

Technical Memo



Responsive partner.
Exceptional outcomes.

To: Margaret Johnson, Middle Fork Crow River Watershed District

From: Lucius Jonett, Wenck Associates, Inc.

Copy: Jon Morales, Middle Fork Crow River Watershed District

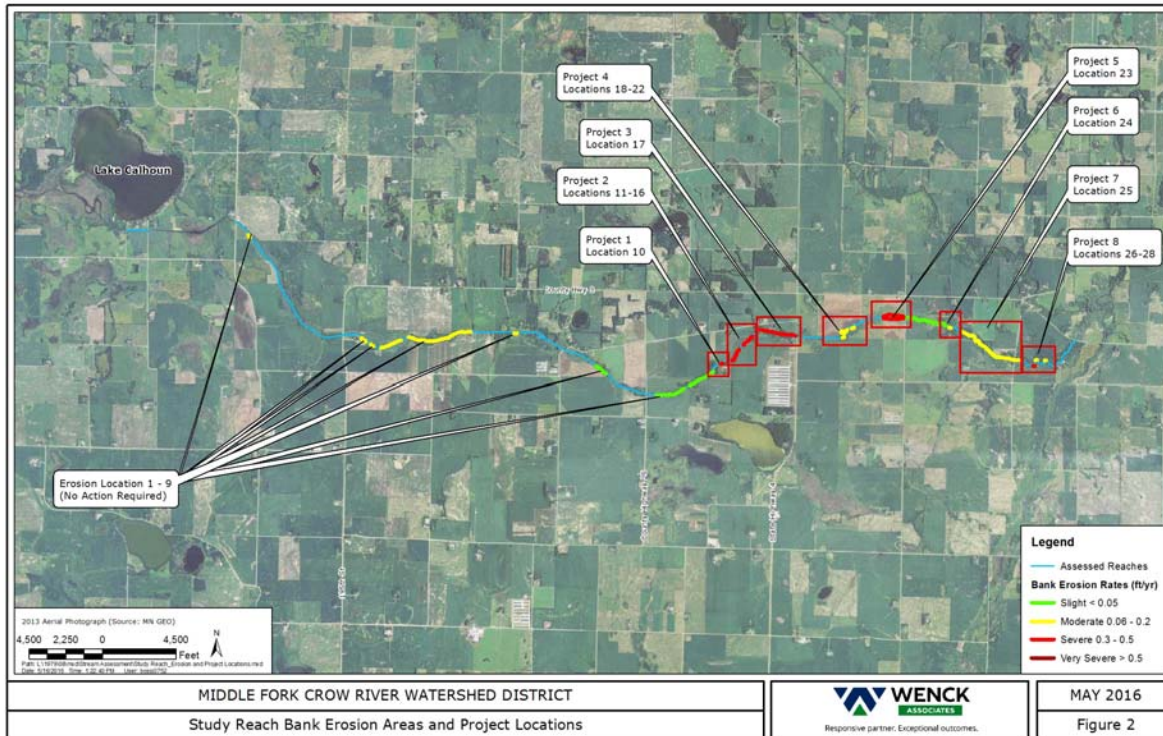
Date: May 20th, 2016

Subject: Middle Fork Crow River Stream Bank Stabilization Projects

Introduction

On October 14th and 15th of 2015, Wenck staff and district staff floated down the Middle Fork of the Crow River from Lake Calhoun to the confluence with the North Fork Crow River to do an assessment of the current conditions of river banks. Locations of erosion were logged with survey equipment, measurements were taken, and photographs were taken. Full sized maps of figures shown are attached at the end of this memo.

Following the field work, Wenck reviewed the data to estimate erosion rates and amounts at each location and attributed severity based upon erosion rates (ft/yr). We then prepared conceptual designs for the erosion locations with moderately-high to severe erosion features and combined locations into projects 1 – 8 based on proximity to one another, access, and number of landowners. A construction cost estimate was prepared for each concept project design and compared to the estimated reductions of erosion to rank the projects based on the dollars per pounds of sediment and phosphorous removed annually from lowest to highest.



Streambank Stabilization Practices

Each streambank stabilization concept design recommends specific stabilization techniques for mitigating erosion and creating long-term solutions to the current issues. Each stabilization practice will be briefly explained and accompanied with images and/or typical construction details. *All figures and details created by Wenck unless otherwise noted.*

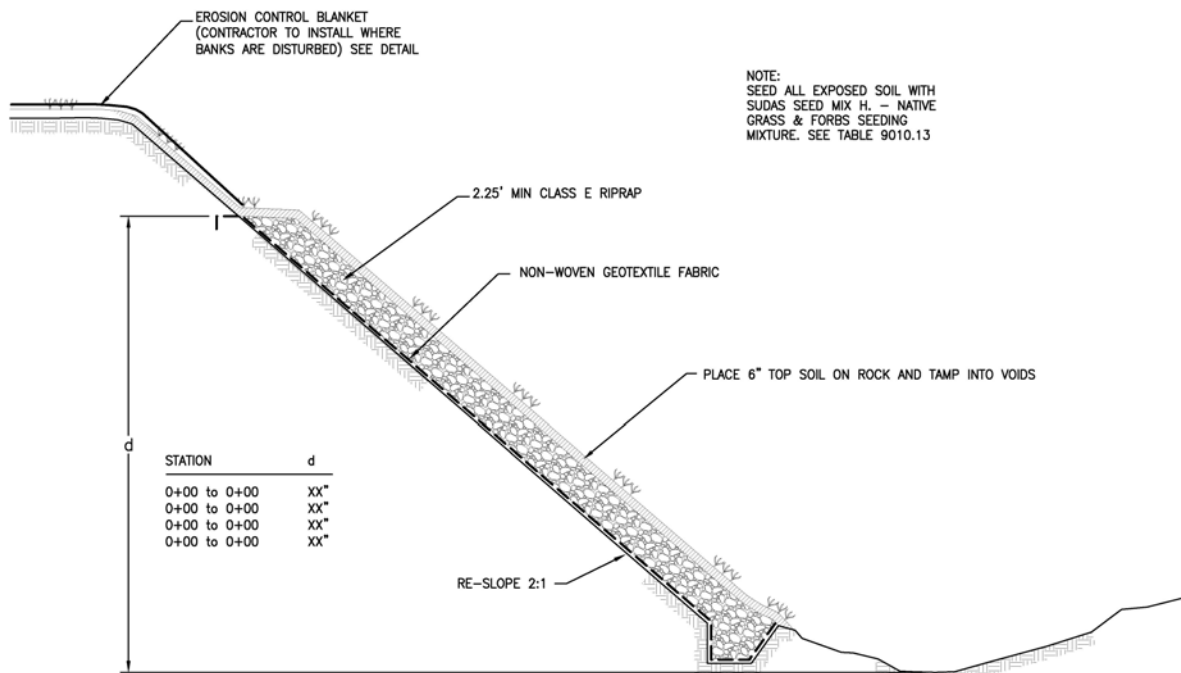
Vegetated Riprap

Vegetated riprap is a slope stabilization technique to be used in instances where flow velocity (5 – 20 CFS) requires hard armoring (rock) instead of bioengineered techniques. Vegetation adds a more natural aesthetic by camouflaging the rock.

Vegetated riprap is intended to provide toe protection on taller (> 4'), vertical, eroding stream banks. Riprap would be installed at the existing toe line of the side slopes and be keyed in slightly below the stream bed. Some bank disturbance would be required to make the vertical bank less steep (ideally, 2:1 H:V or less) by grading from the top of the bank to the new riprap toe. Final stabilization of the riprap toe areas would include revegetation with native seed and either erosion control blanket along the channel where high flows are expected and straw mulch or hydro-mulch in the upland areas. Riprap toe would follow the existing bank, would balance cut and fill on site and would not alter the channel cross section.



Figure 1: Vegetated Riprap Channel, 1 year after construction.



VEGETATED RIPRAP DETAIL
 NOT TO SCALE

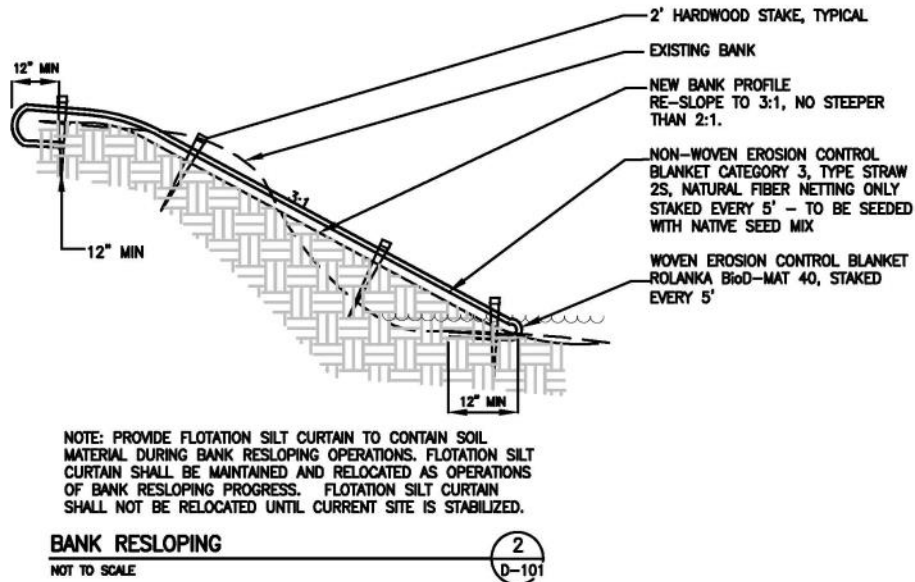
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Bank Resloping with seed & erosion control blanket

Bank resloping is a bioengineering stabilization technique to be used in instances where flow velocity allows (<6 CFS) and/or for the portions of the bank above the normal high water level of a channel. Bank resloping is intended to establish native vegetation and provide toe protection on shorter (<3'), steep stream banks. Resloping the bank ranges from 3:1 (H:V) or less (preferred), to no steeper than 2:1. It is intended to provide a stable slope for new vegetation to establish. The roots of the vegetation hold the slope during periods of inundation and reduce soil migration.



Figure 2: Resloped Banks Constructed During Winter Work on Elm Creek.



Tree Thinning/Tree Removal

Thinning existing trees to presettlement vegetation densities of 5 – 10 trees per acres, allows for more sunlight to reach the soil. Increased sunlight encourages the amount and vigor of ground plane grasses thus mitigating soil movement into adjacent waterbody's.



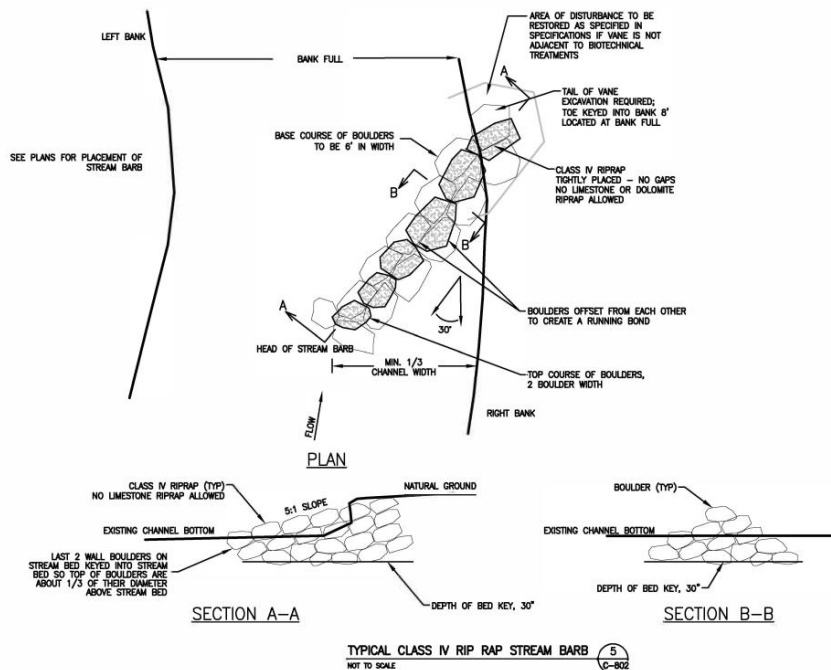
Figure 3: One year after clearing trees, the existing seed bank grew into a healthy grass buffer on Coon Creek

Stream Barbs

Stream barbs are a descending trapezoidal mass of rock, pointed upstream extending from the center of the channel back into the adjacent bank. Stream barbs serve to redirect erosive force within the stream channel back toward the center of the channel and away from the banks. On the downstream side, at approximately 5 times the length of the barb, water flow experiences reduced velocity and erosive action allowing sedimentation to occur.

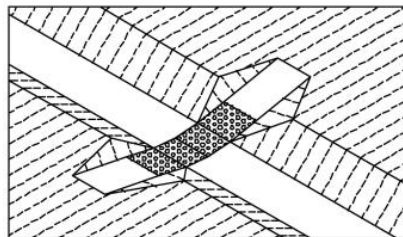


Figure 4: Three stream barbs to turn the flow of Purgatory Creek away from sharp outside bend.



Cattle Crossing & Exclusion Fencing

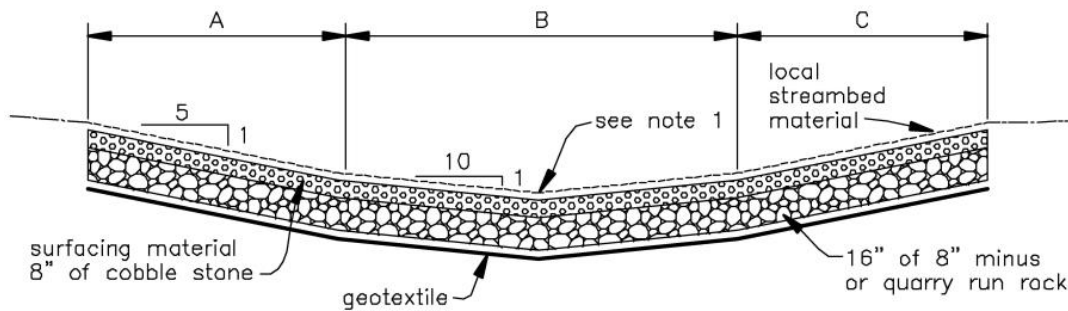
Cattle crossing and exclusion fencing serves to prevent the overgrazing of bank vegetation and trampling of stream banks while still allowing livestock access to water and pastures on the opposite side. Disturbance and erosion of the stream bed and banks is minimized by only allowing access and crossing of the stream in select locations that have been designed and constructed to be stable under cattle and equipment traffic.



ISOMETRIC

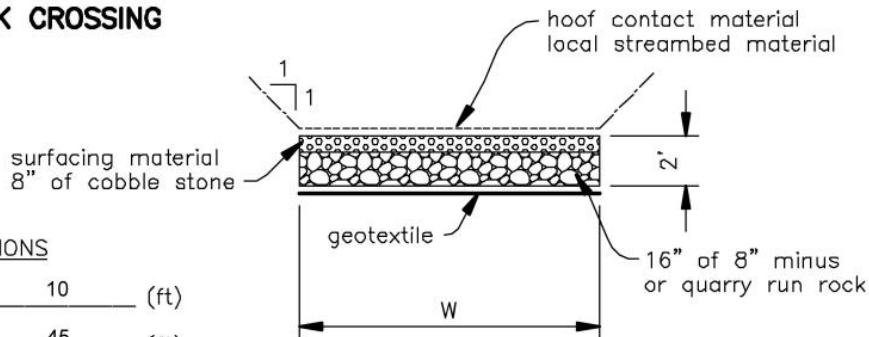
CONSTRUCTION NOTES

1. Crossing surface shall be a minimum of 0.2 ft below channel invert.
2. Surfacing material shall be compacted as per method (4) of CS-15.6.



CENTERLINE PROFILE

LIVESTOCK CROSSING



SECTION

DIMENSIONS

A = 10 (ft)

B = 45 (ft)

C = 10 (ft)

W = 15 (ft)

Station _____

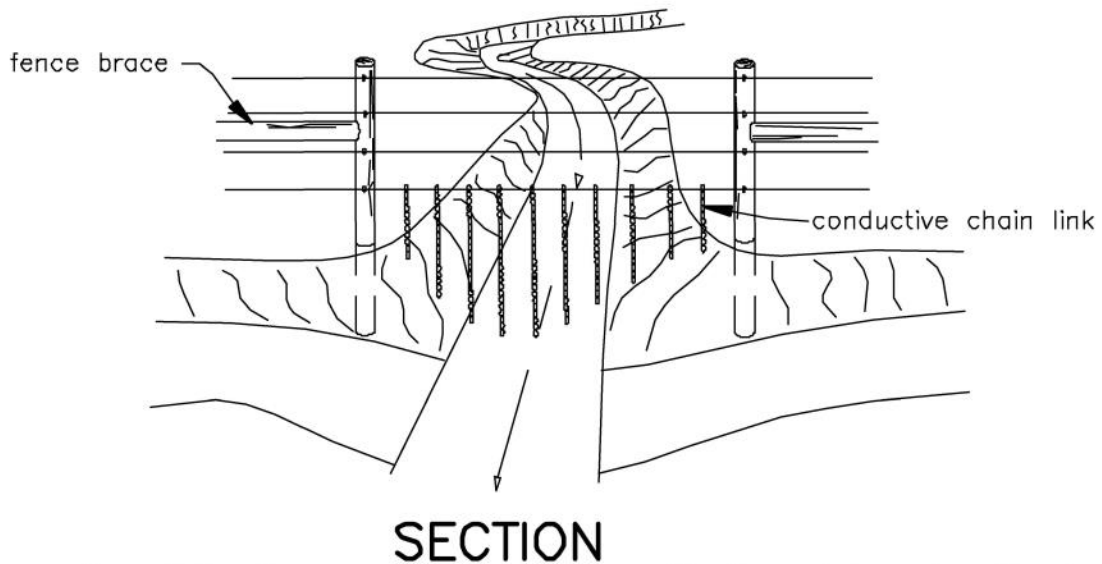
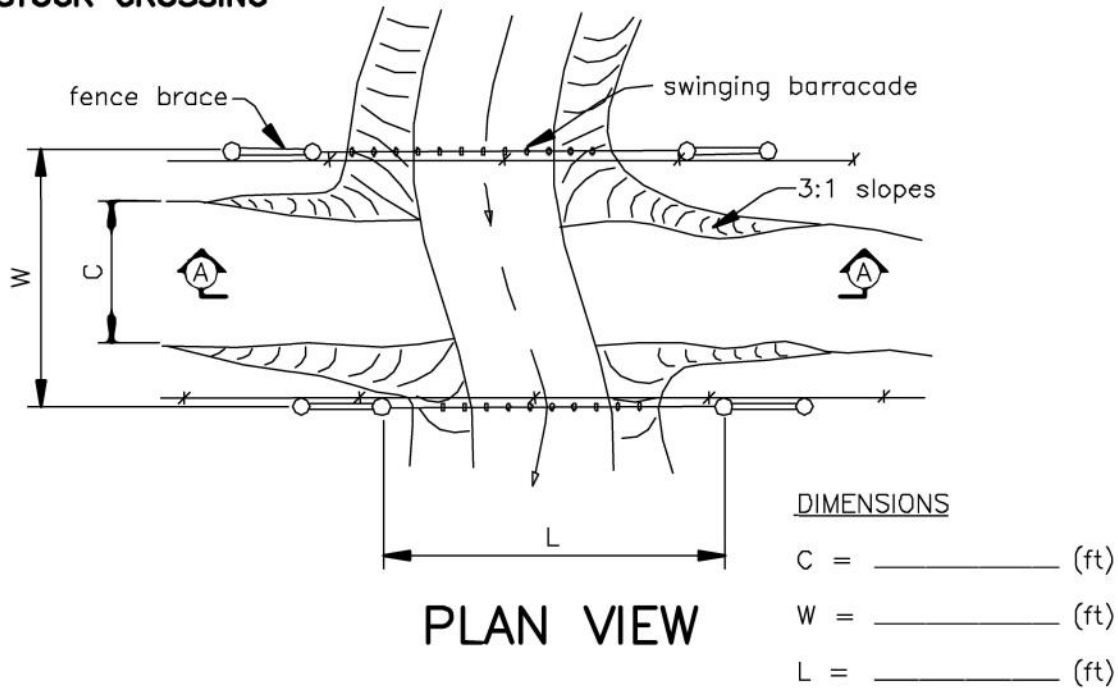
Drawing not to scale.

NOTE:

This standard drawing requires supporting technical documentation prior to use and must be adapted to the specific site.

Note: Construction Details by NRCS

LIVESTOCK CROSSING



Fence must meet Practice Standard No. 382.

Drawing not to scale. Standardized drawing must be adapted to the specific site.

Note: Construction Details by NRCS

1 Rod Buffer

1 rod = 16.5 ft. Buffers stabilize the ground surface near waterways from overland flow, as well as, filter sediments out of stormwater runoff from surrounding areas by reducing flow velocity. Bare farm fields and paved surfaces in particular can contribute sediment into adjacent waterways. Implementation of the new MN Buffer Law will help stabilize the banks and improve water quality and habitat of the Middle Fork Crow River.

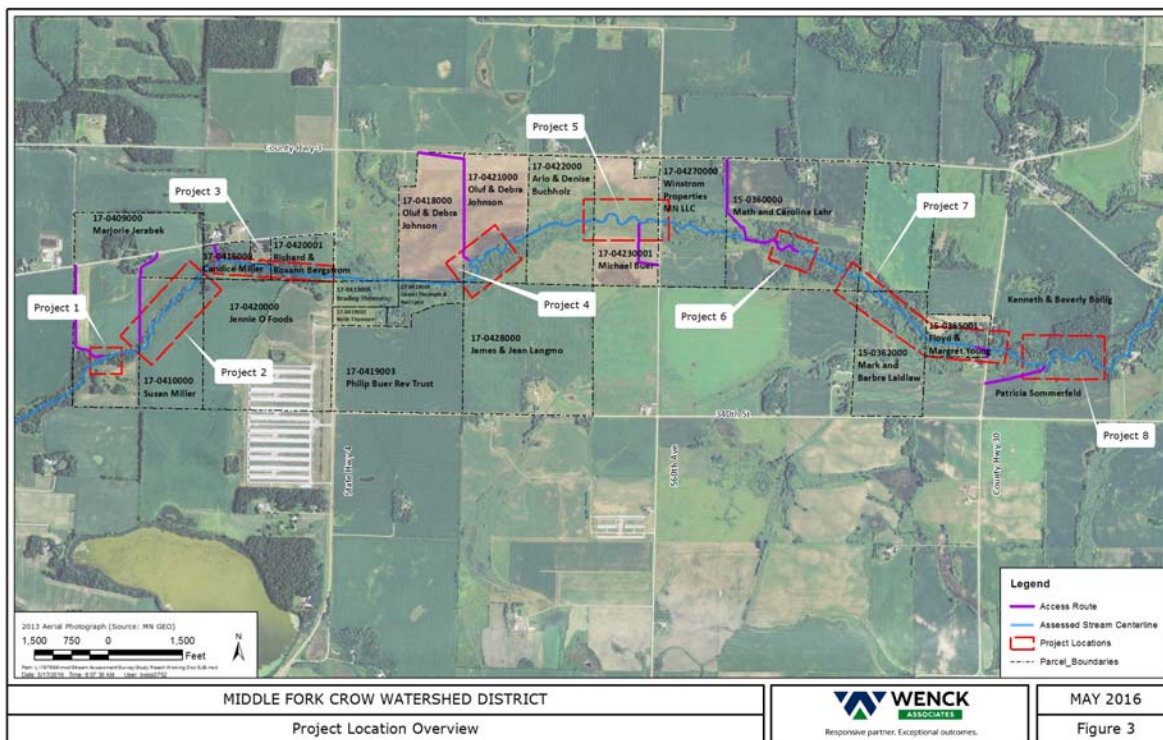


Figure 5: An established grassed buffer. Photo by MN DNR.

Streambank Stabilization Concept Plans

Each of the erosion locations identified from the field visit with a moderate-high to severe erosion rates were grouped into conceptual designs based on location, proximity to other features, access and number of homeowners into feasible construction projects. Refer to the Project Location Overview (Figure 3) map for the locations of each project within the assessed length of the Middle Fork Crow River.

Project Location Overview (Figure 3)



Erosion locations 1 through 9 were assessed using the WI NRCS recession severity classification and fell below the threshold of this document, thus no corrective action is needed at this time. These areas were not included in the project location overview. See table 1, at the end of the document for more detailed information of the erosion locations: Length, Height, Rescission rate, Volume in ft³, and recommended stabilization technique.

Concept Plan 1 (Figure 3A)



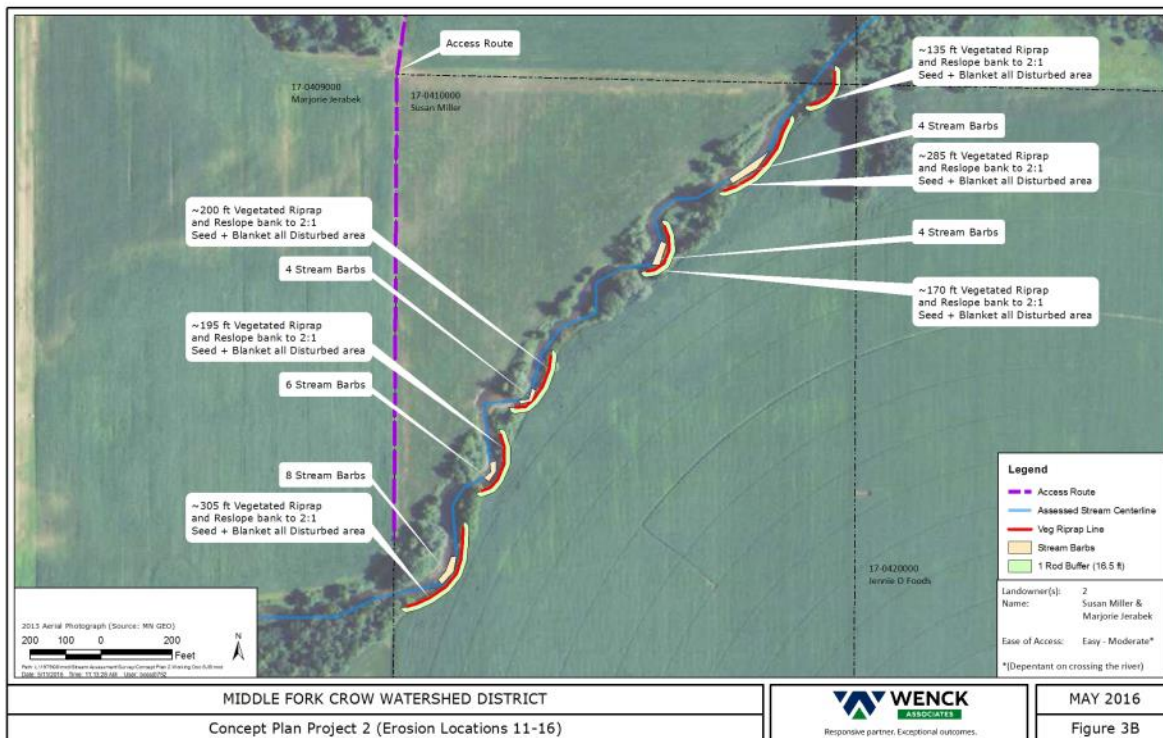
At erosion location 10, river banks are severely eroding for approximately 170 ft. on both sides and have an eroded vertical face of 4 ft. The erosion is due to do a bridge located directly upstream that creates a restriction in flow, a hydraulic jump and circulating eddies coming off the downstream flow onto the embankments. To minimize the current scour, collapse and erosion, both banks will need the toe protected in with vegetated riprap and regraded to a slope of 2:1 (3:1 if possible). In order to accomplish the regrading and allow sunlight to penetrate the new grade trees will need to be removed directly upslope from the affected area.



BID TABULATION					
No.	Item	Units	Qty	Unit Price	Total
1	Mobilization/Demobilization	LS	1	\$ 2,000.00	\$ 2,000.00
2	Site Access & Restoration	LS	1	\$ 5,000.00	\$ 5,000.00
3	Tree Removal	LS	1	\$ 7,500.00	\$ 7,500.00
4	Bank Resloping	LF	340	\$ 10.00	\$ 3,400.00
5	Class II Rip Rap (Veg. Riprap)	TON	150	\$ 120.00	\$ 18,000.00
6	Geotextile (MnDOT typ. 5)	SY	420	\$ 5.00	\$ 2,100.00
7	Floating silt curtain	LF	100	\$ 20.00	\$ 2,000.00
8	Erosion Control Blanket	SY	490	\$ 3.00	\$ 1,470.00
9	Seeding (MN state mix 34-261)	SY	490	\$ 2.00	\$ 980.00
SUBTOTAL					\$ 42,450.00
20% CONTINGENCY					\$ 8,490.00
TOTAL					\$ 50,940.00

Cost Estimate for Concept Plan 1

Concept Plan 2 (Figure 3B)



At erosion locations 11 – 16, river banks are severely eroding on the outside bends for approximately 1290 ft. and have an eroded vertical face from 4 - 12 ft. To stabilize the

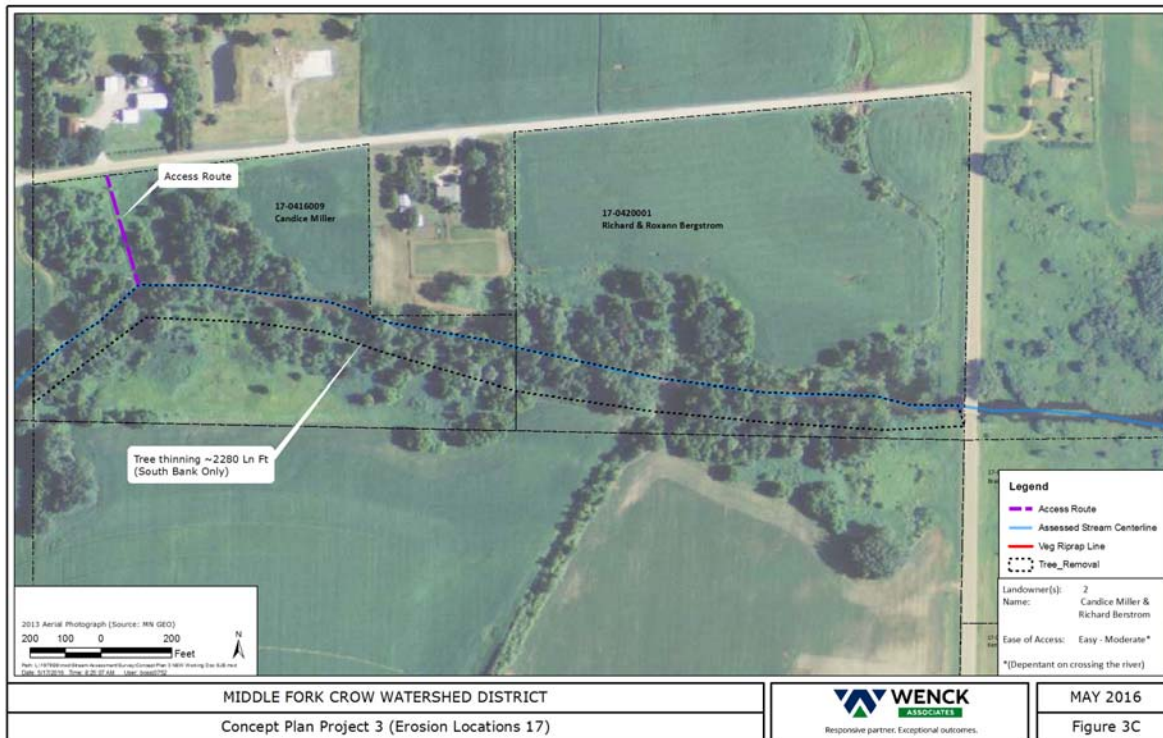
erosion, banks will need to be regraded to a slope of 2:1 with the toe protected with vegetated riprap. If the landowner isn't willing to loose land for the 2:1 slope a steeper slope will need to be explored. In addition to the vegetated riprap, 26 stream barbs are proposed to redirect erosive force within the stream channel back toward the center of the channel and away from the banks. In order to mitigate the runoff coming off of the adjacent farm field upslope enforcement of the 1 rod buffer should also be invoked.



BID TABULATION					
No.	Item	Units	Qty	Unit Price	Total
1	Mobilization/Demobilization	LS	1	\$ 13,000.00	\$ 13,000.00
2	Site Access & Restoration	LS	1	\$ 10,000.00	\$ 10,000.00
3	Bank Resloping	LF	1290	\$ 10.00	\$ 12,900.00
4	Class II Rip Rap (Veg. Riprap)	TON	535	\$ 120.00	\$ 64,200.00
5	Class III Rip Rap (Stream Barbs)	TON	400	\$ 130.00	\$ 52,000.00
6	Geotextile (mnDOT typ. 5)	SY	1615	\$ 5.00	\$ 8,075.00
7	Floating silt curtain	LF	50	\$ 20.00	\$ 1,000.00
8	Erosion Control Blanket	SY	2315	\$ 3.00	\$ 6,945.00
9	Seeding (MN state mix 34-261)	SY	2315	\$ 2.00	\$ 4,630.00
				SUBTOTAL	\$ 172,750.00
				20% CONTINGENCY	\$ 34,550.00
				TOTAL	\$ 207,300.00

Cost Estimate for Concept Plan 2

Concept Plan 3 (Figure 3C)



At erosion location 17, the river has been straightened and the channel is over-widened, incised or confined by flood and spoil deposition on the banks. River banks are severely eroding for approximately 2280 ft. while the channel runs through the floodplain forest. Erosion is noticeably worse in this reach compared to the next reach that is also straightened but has much less tree density and more extensive grass ground cover. To minimize the current erosion, and mimic the more stable reference reach downstream, the existing tree canopy should be thinned on the southern bank to allow sunlight to penetrate the areas on both banks for stabilizing grasses to germinate and grow. This project could be accomplished by a crew of Conservation Corps employees over approximately a three week period.

Two options exist for Conservation Corps workers:

1. Hire crew for full price of \$1,500.00 per day plus the cost of the seed and herbicide associated with the project.
2. Apply for a project grant which the labor cost is 25% of the estimated cost. The district would have to supply the seed and the herbicide (Garlon 4)

BID TABULATION (NO GRANT)					
No.	Item	Units	Qty	Unit Price	Total
1	Tree Removal (CC-MN)	DAYS	12	\$ 1,500.00	\$ 18,000.00
2	Seeding (MN state mix 34-261)	LBS	180	\$ 20.00	\$ 3,600.00
3	Herbicide Treatment	Gallon	35	\$ 111.00	\$ 3,885.00
SUBTOTAL					\$ 25,485.00
20% CONTINGENCY					\$ 5,097.00
TOTAL					\$ 30,582.00

BID TABULATION (WITH GRANT)					
No.	Item	Units	Qty	Unit Price	Total
1	Tree Removal (CC-MN)*	DAYS	12	\$ 1,500.00	\$ 4,500.00
2	Seeding (MN state mix 34-261)**	LBS	180	\$ 20.00	\$ 3,600.00
3	Herbicide Treatment***	Gallon	35	\$ 111.00	\$ 3,885.00
* With Grant labor rate is 25% of total cost					
* (30 lbs/Acre x 6 Acres)					
** (6 Quarts/Acre x 6 Acres)					
SUBTOTAL					\$ 11,985.00
20% CONTINGENCY					\$ 2,397.00
TOTAL					\$ 14,382.00

Cost Estimate for Concept Plan 3

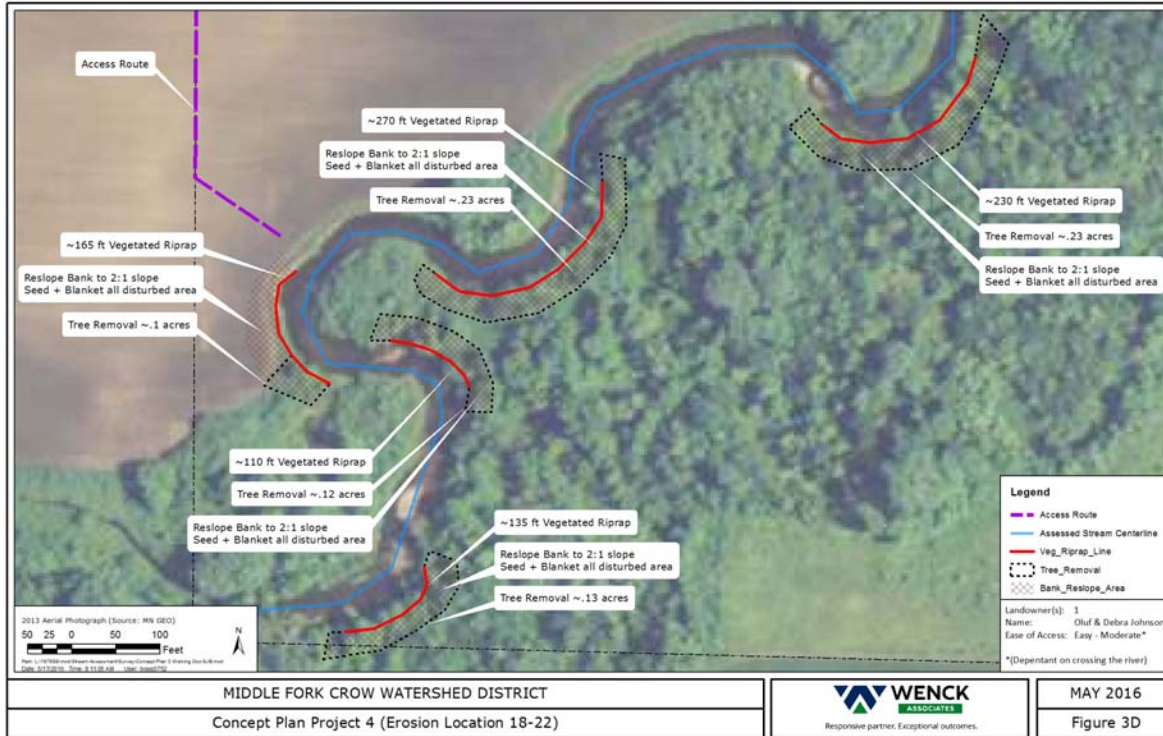


Lack of groundcover vegetation and eroding banks on erosion location 17.



Downstream reach with less tree canopy and more extensive grass ground cover.

Concept Plan 4 (Figure 3D)



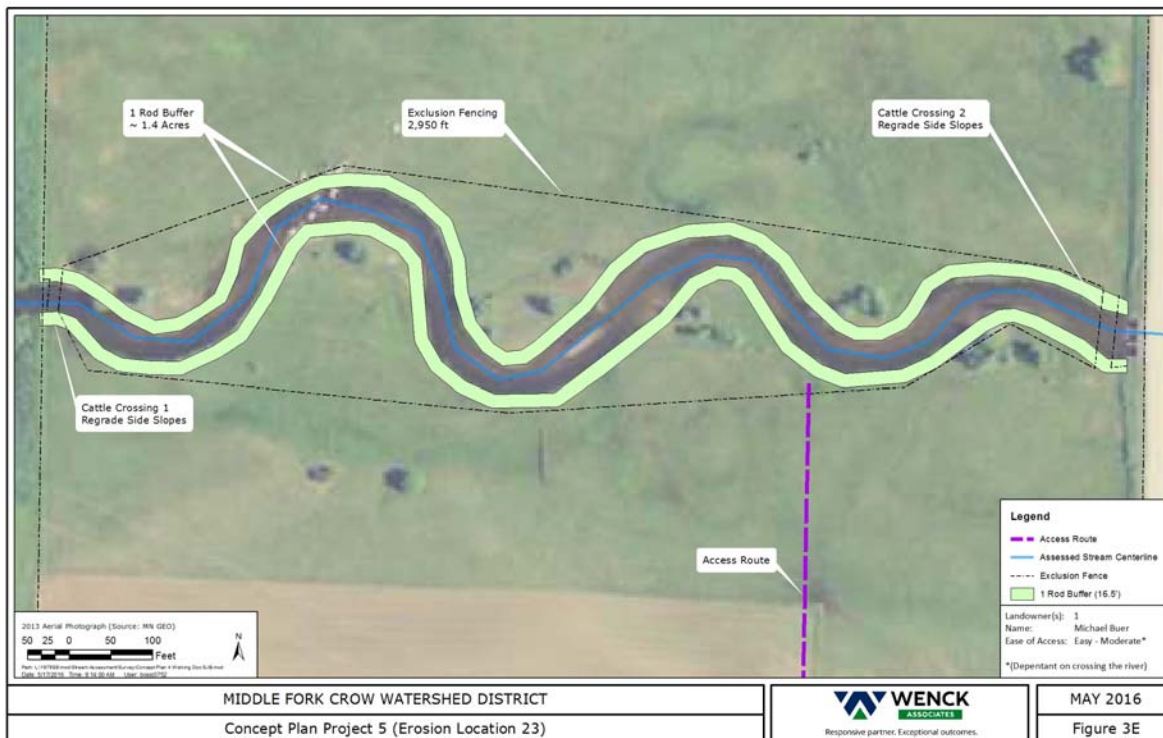
At erosion locations 18 - 22, river banks are moderately eroding on the outside bends for approximately 910 ft. and have an eroded vertical face of 4 ft. To minimize the current erosion, banks will need to be regraded to a slope of 2:1 with the toe protected with vegetated riprap. In order to accomplish the regrading and allow sunlight to penetrate the new grade trees will need to be removed directly upslope from the affected area for stabilizing grasses.



BID TABULATION					
No.	Item	Units	Qty	Unit Price	Total
1	Mobilization/Demobilization	LS	1	\$ 4,000.00	\$ 4,000.00
2	Site Access & Restoration	LS	1	\$ 2,000.00	\$ 2,000.00
3	Tree Removal (CC-MN)	LS	1	\$ 8,500.00	\$ 8,500.00
4	Bank Resloping	LF	910	\$ 10.00	\$ 9,100.00
5	Class II Rip Rap (Veg. Riprap)	TON	380	\$ 120.00	\$ 45,600.00
6	Geotextile (mnDOT typ. 5)	SY	1140	\$ 5.00	\$ 5,700.00
7	Floating silt curtain	LF	50	\$ 20.00	\$ 1,000.00
8	Erosion Control Blanket	SY	1315	\$ 3.00	\$ 3,945.00
9	Seeding (MN state mix 34-261)	SY	1315	\$ 2.00	\$ 2,630.00
				SUBTOTAL	\$ 82,475.00
				20% CONTINGENCY	\$ 16,495.00
				TOTAL	\$ 98,970.00

Cost Estimate for Concept Plan 4

Concept Plan 5 (Figure 3E)



At erosion location 23, river banks are severely eroding for approximately 3400 ft. on both sides and have an eroded vertical face up to 3 ft. The erosion is due to do cattle watering and crossing the river. To minimize the current erosion, we recommend adding 2 specific

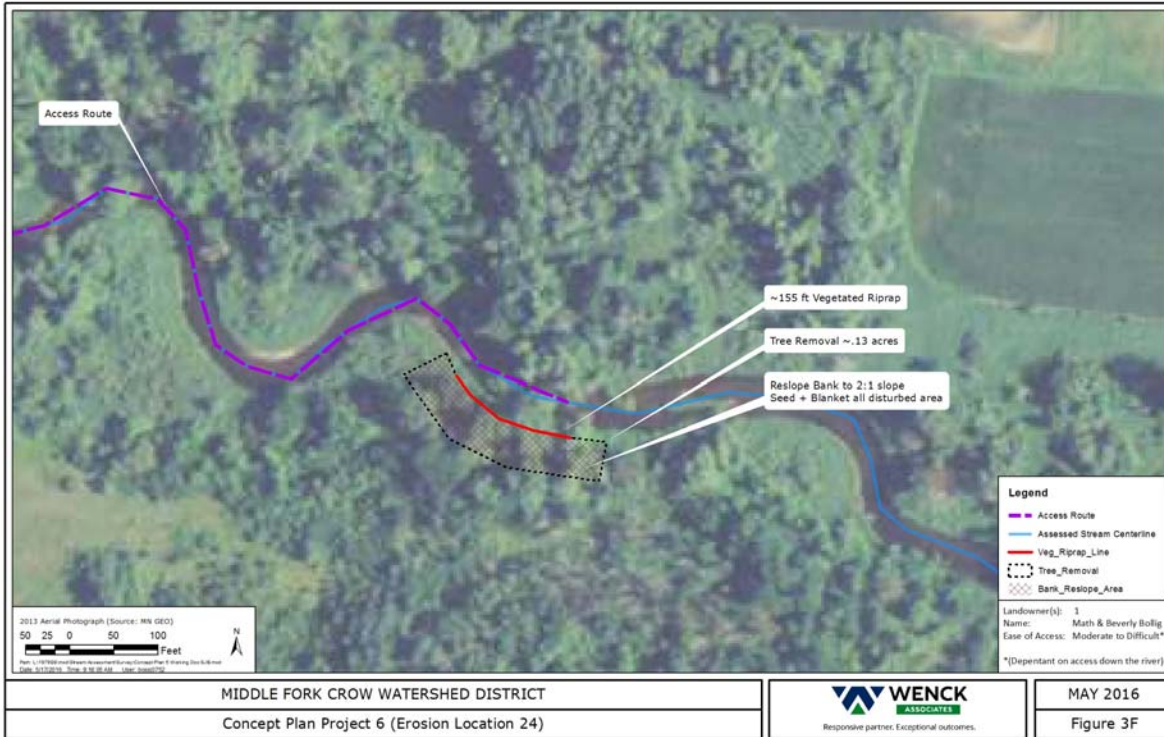
cattle crossing/watering points with reinforcement gravel on the property and installing exclusion fencing in all other areas along the river. Enforcement of the 1 rod buffer should also be invoked to increase the vegetation height and rooting depth of grasses to secure the river banks.



BID TABULATION					
No.	Item	Units	Qty	Unit Price	Total
1	Mobilization/Demobilization	LS	1	\$ 2,500.00	\$ 2,500.00
2	Grading	CY	40	\$ 40.00	\$ 1,600.00
3	Fencing (3 lines w conductive chain over stream)	LF	3600	\$ 5.00	\$ 18,000.00
4	Filter Agregate	TON	70	\$ 80.00	\$ 5,600.00
5	Class II Rip Rap	TON	130	\$ 120.00	\$ 15,600.00
6	Geotextile (mndOT typ. 5)	SY	75	\$ 5.00	\$ 375.00
7	Floating silt curtin	LF	100	\$ 20.00	\$ 2,000.00
8	Erosion Control Blanket	SY	435	\$ 3.00	\$ 1,305.00
9	Seeding (MN state mix 34-261)	SY	435	\$ 2.00	\$ 870.00
				SUBTOTAL	\$ 47,850.00
				20% CONTINGENCY	\$ 9,570.00
				TOTAL	\$ 57,420.00

Cost Estimate for Concept Plan 5

Concept Plan 6 (Figure 3F)



At erosion location 24, river bank is moderately eroding on the outside bend for approximately 155 ft. and have an eroded vertical face of 4 ft. To minimize the current erosion, banks will need the toe protected with vegetated riprap. In order to allow sunlight to penetrate, trees will need to be removed directly upslope from the affected area for stabilizing grasses to germinate and grow.



BID TABULATION					
No.	Item	Units	Qty	Unit Price	Total
1	Mobilization/Demobilization	LS	1	\$ 1,000.00	\$ 1,000.00
2	Site Access & Restoration	LS	1	\$ 4,000.00	\$ 4,000.00
3	Tree Removal	LS	1	\$ 2,000.00	\$ 2,000.00
4	Bank Resloping	LF	155	\$ 10.00	\$ 1,550.00
5	Class II Rip Rap (Veg. Riprap)	TON	65	\$ 120.00	\$ 7,800.00
6	Geotextile (mnDOT typ. 5)	SY	195	\$ 5.00	\$ 975.00
7	Floating silt curtain	LF	50	\$ 20.00	\$ 1,000.00
8	Erosion Control Blanket	SY	225	\$ 3.00	\$ 675.00
9	Seeding (MN state mix 34-261)	SY	225	\$ 2.00	\$ 450.00
				SUBTOTAL	\$ 19,450.00
				20% CONTINGENCY	\$ 3,890.00
				TOTAL	\$ 23,340.00

Cost Estimate for Concept Plan 6

Concept Plan 7 (Figure 3G)



At erosion locations 25, the river has been straightened and the channel is over-widened, incised or confined by flood and spoil deposition on the banks. River banks are moderately eroding for approximately 8600 ft. while the channel runs through the floodplain forest. To minimize the current erosion, the existing tree canopy should be thinned on the southern bank to allow sunlight to penetrate the areas on both banks for stabilizing grasses to germinate and grow. This project could be accomplished by a crew of Conservation Corps employees over approximately a four week period.

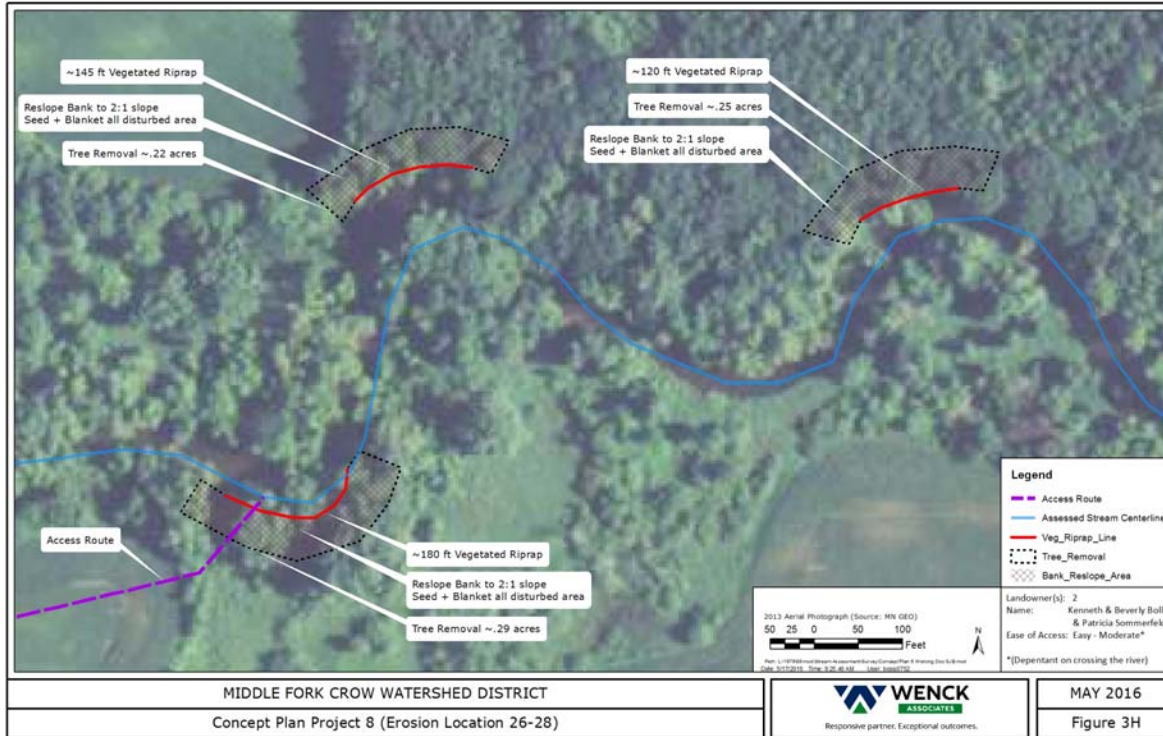
Two options exist for Conservation Corps workers:

1. Hire crew for full price of \$1,500.00 per day plus the cost of the seed and herbicide associated with the project.
2. Apply for a project grant which the labor cost is 25% of the estimated cost. The district would have to supply the seed and the herbicide (Garlon 4)

BID TABULATION (NO GRANT)					
No.	Item	Units	Qty	Unit Price	Total
1	Tree Removal (CC-MN)	DAYS	16	\$ 1,500.00	\$ 24,000.00
2	Seeding (MN state mix 34-261)	LBS	180	\$ 20.00	\$ 3,600.00
3	Herbicide Treatment	Gallon	35	\$ 11.00	\$ 385.00
				SUBTOTAL	\$ 27,985.00
	* Seeding & Herbicide included in price/day			20% CONTINGENCY	\$ 5,597.00
				TOTAL	\$ 33,582.00
BID TABULATION (WITH GRANT)					
No.	Item	Units	Qty	Unit Price	Total
1	Tree Removal (CC-MN)*	DAYS	16	\$ 1,500.00	\$ 6,000.00
2	Seeding (MN state mix 34-261)**	LBS	240	\$ 20.00	\$ 4,800.00
3	Herbicide Treatment***	Gallon	48	\$ 111.00	\$ 5,328.00
	* With Grant labor rate is 25% of total cost			SUBTOTAL	\$ 16,128.00
	* (30 lbs/Acre x 6 Acres)			20% CONTINGENCY	\$ 3,225.60
	** (6 Quarts/Acre x 8 Acres)			TOTAL	\$ 19,353.60

Cost Estimate for Concept Plan 7

Concept Plan 8 (Figure 3H)



At erosion locations 26 - 28, river banks are moderately to severely eroding on the outside bends for approximately 445 ft. and have an eroded vertical faces from 4 – 8 ft. To minimize the current erosion, banks will need to be regraded to a slope of 2:1 with the toe protected with vegetated riprap. In order to accomplish the regrading and allow sunlight to penetrate the new grade, trees will need to be removed directly upslope from the affected area for stabilizing grasses to germinate and grow.

BID TABULATION						
No.	Item	Units	Qty	Unit Price	Total	
1	Mobilization/Demobilization	LS	1	\$ 3,500.00	\$ 3,500.00	
2	Site Access & Restoration	LS	1	\$ 2,000.00	\$ 2,000.00	
3	Tree Removal (CC-MN)	LS	1	\$ 8,000.00	\$ 8,000.00	
4	Bank Resloping	LF	445	\$ 10.00	\$ 4,450.00	
5	Class II Rip Rap (Veg. Riprap)	TON	300	\$ 120.00	\$ 36,000.00	
6	Geotextile (mnDOT typ. 5)	SY	560	\$ 5.00	\$ 2,800.00	
7	Floating silt curtain	LF	150	\$ 20.00	\$ 3,000.00	
8	Erosion Control Blanket	SY	1030	\$ 3.00	\$ 3,090.00	
9	Seeding (MN state mix 34-261)	SY	1030	\$ 2.00	\$ 2,060.00	
					SUBTOTAL	\$ 64,900.00
					20% CONTINGENCY	\$ 12,980.00
					TOTAL	\$ 77,880.00

Cost Estimate for Concept Plan 8

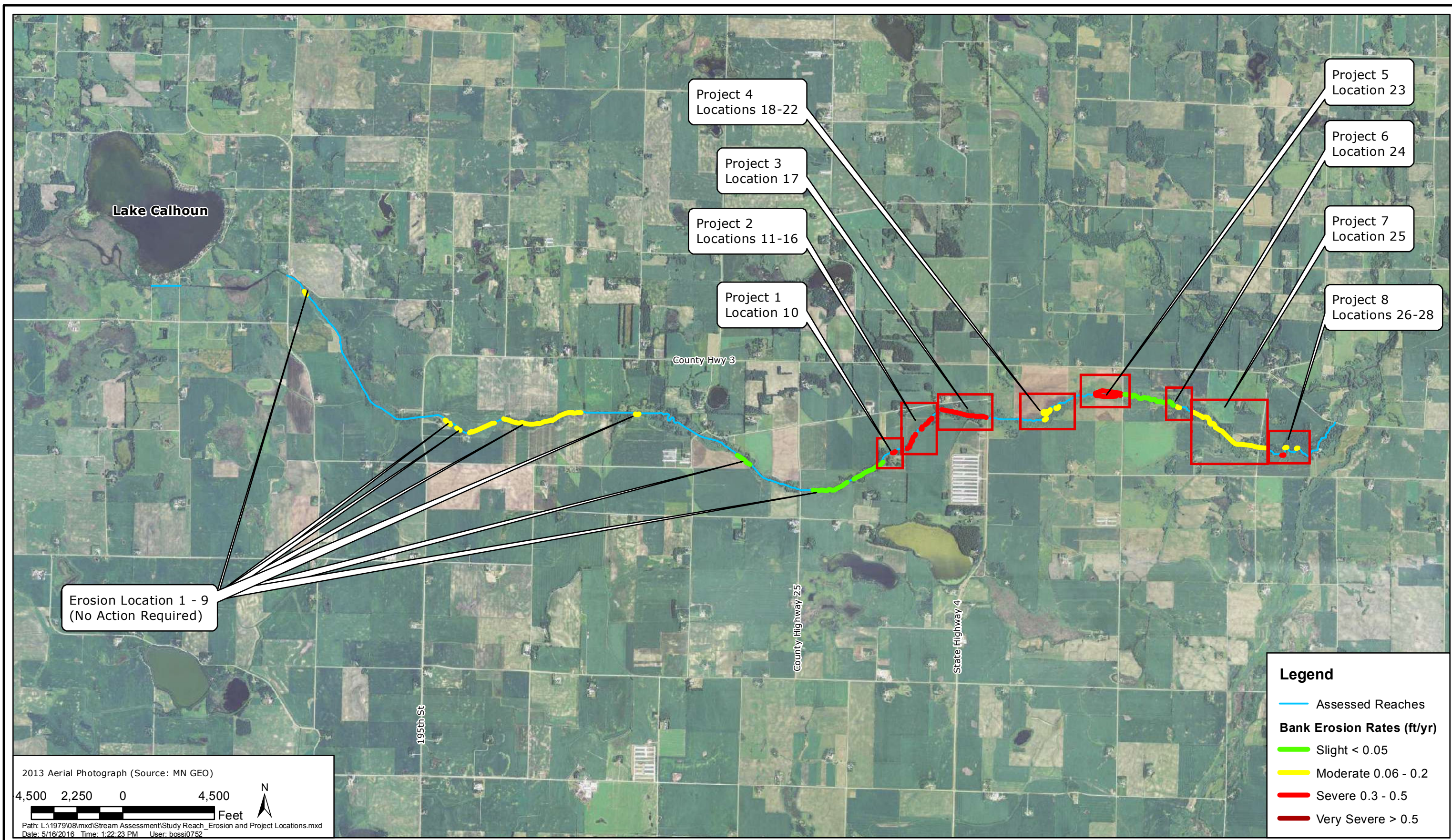
Cost Benefit Analysis

All of the proposed projects are effective at reducing total suspended solids and phosphorous contributions to the Middle Fork Crow River. If all projects were built, 797 tons of sediment and 160 lbs. of phosphorous would be reduced, but the project cost would be \$ 562,050.00. The target reduction of the sediment from the study reach to the reference reach identified in the streambank assessment was 1000 tons of sediment annually. To help prioritize the order in which projects should be pursued, the following table summarizes each project and ranks them from lowest to highest in dollars per pound of phosphorous.

Project Rank	Project #	Tons/Year of TSS	lbs/year P	Project Estimate	\$/TON TSS	\$/lbs P
1	3	205.2	41.13	\$ 30,582.00	\$ 149.04	\$ 743.61
2	7	172	34.47	\$ 33,582.00	\$ 195.24	\$ 974.17
3	5	153	30.66	\$ 57,420.00	\$ 375.29	\$ 1,872.53
4	2	188.49	37.78	\$ 207,300.00	\$ 1,099.79	\$ 5,487.43
5	1	20.04	4.02	\$ 50,940.00	\$ 2,541.92	\$12,682.92
6	8	24.84	4.98	\$ 77,880.00	\$ 3,135.27	\$15,643.45
7	4	31.32	6.28	\$ 98,970.00	\$ 3,159.96	\$15,766.67
8	6	3.08	0.62	\$ 23,340.00	\$ 7,577.92	\$37,810.00

Conclusion

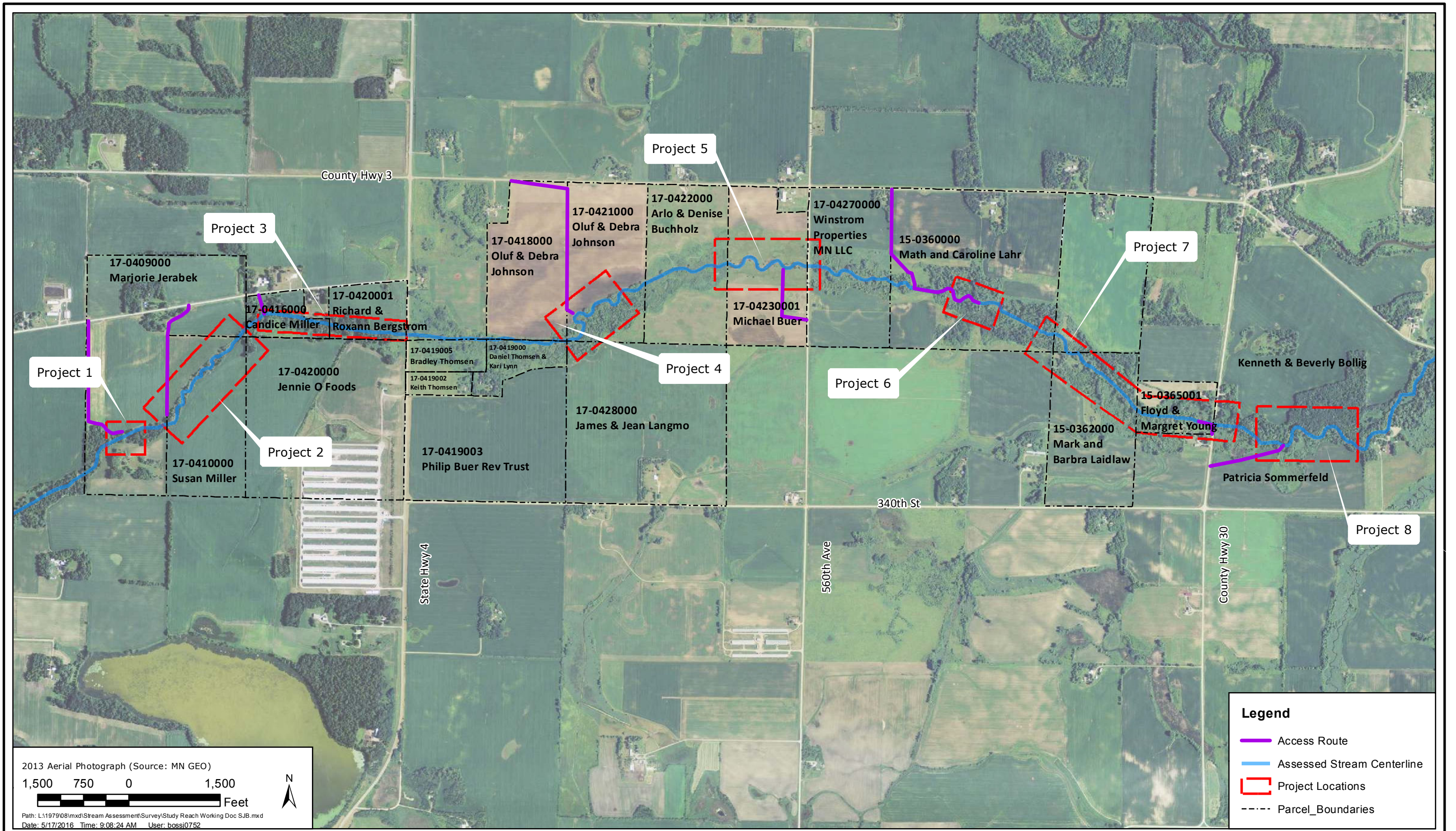
Following the Middle Fork Crow River Stream assessment an annual reduction of 1000 tons per year of sediment was identified for the study reach of the river. After evaluating the erosion features, causes and potential stabilization techniques for long term protection, eight projects were identified that combined 18 erosion locations into 8 groups that minimize access, disturbance and construction costs while achieving the goal of reducing streambank erosion by 798 tons of sediment and 160 lbs. of phosphorous each year. A cost benefit analysis was completed to help prioritize projects based on maximum reduction of erosion for the lowest cost per pound of pollutants reduced. Through the analysis, the top 3 most effective projects include vegetation maintenance and cattle exclusion only. No hard armoring is required until the fourth project and beyond.



MIDDLE FORK CROW RIVER WATERSHED DISTRICT
 Study Reach Bank Erosion Areas and Project Locations



MAY 2016
 Figure 2



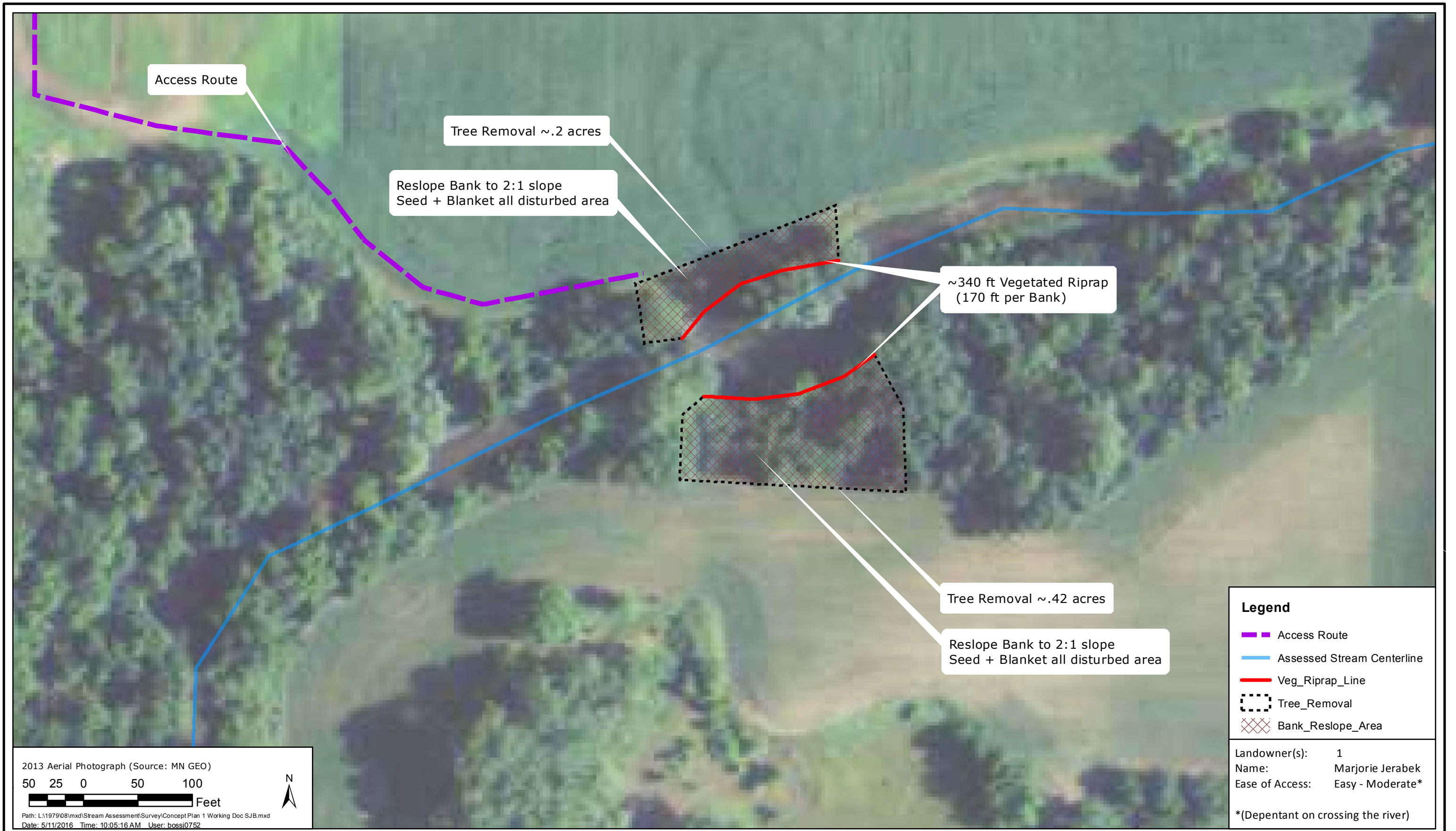
MIDDLE FORK CROW WATERSHED DISTRICT

Project Location Overview



MAY 2016

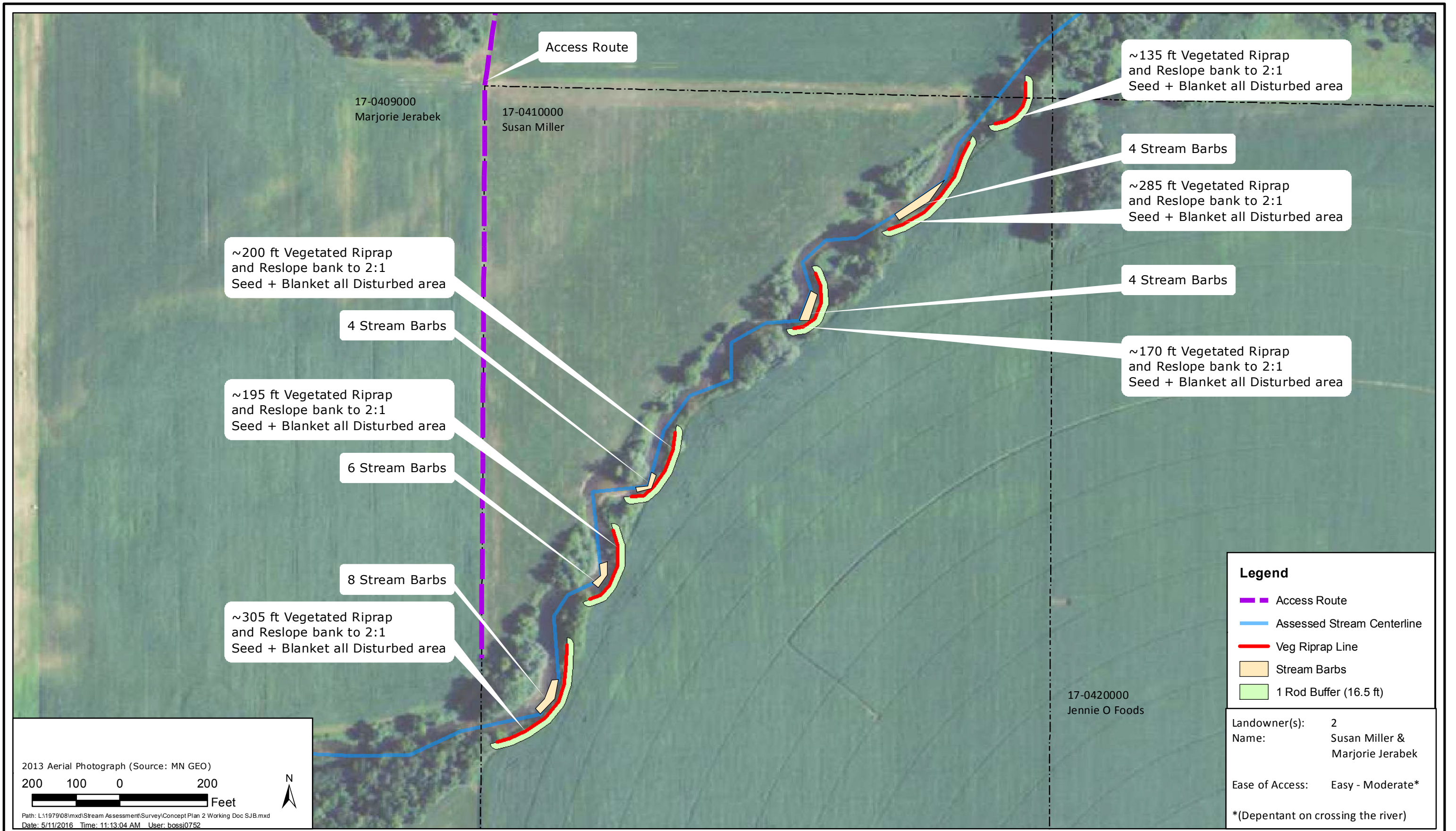
Figure 3



MIDDLE FORK CROW WATERSHED DISTRICT
Concept Plan Project 1 (Erosion Location 10)



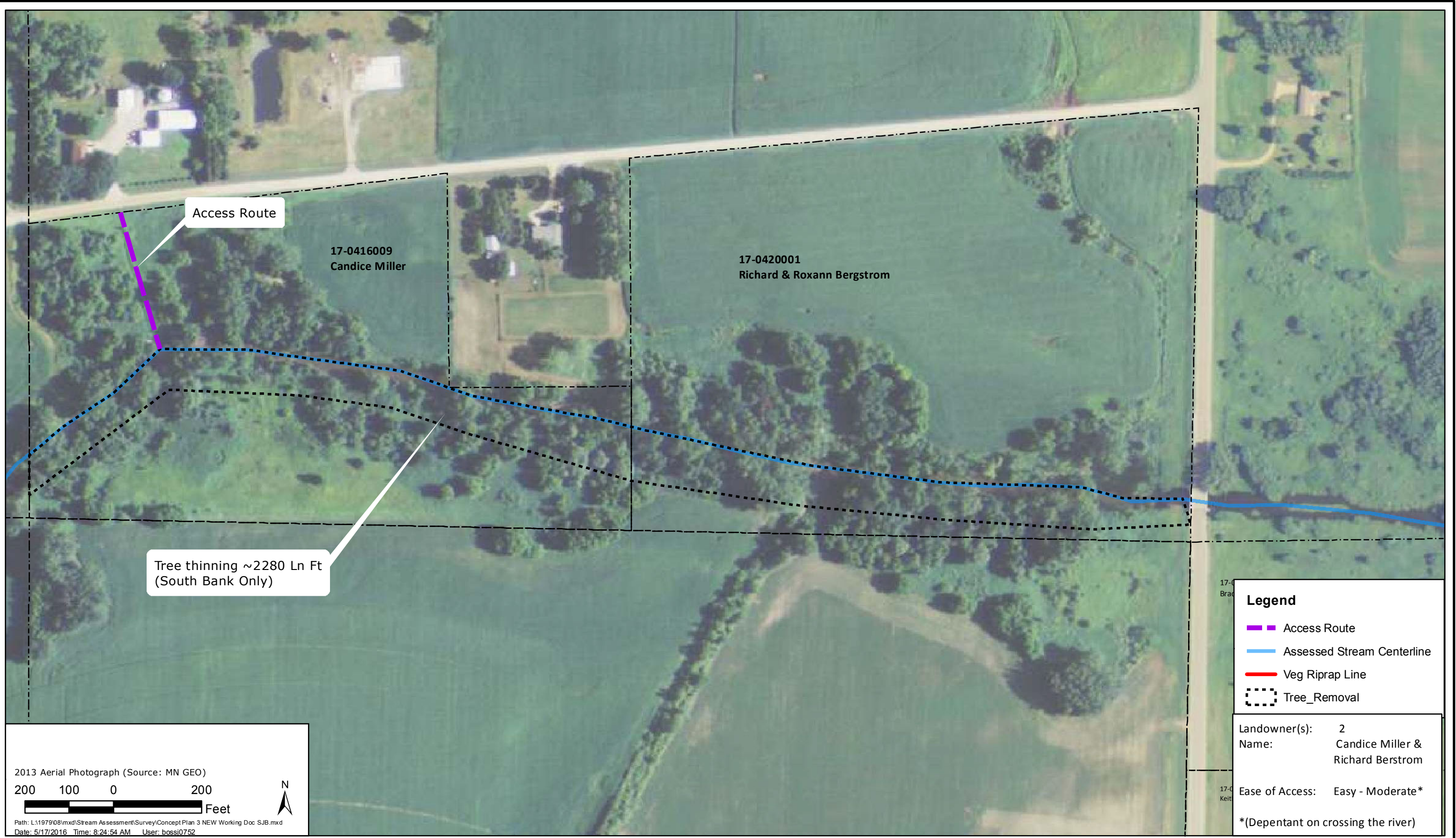
MAY 2016
Figure 3A



MIDDLE FORK CROW WATERSHED DISTRICT
Concept Plan Project 2 (Erosion Locations 11-16)



MAY 2016
Figure 3B



2013 Aerial Photograph (Source: MN GEO)



Path: L:\1979\08\Stream Assessment\Survey\Concept Plan 3 NEW Working Doc SJB.mxd
 Date: 5/17/2016 Time: 8:24:54 AM User: bossj0752

- Legend**
- Access Route
 - Assessed Stream Centerline
 - Veg Riprap Line
 - Tree Removal

Landowner(s): 2
 Name: Candice Miller & Richard Berstrom

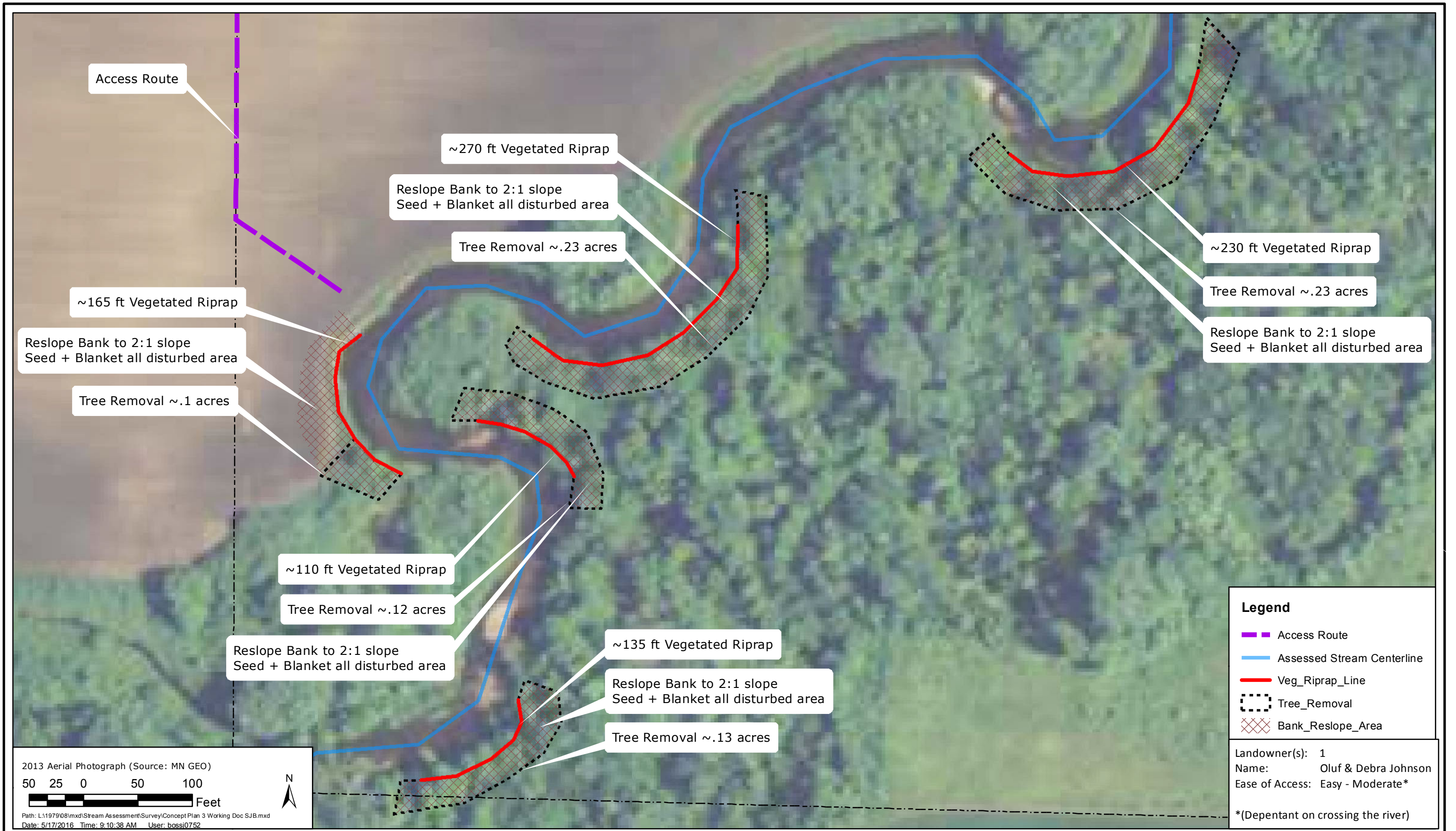
Ease of Access: Easy - Moderate*

*(Dependant on crossing the river)

MIDDLE FORK CROW WATERSHED DISTRICT
 Concept Plan Project 3 (Erosion Locations 17)



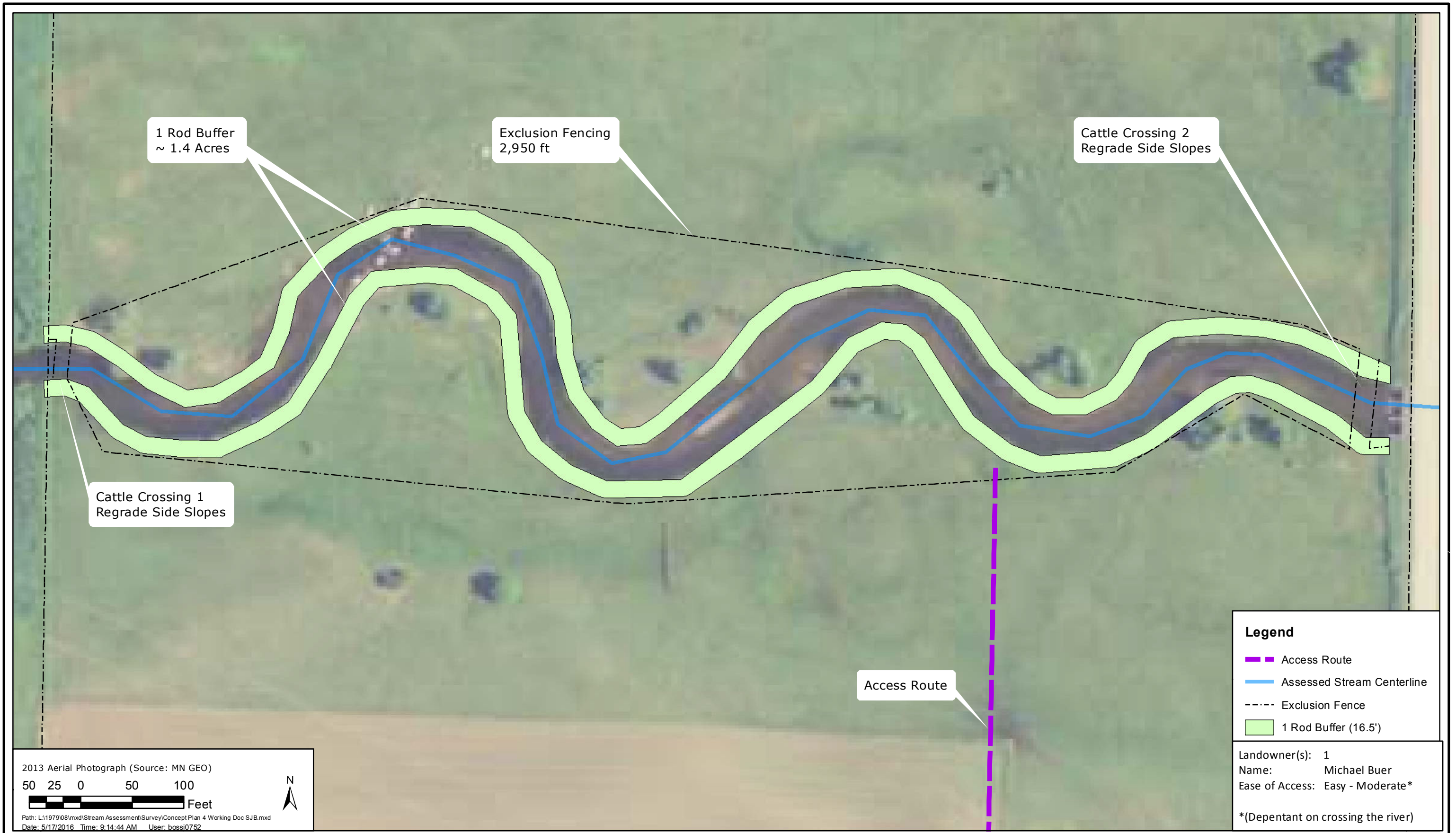
MAY 2016
 Figure 3C



MIDDLE FORK CROW WATERSHED DISTRICT
Concept Plan Project 4 (Erosion Location 18-22)



MAY 2016
Figure 3D



1 Rod Buffer
~ 1.4 Acres

Exclusion Fencing
2,950 ft

Cattle Crossing 2
Regrade Side Slopes

Cattle Crossing 1
Regrade Side Slopes

Access Route

2013 Aerial Photograph (Source: MN GEO)
50 25 0 50 100 Feet
Path: L:\1979\08\Stream Assessment\Survey\Concept Plan 4 Working Doc SJB.mxd
Date: 5/17/2016 Time: 9:14:44 AM User: bossj0752

Legend

- Access Route
- Assessed Stream Centerline
- Exclusion Fence
- 1 Rod Buffer (16.5')

Landowner(s): 1
Name: Michael Buer
Ease of Access: Easy - Moderate*

*(Dependant on crossing the river)



MIDDLE FORK CROW WATERSHED DISTRICT
 Concept Plan Project 6 (Erosion Location 24)



MAY 2016
 Figure 3F



MIDDLE FORK CROW WATERSHED DISTRICT
Concept Plan Project 7 (Erosion Location 25)



MAY 2016
Figure 3G

