs and grasses. The provisions for weed suppression (hardwood mulch), herbivore exclusion (temporary fencing), pedestrian access/circulation restrictions (split rail fencing) and shoreline stabilization (coir bio-log) and the plants and planting are of current science.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   No

   No substantial changes were reported or witnessed.

9. ***In what ways did alterations change the proposed project outcome?***
   N/A

Site Assessment

Field Review Date: 9/11/2019

Field Visit Attendees: Michael Schumann–Ramsey County; Stephanie McNamara–VLAWMO; Dawn Tanner–VLAWMO; Wade Johnson–MnDNR; Kevin Biehn-EOR

10. ***Surrounding Landscape Characteristics:***
    The project is on the Sucker Lake Channel and is wholly contained within the Vadnais-Snail Regional Park. The Sucker Lake Channel is part of the Vadnais chain of lakes, which is the drinking supply for over 400,000 people, including the city of St. Paul and thirteen additional Municipalities. Vadnais-Snail Regional Park is a mosaic of forests, emergent marshes and small lakes; including Snail Lake, Grass Lake and Vadnais Lake. The project site is a center of recreation for the park with landscaping that is typical of a parkland setting; close cropped grass with a canopy of mature deciduous trees. It is bordered by Sucker Lake and channel to the east, mixed deciduous forests grading into marshland on the south and west, and Highway 96 on the north.

11. ***Site Characteristics:***
    a. ***Soil Series:***
       The site is completely composed of Blomford loamy fine sand which is a hydric soil which typically has a high water table (within 6 inches of surface) yet a fairly rapid infiltration rate (0.57 to 1.98 in/hr).
    b. ***Topography:***
       The planting bed generally slopes gently towards the Sucker Lake Channel.
    c. ***Hydrology:***
       The watershed has an average annual precipitation of 31.5”, which is increasing at a rate 0.3” per decade. Sucker Lake water levels fluctuate approximately 1-3 feet intra-annually based on data from 1983-1996.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
       The native planting was completed within 15 months of this evaluation, with positive planting establishment and minimal volunteer establishment thus far. As such the planted species comprise ≥ 90% of the vegetative cover. See Table 38-1 for the project planting list and associated plant sizes and quantities. The only volunteer species of note identified is Sandbar Willow, (Salix interior), which will require ongoing maintenance to minimize further establishment.
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
       A meander search was not completed given that the vegetation mirrors the planting plan at this early date.
12. ***Is the plan based on current science?*** Yes

The plan is generally based on current science. Of note - it is a relatively common practice to plant into coir logs, which was specified here. The common characteristics of the coir logs, including greatly fluctuating moisture, pose plant establishment challenges and as such, this application should be used cautiously.

A few of the specified plant species (e.g. Carex lacustris) do not match the characteristics (e.g. soil moisture) of the planting area.

13. ***List indicators of project goals at this stage of project:***
    The majority (≥ 70%) of the native plantings are taking hold and thriving. The provisions for herbivore and pedestrian restrictions appear to be adequate. Per project agreements, provisions for essential vegetation maintenance have been made.
14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    The stated levels of TP, TSS and/or stormwater runoff volume reductions may be difficult to achieve, as the BWSR calculator utilized may have overestimated returns. Regardless, the project is likely to achieve meaningful reductions.
15. ***Are corrections or modifications needed to achieving proposed goals?***
    No warranted modifications are apparent at this time
16. ***Do proposed or planned future steps, including long-term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    Without regular and indefinite vegetation maintenance, the site will tend towards a woody regime with turf grass and Reed canary Grass (Phalaris arundinacea) colonization as well. This situation is not unique to this project, but more challenging here given the small planting area and amount of associated edge.
17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    Other than the aforementioned maintenance requirements, no detractions are apparent.
18. ***Are follow-up assessments needed? Explain.***
    Since the project is straightforward and on a positive, albeit early trajectory, follow up visits are given a low priority.
19. ***Additional comments on the restoration project.***
    Greater environmental benefit would likely have been gained from a more robust plant buffer. Additionally, greater habitat and water quality returns could have been expected from a buffer that had more connectivity to the channel. As implemented, the buffer is isolated from the channel by the coir log and rock revetment.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    achieved the stated goals.
21. ***The project will:***

Minimally meet proposed outcomes

Confidence of outcome determination:

Medium

22. ***Provide explanation of reason(s) for determination.***

    It is too early in the vegetation establishment phase to confidently assume that the project will meet or exceed the stated measures of restoration success. Furthermore, the specified TP and TPP reductions appear to be high given the setting, which may be a product of overestimated returns via the BWSR Pollution Reduction Estimator calculations.

23. ***Site Assessor(s) Conducting Review:***

    Kevin Biehn - EOR

Appendix A: Site maps, Project plans or Vegetation tables

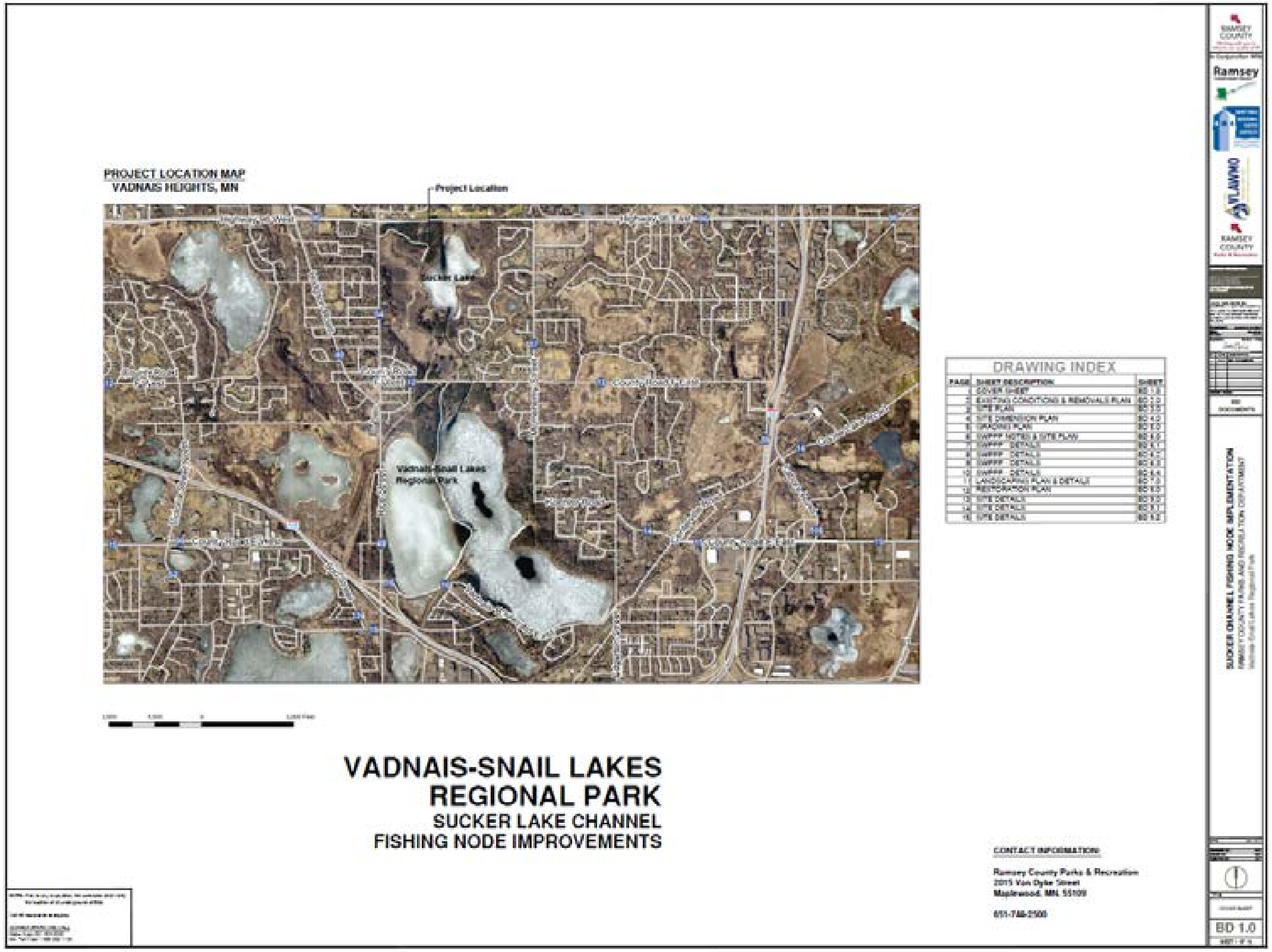


Figure 38-1 Cover Sheet (Sheet 1 of 15) of the Sucker Channel Fishing Node Implementation Construction Plan Set. Authored by Ramsey County Parks & Recreation Department for the Vadnais-Snail Lakes Regional Park. Dated July 7, 2017.

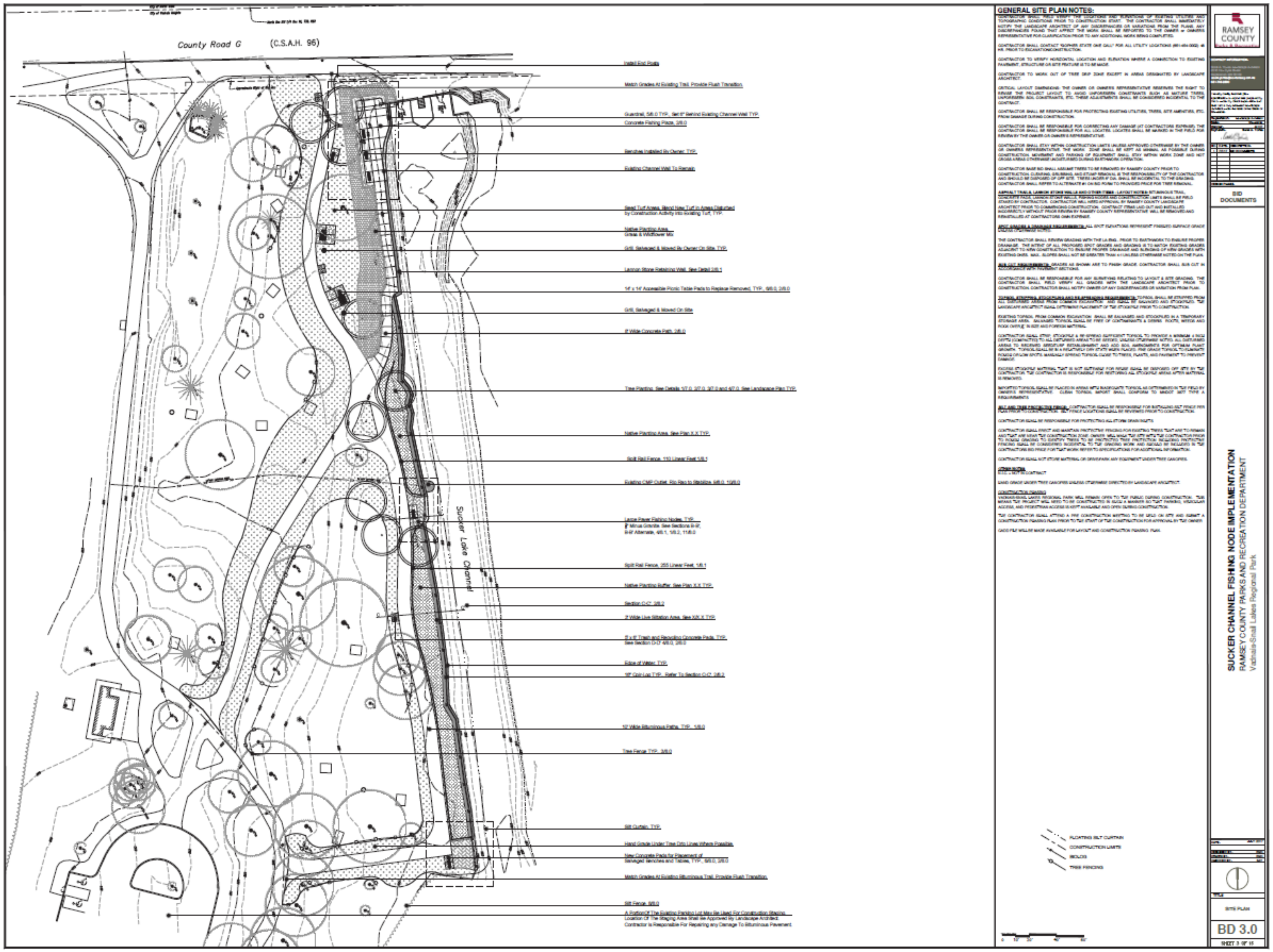


Figure 38-2 Site Plan (Sheet 3 of 15) of the Sucker Channel Fishing Node Implementation Construction Plan Set. Authored by Ramsey County Parks & Recreation Department for the Vadnais-Snail Lakes Regional Park. Dated July 7, 2017.

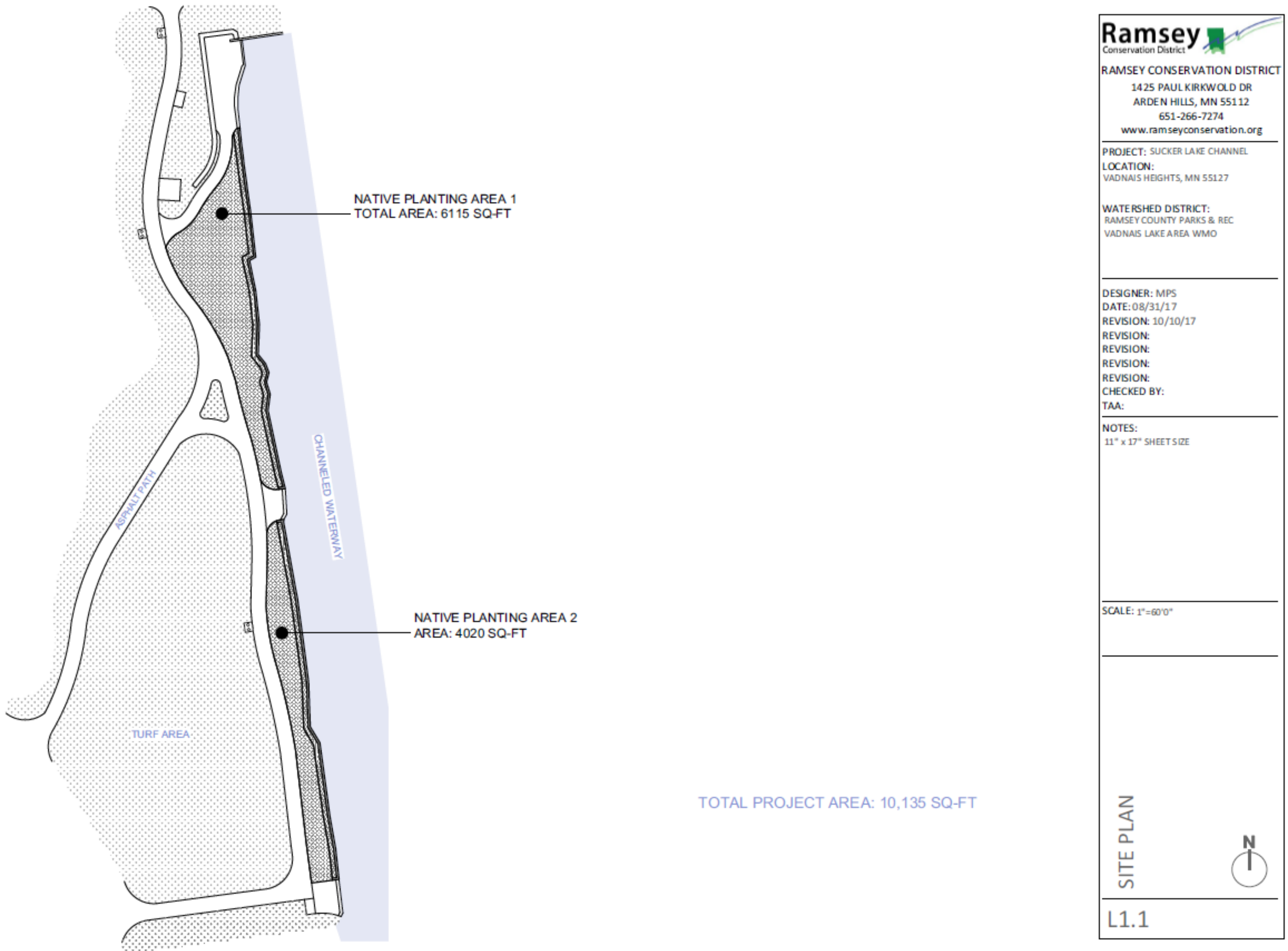


Figure 38-3 Site Plan (Sheet 1 of 6) of Sucker Lake Channel – Planting Plan. Authored by Ramsey Conservation District. Dated October 12, 2017.

Table 38-1 Planting list excerpted from Sucker Lake Channel – Planting Plan. Authored by Ramsey Conservation District. Dated October 12, 2017.

MASTER PLANT SCHEDULE					
ID	QTY	BOTANICAL	COMMON	SIZE	SPACING
S1	30	ARONIA MELANOCARPA	GLOSSY BLACK CHOKEBERRY	2 GALLON	48" O.C.
P1	48	ACORUS CALAMUS	SWEET FLAG	2" PLUG	24" O.C.
P2	258	AGASTACHE FOENICULUM	ANISE HYSSOP	2" PLUG	18" O.C.
P3	362	ASCLEPIAS INCARNATA	SWAMP MILKWEED	2" PLUG	18" O.C.
P4	132	CALAMAGROSTIS CANADENSIS	BLUE JOINT GRASS	4" POT	18" O.C.
P5	216	CAREX BEBBII	BEBB'S SEDGE	2" PLUG	18" O.C.
P6	48	CAREX COMOSA	BOTTLEBRUSH SEDGE	2" PLUG	24" O.C.
P7	62	CAREX CRINITA	FRINGED SEDGE	4" POT	18" O.C.
P8	96	CAREX HYSTERICINA	PORCUPINE SEDGE	4" POT	18" O.C.
P9	48	CAREX LACUSTRIS	LAKE SEDGE	2" PLUG	24" O.C.
P12	206	ECHINACEA PURPUREA	PURPLE CONEFLOWER	2" PLUG	18" O.C.
P13	136	EUPATORIUM PERFOLIATUM	BONESET	2" PLUG	18" O.C.
P14	392	HELENIUM AUTUMNALE	SNEEZEWEED	2" PLUG	18" O.C.
P15	132	IRIS VERSICOLOR	BLUE FLAG IRIS	4" POT	18" O.C.
P16	48	JUNCUS EFFUSUS	COMMON RUSH	2" PLUG	24" O.C.
P18	184	MIMULUS RINGENS	MONKEY FLOWER	2" PLUG	18" O.C.
P19	326	MONARDA FISTULOSA	BEEBALM	2" PLUG	18" O.C.
P20	152	PENSTEMON DIGITALIS	SMOOTH PENSTEMON	2" PLUG	18" O.C.
P21	244	PYCANTHEMUM VIRGINIANUM	VIRGINIA MOUNTAIN MINT	2" PLUG	18" O.C.
P22	156	SCHYZACHIRIUM SCOPARIUM	LITTLE BLUESTEM	2" PLUG	18" O.C.
P23	98	SCIRPUS ATROIRENS	GREEN BULRUSH	4" POT	18" O.C.
P24	124	SCIRPUS CYPERINUS	WOOLGRASS	4" POT	18" O.C.
P25	48	SPARGANIUM EURYCARPUM	GIANT BUR REED	2" PLUG	24" O.C.
P26	172	SPOROBOLUS HETEROLEPIS	PRAIRIE DROPSEED	2" PLUG	18" O.C.
P27	210	SYMPHYOTRICHUM NOVAE-ANGLEA	NEW ENGLAND ASTER	2" PLUG	18" O.C.
P28	384	ZIZIA AUREA	GOLDEN ALEXANDER	2" PLUG	18" O.C.
	4312	TOTAL			

Appendix B: Site Photographs

Photo 38-1 Before project photograph of planting area looking downstream (South). Image provided by Ramsey County, date 10/03/2017.

Photo 38-2 Representative image of native planting looking upstream (north). Photograph taken by Kevin Biehn during 9/11/2019 site visit.

39) Trout Brook Channel Restoration

Project Background

Project Name: Afton State Park Trout Brook Restoration

Project Site: Afton State Park, Washington County

Township/Range Section: Township 27N Range 20W Section 3

Project Manager / Affiliated Organization: Anton Benson / Minnesota Department of Natural Resources

Fund: PTF ***Fiscal Year Funds:*** 2016

Project Start Date: 10/2014

Predominant Habitat type: Aquatic Habitat

Additional Habitat types: Forest

Project Status: Post Establishment Phase

County: Washington County

Primary Activity: Stream/River Enhancement

Project Size: 3,500 linear feet

Project Completed: 12/2015

Project Goals and Planning

(Site Assessment Preparation from Plan Sets and Documents)

1. ***What are the specific project components and treatments?***

   There were ~26 improvement sites along a ~3,500-foot stretch of Trout Brook (Figure 39-1). Enhancement included but were not limited to the following types of treatments. All work was completed by hand labor and may have been modified from industry norms to account for associated limitation in material supply and construction.

- Removal of large debris jams (Photo 39-1).
- Installation of toewood structures
- Installation of j-hook structures and cross vanes (both wood, rock & combination structures)
- ‘Brush Bundle’ treatments for bank stability and channel narrowing
- Woody invasive species removal/treatment

2. ***What plans / record of project decisions / prescription worksheets are available? Provide location for the data?***

Formal plans were not available but the following documents articulate approach:

- PowerPoint presentation detailing work locations and treatments. Trout Brook – Upper Afton State Park Habitat Project v2, Nick Proulx, Fall 2014.

3. ***What are the stated goals of the project?***

   The primary goal of the project was to improve habitat for cold-water species including Brook & Brown Trout.

4. ***What are the desired outcomes of achieving the stated goals of the project?***

   The desired outcomes are to improve cold-water habitat throughout the project reach by:

- Increasing & maintaining deep pool habitat
- improve fish passage upstream
- accelerating legacy sediment transport downstream and sediment deposition on the floodplain

5. ***Were measures of restoration success identified in plans? No***
   If yes, list specific measurements.
   No measurements were explicitly stated, but one could readily infer the following:
   - Greater pool frequency/number and depth
   - Lessened passage barriers

6. ***Are plan Sets available?*** No ***Have project maps been created?*** Yes
   If yes, provide in Appendix A and list Maps provided:
   Map depicting location of work can be found in Appendix A

7. ***Provide list of best management practices, standards, guidelines identified in plan set? Are these based on best current science?***
   No construction plan set available.

Project Implementation

(Questions for Site Manager and Cooperating Professionals)

8. ***Were alterations made to the plan during project implementation?***
   Yes
   Per site assessment dialog with project stakeholders the original plan was deviated from in response to professional judgement, changed site conditions, available labor force and limited material supply.
9. ***In what ways did alterations change the proposed project outcome?***
   Given that the original plan was not available and limited specifics on alterations could be recalled, impact on project outcome is unknown.

Site Assessment

Field Review Date: **7/18/2019**

Field Visit Attendees:

- Anton Benson – MN DNR Parks and Trails
- Kevin Biehn – EOR (site assessor)
- Sue Galatowitsch – University of Minnesota (restoration evaluation panel member)
- Wade Johnson – MN DNR Ecological and Water Resources
- Nick Proulx – MN DNR Ecological and Water Resources
- Gina Quiram – MN DNR Ecological and Water Resources
- Nate Renk – MN DNR Parks and Trails

10. ***Surrounding Landscape Characteristics:***
    The reach of Trout Brook of interest resides within a Mesic Hardwood Forest, entirely within Afton State Park.

11. ***Site Characteristics:***
    a. ***Soil Series:***
       The dominate soil type the stream meanders through is Algansee loamy sand in the upper half and Chaska silt loam in the lower half.
    b. ***Topography:***
       Channel slope of reach of interest is ~1.0%. The typical floodplain width is ~300' and confined by ~200' vertical terraces.
    c. ***Hydrology:***
       The drainage area of the study area is roughly 6 square miles. Per Washington Conservation District automated stream-flow measurements from 2004-2006, typical Trout Brook base flows ranged from extended weeks around 4.5cfs to extended weeks less than 1cfs. Fourteen precipitation related spikes exceeding 15cfs were witnessed over the 3 years and three events exceeding 30cfs were recorded over this period of record. Average annual precipitation is about 31.5 inches.
    d. ***Vegetation A: Plant Communities, Dominant Species & Invasives % Cover:***
       Vegetation inputs were a minor component of this project. Aside from woody invasive species management, (initial cutting and some subsequent prescribed burns), the current vegetation composition was not significantly altered by this project. Per the current Minnesota Land Cover Classification System (MLCCS) the lower half of the project area is defined as Altered/non-native deciduous forest (42130) and the upper half is define as Oak forest mesic subtype (32112) and Floodplain forest silver maple subtype (32211).
    e. ***Vegetation B: Meander Search Species List (as appropriate for site)***
       See Appendix A for species identified via informal 7/18/2019 meander search

12. ***Is the plan based on current science?*** Yes

The practices employed, such as Toe-Wood, are common practices currently utilized on stream restoration / stabilization projects in Minnesota. The hand labor limitations (both material supply and installation) may have resulted in deviations from industry specifications.

13. ***List indicators of project goals at this stage of project:***
    The following indicators were visibly apparent during site assessment:
    - Passage – debris dams, which were causing aggradation and restricting fish passage have been removed; the formation of new debris dams was occurring (Photo 39-1 & Photo 39-2)
    - Pool number and depth – pools frequency and depth was not consistent, project improvement not likely (**Error! Reference source not found.**)

14. ***Does the project plan / implementation of the project plan reasonably allow for achieving proposed project goals?***
    Removal of debris jams was warranted and successfully accomplished. New debris jam formation should be monitored.
    Desired pool enhancement development has not occurred consistently and is not likely to be achieved by implementation.

15. ***Are corrections or modifications needed to achieving proposed goals?***
    Most of the sediment issues facing Trout Brook are thought to be bedload (filling in of pool habitat) & not streambank erosion. This reach is understood to have legacy sediments (predominately sand) that have been deposited across the floodplain and the stream is thought to be incised within this legacy sediment. The floodplain aggradation stemmed from the land use and land cover changes of the late 19th and early 20th centuries. Sediment deposition and lateral instability are apparent in aerial photography prior to the 1950's (**Error! Reference source not found.**). Given the complex legacy sand implications, the solution to achieve this may be complex and/or costly. Additional work was identified to address incised segments but was cut due to funding limitations.
16. ***Do proposed or planned future steps, including long term management, appear practical and reasonable? Were or are there any opportunities to improve project goals/outcomes? What are the potential challenges or limitations?***
    - Additional invasive species treatment work is planned (hand, mechanical forestry mower work, prescribed burn) was stated and is necessary to address the predictable dense germination of woody invasives stemming from woody removal.
    - Plans to reconnect an incised section of the stream channel to the floodplain using heavy equipment has been stated, but no known funding or plans are currently in place to do so though stakeholders continue to actively seek funding. Legacy sediment implications (stated in response to question #15) will pose design and funding challenges.

17. ***Do any of the project activities, planned or implemented, likely detract from existing or potential habitat? Explain.***
    No detractions are apparent or forecasted.

18. ***Are follow-up assessments needed? Explain.***

Follow up to this particular project on Trout Brook is not a priority. Removal of debris jams was warranted and successfully accomplished. Pool development has not occurred and is not likely to be achieved by implementation.

19. ***Additional comments on the restoration project.***
    There is value in understanding the financial contributions to a project and scaling the return on investment. Per dialog with project proposers, the total cost of the project was less than $10,000. This cost does not include in-kind state labor to assess the stream, prepare plans, garner/administer funding, nor manage construction.

Project Evaluation

Projects can be designated as likely to not meet proposed outcomes, minimally meet proposed outcomes, meet proposed outcomes, or exceed proposed outcomes with a low, medium or high degree of confidence in the determination.

20. ***The project has:***
    minimally achieved the stated goals.
21. ***The project will:***
    Minimally meet proposed outcomes
    Confidence of outcome determination:
    High
22. ***Provide explanation of reason(s) for determination.***
    Because the project successfully removed substantial barriers, but did not achieve pool development and the development of new debris jams may be occurring the project is expected to 'Minimally' meet proposed goals and outcomes. A high degree of confidence in this determination was given due to the legacy sediment implications and similar confirmation from professional project stakeholders.
23. ***Site Assessor(s) Conducting Review:***
    Kevin Biehn – EOR

Appendix A: Site maps, Project plans or Vegetation tables

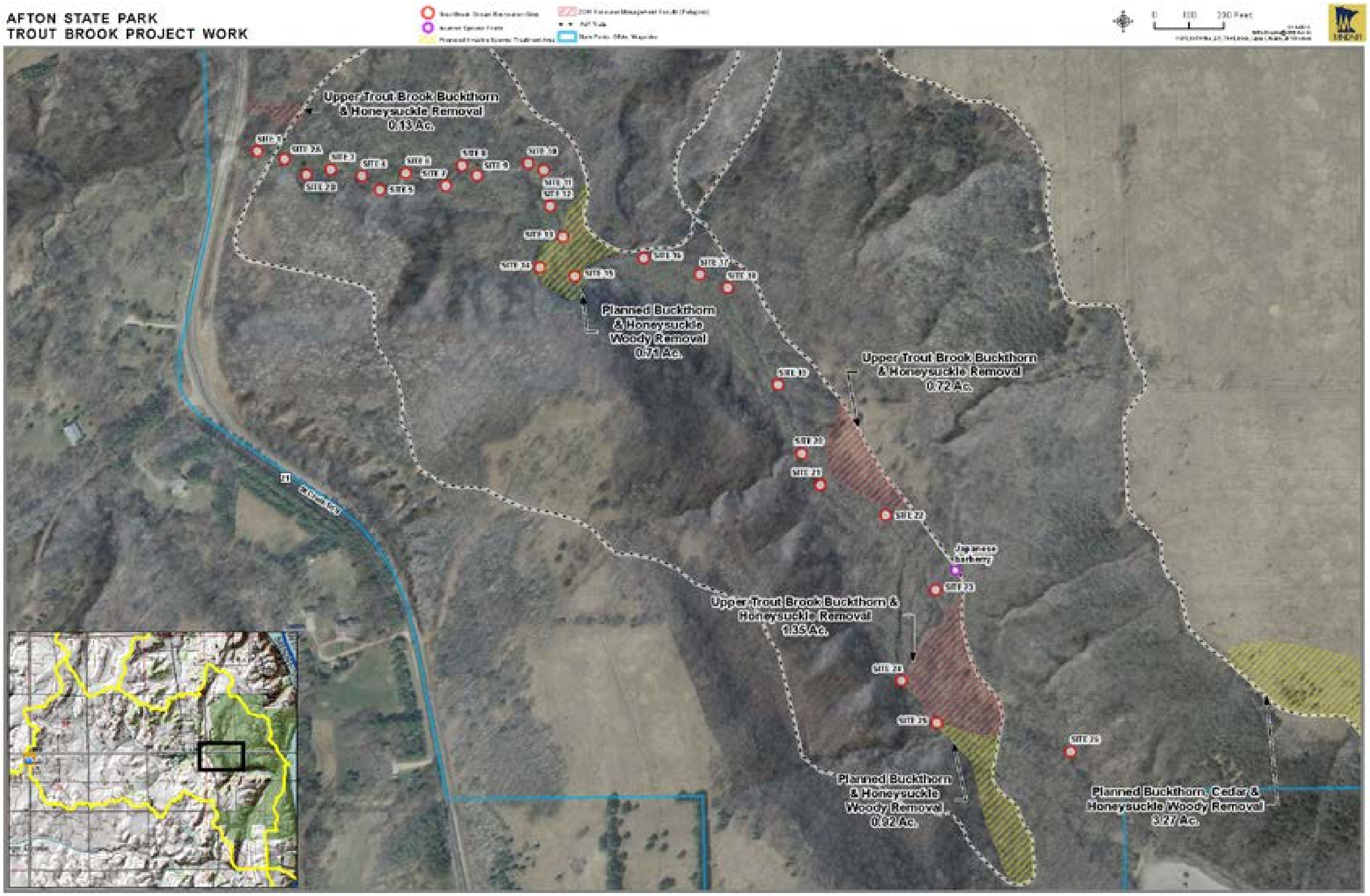


Figure 39-1 Map depicting the location of work on Trout Brook within Afton State Park. Map provided by MNDNR, dated 11/14/2014.

List 39-1 Calcification of work completed provided by project partners.

- Upper Afton State Park – in-channel projects Fall of 2014
- Clarifications regarding actual work completed
- Site 1 – Rocks were removed to restore targeted cross sectional area and j-hook constructed on the upstream end of pool.
- What worked: This was successful in terms of deepening the upstream pool. Once the rocks were removed a small headcut moved upstream to the grade control riffle just below the bridge (as planned). This removed some of the aggraded sand to create some depth, but not as much as we would have liked.
- What did not work: This blew out during the subsequent year (6” rain event).
- Likely cause: The log and sill were hand dug and did not get enough ballast to hold the structure.
- Site 2 – Was constructed as laid out in the document provided (Trout brook – Upper Afton State Park projectv2.pdf).
- What worked: A portion of the toewood constructed is still present, however roughly 40% was washed away. Woody debris was removed to reduce sand aggradation.
- What did not work: The grade control riffle is not functioning; few rocks remain. No additional pool depth was achieved.
- Likely cause: The grade control structure used rocks only large enough to carry by hand. Rocks needed to be larger to hold grade. In addition, the structure was built on a sand bed which was undermined during the flood event. An attempt was made by the crew to dig the aggraded sand out to find the original riffle material, but was not able to keep up with the sand material collapsing in on itself. The toewood partial failure was due to limitations of hand labor, specifically not enough ballast and logs were shorter than desired due to weight.
- Site 3 – Was constructed as planned, with the addition of a toewood structure. This change in plans was due to the channel being overwide and the need to narrow it up.
- What worked: Woody debris was removed to reduce sand aggradation. About 50% of the toewood is still present.
- What did not work: No additional depth was achieved
- Likely cause: Limitations of hand labor.
- Site 4 – constructed as planned. Removed debris, rerouted stream and created toewood. Used brush bundles to narrow stream.
- What worked: Debris was removed and the channel was rerouted. The toewood is buried but present.
- What did not work: Additional debris came in, which is causing some aggradation of sand. The brush bundles did not narrow stream.
- Likely causes: Upstream wood sources likely moved to this location.
- Site 5 – Was not constructed as planned. Just the debris removal took place.
- What worked: Woody debris was removed and gravel has been exposed in this segment. Some pool depths improved.
- Site 6 – Was constructed as planned

- What worked: Woody debris was removed and pool depth increased.
- Site 7 – Constructed as planned – removed woody debris and embedded the large log into the bank.
- What worked: Woody debris was removed, pool depth increased and the log remains in place with vegetation on the bench.
- Site 8 – reference site survey
- Site 9 – Constructed as planned. Woody debris removal and toewood.
- What worked: Woody debris was removed
- What did not work: Toe wood was blew out and no longer remains.
- Likely cause: Limitations of hand labor, in addition to the concerns for site 2, a large willow reduced the floodprone cross sectional area focusing the flood flows. This increased shear stress on the bank during the post project flood event.
- Site 10 – not constructed
- Site 11 – constructed as planned with the addition of a log step pool upstream of this location. The addition of this structure was to create pool habitat.
- Work did not work: Both structures were blown out, with only a few rocks remaining along the bank.
- Likely cause: Limitations due to hand labor – logs needed to be longer and dug into the banks much deeper.
- Site 12 – constructed as planned
- Work worked: Woody debris was removed and exposed some gravels.
- Site 13 – 15 – Constructed as planned, woody debris removal. In addition, one j-hook was installed and a log step pool at site 13.
- What worked: Woody debris was removed and pool depths increased as well as gravels are exposed.
- What did not work: J-hook and log step pool structures were blown out.
- Likely cause: Limitations due to hand labor – logs needed to be longer and dug into the banks much deeper.
- Site 16 – Constructed as planned.
- What worked: Adjusted the pool to pool spacing within reference conditions
- What did not work: The structures were modified by Park users (piled to create a crossing).
- Likely cause: Limitations of hand labor, rocks needed to be bigger and public interference.
- Site 17 – did not construct
- Site 18 – constructed as planned, stabilize head cut
- What did not work: Structure blew out.
- Likely cause: Limitations due to hand labor – logs needed to be longer and dug into the banks much deeper and rocks needed to be bigger.
- Site 19 – not constructed
- Site 20 – not constructed

- Site 21 – 23, 25 – Constructed as planned. Woody debris removal.
- What worked: Woody debris is removed and aggraded sand removed, increasing depth.
- Site 24 – constructed as planned. Toe wood structure.
- What worked: Portions of the toewood are still in place – approx. 40% and there is some minor improvement in pool depth.
- What did not work: Toewood partially blew out and the bench has been removed.
- Likely causes: limitations of hand labor, logs needed to be longer and dug in deeper.
- Site 26 – constructed as planned. Woody debris removal and creation of a log step pool.
- What worked: Woody debris has been removed and a slight increase in depth at the site. Removing this structure improved upstream pool depths just downstream of the walking bridge.
- What did not work: Log step pool structure was blown out. Some of the rocks used are still in place.
- Likely causes: limitations of hand labor, logs needed to be longer and dug in deeper.

Figure 39-2 Aerial Photo comparison of 1938 imagery (upper) and 2016 imagery (lower). Note lateral instability and aggradation of project area (1) apparent 1938 photograph.

Table 39-1 Meander Search Species List of Trout Brook corridor compiled by Kevin Biehn on 7/18/2019.

Scientific Name	Common Name	Cover Range	Species Planted/Seeded	Species Status
Acer negundo	Box Elder	5-25%	No	Native
Acer saccharinum	Silver Maple	1-5%	No	Native
Alliaria petiolate	Garlic Mustard	1-5%	No	Invasive
Amphicarpaea bracteata	Hog Peanut	5-25%	No	Native
Asclepias syriaca	Common Milkweed	1-5%	No	Native
Carex spp	Multiple Sedge species	5-25%	No	Native
Carpinus caroliniana	Blue Beech	1-5%	No	Native
Elymus hystrix	Bottlebrush grass	1-5%	Yes	Native
Glechoma hederacea	Ground Ivy	5-25%	No	Non-Native
Impatiens capensis	Jewelweed	5-25%	No	Native
Juglans nigra	Black Walnut	1-5%	No	Native
Laportea Canadensis	Canadian Wood Nettle	1-5%	No	Native
Leersia oryzoides	Rice Cutgrass	1-5%	No	Native
Ostrya virginiana	Ironwood	1-5%	No	Native
Phalaris arundinacea	Reed Canary Grass	5-25%	No	Invasive
Populus deltoides	Cottonwood	5-25%	No	Native
Rhamnus cathartica	Common Buckthorn	25-50%	No	Invasive
Salix nigra	Black Willow	5-25%	No	Native
Sambucus canadensis	Common Elderberry	1-5%	No	Native
Urtica dioica	Stinging Nettle	1-5%	No	Native

Appendix B: Site Photographs

Photo 39-1 Representative photograph of pre-project debris jam and associated barrier to fish passage, taken at Site 26. Image provided by MNDNR, date unknown.

Photo 39-2 Representative image of formation of new debris jam within project area. Photograph taken by Kevin Biehn during 7/18/2019 site visit.

Photo 39-3 Representative images of both low gradient (left) and high gradient (right) reaches of project area. Note lacking pool frequency & depth in both images and sand substrate in lower gradient stretches (left). Photos taken by Kevin Biehn on 7/18/2019.

Photo 39-4 Photograph of Toewood Stabilization (right side of photo) constructed by hand labor. Structure has degraded substantially in 4 to 5 years since installation but is still provide some habitat and stability benefit. Photograph taken by Kevin Biehn during 7/18/2019 site visit.