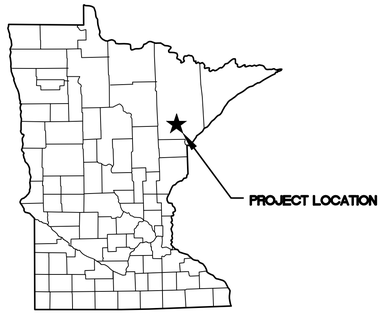
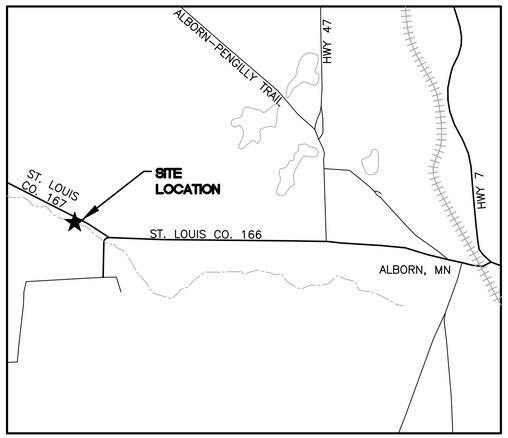
Attachments

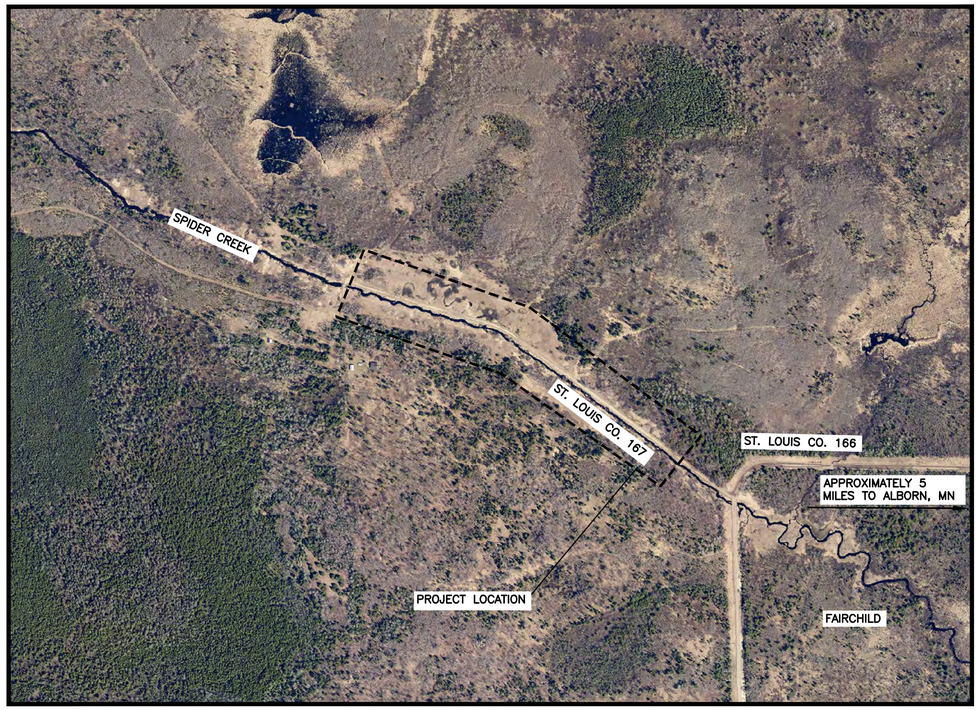
Attachment A: Spider Creek Plan Set

SPIDER CREEK RESTORATION
NESS, MINNESOTA





SITE LOCATION



VICINITY MAP

NESS TOWNSHIP, ST. LOUIS COUNTY, MINNESOTA

SHEET INDEX

LEGEND

- PROPERTY BOUNDARY
- EXISTING MAJOR CONTOURS — 1000
- EXISTING MINOR CONTOURS — 1002
- PROPOSED MAJOR CONTOURS — 1000
- PROPOSED MINOR CONTOURS — 1002
- PROPOSED STREAM ℄
- PROPOSED GRADE CONTROL RIFFLE
- PROPOSED TOE WOOD
- PROPOSED DITCH PLUG

NOTES:

- ALL COORDINATES BASED ON UTM ZONE 15N, NAD83 US FOOT.
- ALL ELEVATIONS BASED ON NAVD83, 2012 VERTICAL DATUM.
- SEE SHEET C–01 FOR GENERAL CONSTRUCTION NOTES.

ISSUED FOR PERMIT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION
B	RRR2	--	JCO	2/15/17	ISSUED FOR PERMIT
A	EPF	--	JCO	12/23/15	ISSUED FOR 60% REVIEW

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PRINTED NAME JESSICA C. L. OLSON
SIGNATURE
DATE 2/15/17 LICENSE # 43102

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CONSTRUCTION								
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	DATE RELEASED							

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Scale	AS SHOWN
Date	5/26/15
Drawn	EPF
Checked	JCO
Designed	JCO
Approved	

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MINNESOTA ORE OPERATIONS – MINNTAC
MOUNTAIN IRON, MINNESOTA

SPIDER CREEK RESTORATION
NESS, MINNESOTA

LOCATION MAP, LEGEND AND SHEET INDEX

BARR PROJECT No. 23/69–1303
CLIENT PROJECT No.
DWG. No. G–01
REV. No. B

STATEMENT OF ESTIMATED QUANTITIES

BID ITEM NO	MEASUREMENT AND PAYMENT ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY
1	A	MOBILIZATION/DEMOBILIZATION	L.S.	
2	B	CONTROL OF WATER	L.S.	
3	C	ROCK CONSTRUCTION ENTRANCE	EA.	
4	D	RESTORE ACCESS PATHS & HAUL ROADS	L.S.	
5	E	RESTORE COUNTY ROAD	S.Y.	
6	F	CLEARING AND GRUBBING	L.S.	
7	G	SEDIMENT REMOVAL - ON-SITE USE/DISPOSAL (SEE NOTE)	L.S.	
8	H	LOG STEP RIFFLES	L.F.	
9	I	TOE WOOD	L.F.	
10	J	LIVE STAKES	EA.	
11	K	X' x X' CONCRETE BOX CULVERT, EMBEDDED	L.S.	
12	L	SITE GRADING	C.Y.	
13	M	IMPORT TOPSOIL	TON	
14	N	FIELD STONE RIPRAP MNDOT CLASS I	C.Y.	
15	O	FIELD STONE RIPRAP MNDOT CLASS II	C.Y.	
16	P	FILTER AGGREGATE	C.Y.	
17	Q	SILT FENCE	L.F.	
18	R	FILTER LOG	L.F.	
19	S	EROSION CONTROL BLANKET	S.Y.	
20	T	STRAW MULCH	S.Y.	
21	U	HYDROMULCH	S.Y.	
22	V	SEEDING NATIVE MIX (PRAIRIE GENERAL)	S.Y.	
23	W	SEEDING NATIVE MIX (PRAIRIE NW)	S.Y.	
24	W	SEEDING NATIVE MIX (BACKSLOPE CUT)	S.Y.	
25	W	SEEDING TURF	S.Y.	
26	X	TREES	EA.	
27	Y	SHRUBS	EA.	
28	Z	VEGETATION MANAGEMENT AND MAINTENANCE	L.S.	

* NEW CHANNEL EXCAVATION ESTIMATED TO BE XX CY.
OLD CHANNEL FILL ESTIMATED TO BE XX CY.

STREAM RESTORATION STRUCTURES TABLE

STRUCTURE	FIRST CONTROL POINT X1		SECOND CONTROL POINT X2		THIRD CONTROL POINT X3		FOURTH CONTROL POINT X4		BEDDING MATERIAL		FILTER MATERIAL THICKNESS (IN)	POOL BOTTOM CONTROL POINT X5		Notes
	STATION (FT)	ELEVATION (FT)	STATION (FT)	ELEVATION (FT)	STATION (FT)	ELEVATION (FT)	STATION (FT)	ELEVATION (FT)	TYPE	THICKNESS (IN)		STATION (FT)	ELEVATION (FT)	
LOG STEP RIFFLES GROUPS - SEE DETAIL 2 ON D-03														
ROCK RIFFLES - SEE DETAIL 1 ON D-01														
TOE WOOD - SEE D-02														

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X-REFS
IMAGE
DATE

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SPIDER CREEK RESTORATION
NESS, MINNESOTA

STRUCTURE TABLE AND QUANTITIES

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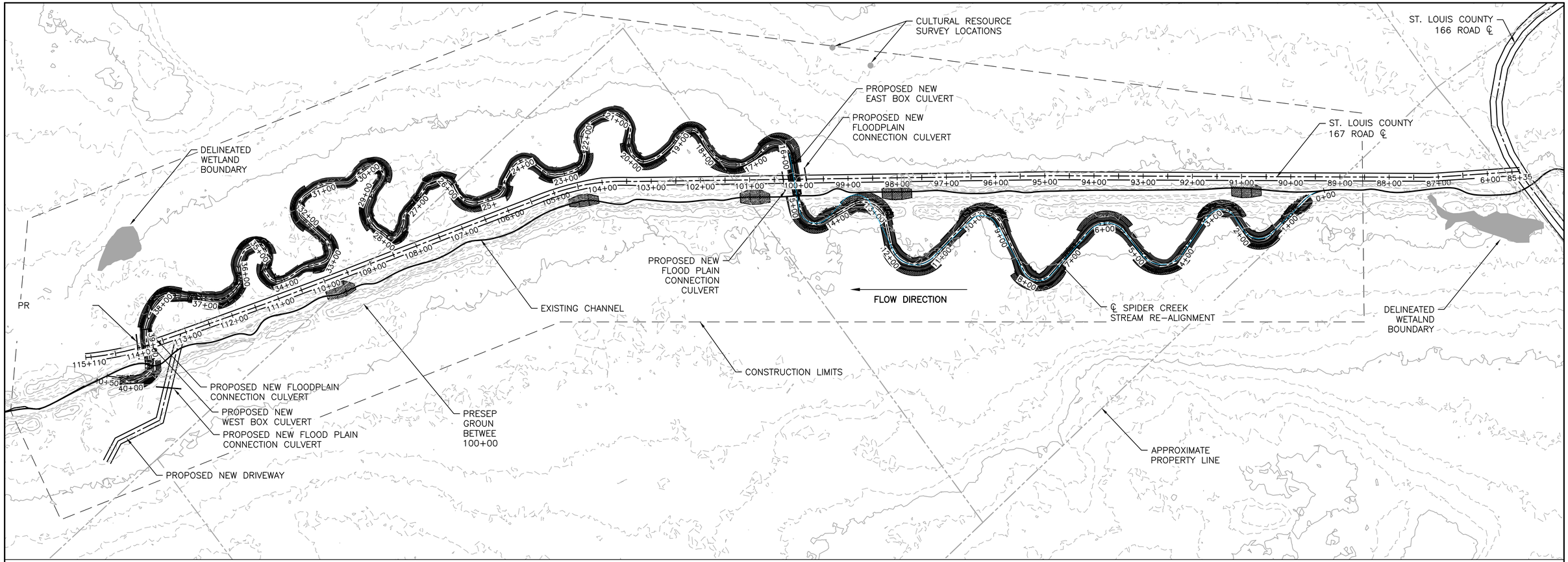

1 PLAN: SPIDER CREEK STREAM RE-ALIGNMENT

0 100 200

SCALE IN FEET

GENERAL NOTES:
THESE DRAWINGS HAVE BEEN ISSUED FOR PURPOSES OF PERMIT REVIEW. PROPOSED CONTOURS AS SHOWN ARE NOT FINAL, AND WILL BE EDITED PRIOR TO FINAL DRAWINGS BEING ISSUED.

PROJECT SHALL BE CONSTRUCTED IN TWO PHASES. THE FIRST PHASE WILL INCLUDE EXCAVATING THE NEW CHANNEL OFF-LINE OF THE EXISTING DITCHED CHANNEL. THE SECOND PHASE WILL TAKE PLACE AFTER AT LEAST ONE FULL GROWING SEASON. THE EXISTING DITCH WILL BE SHAPED AND FILLED TO ROUTE STREAM FLOW INTO THE NEW CHANNEL, NEW CULVERTS WILL BE INSTALLED, AND A NEW DRIVEWAY WILL BE BUILT.

PHASE ONE GENERAL NOTES
1. SALVAGE ALL TOPSOIL FOR RE-USE ON ON SITE.
2. CONTRACTOR TO OBTAIN CONSTRUCTION SITE NPDES PERMITS, AS NEEDED, FOR EACH PHASE OF CONSTRUCTION SEDIMENT AND EROSION CONTROL.
3. EXCESS EXCAVATED MATERIAL SHALL BE PLACED ON SITE FOR USE IN PHASE TWO AND TO CREATE GRADUAL SURFACE VARIATIONS WITHIN THE FLOODPLAIN AS DIRECTED BY THE ENGINEER. ANY ADDITIONAL EXCESS WILL BE PLACED IN AN UPLAND LOCATION NEAR THE EDGE OF THE FLOODPLAIN TO CREATE MOUNDS.
4. STOCKPILES SHALL BE TEMPORARILY SEEDED IF LEFT FOR MORE THAN 3 DAYS AND SURROUNDED WITH SILT FENCE.
5. ALL DISTURBED AREAS, HAUL ROADS, ECT. SHALL BE RESTORED, SEEDED AND MULCHED PRIOR TO LEAVING SITE.
6. WORK TO BE PHASED TO MINIMIZE AREA OF DISTURBED SOIL.
7. CONTRACTOR SHALL MONITOR THE SITE FOR PRESENCE OF BLANDING'S TURTLES AND SHALL RELOCATE ANY TURTLE OBSERVED IN THE WORK AREAS.

PHASE TWO GENERAL NOTES
1. SALVAGE ALL TOPSOIL FOR RE-USE ON SITE.
3. CONTRACTOR TO OBTAIN CONSTRUCTION SITE NPDES PERMITS, AS NEEDED, FOR EACH PHASE OF CONSTRUCTION SEDIMENT AND EROSION CONTROL.
4. DIRECT FLOW TO NEW CHANNEL BY FILLING OLD DITCHED CHANNEL. PHASE CONSTRUCTION TO PREVENT WORK IN FLOWING CHANNEL.
5. STOCKPILES SHALL BE TEMPORARILY SEEDED IF LEFT FOR MORE THAN 3 DAYS AND SURROUNDED WITH SILT FENCE.
6. ALL DISTURBED AREAS, HAUL ROADS, ETC. SHALL BE RESTORED, SEEDED AND MULCHED PRIOR TO LEAVING SITE.
7. CONSTRUCTION ACTIVITIES WITHIN SPIDER CREEK, INCLUDING CONTROL OF WATER, SHALL BE PERFORMED WITHIN THE WORK IN WATER PERIOD OF JULY 1 TO MARCH 31.
8. CONTROL WATER AS NECESSARY TO MAINTAIN WORKING CONDITIONS IN CONSTRUCTION AREA.
9. CONTROL PUBLIC ACCESS TO CONSTRUCTION AND ACCESS AREAS AS NECESSARY WITH CONSTRUCTION FENCING OR SILT FENCING.
10. CONTRACTOR SHALL MONITOR THE SITE FOR PRESENCE OF BLANDING'S TURTLES AND SHALL RELOCATE ANY TURTLE OBSERVED IN THE WORK AREAS.

PROPOSED CHANNEL DETAILS
CHANNEL TYPE: E
RIFFLE DIMENSIONS:
- WIDTH – 17 FT. +/– 1 FT.
- MEAN DEPTH – 2.4 FT. +/– 0.2 FT.
- MAX DEPTH – 3.7 FT. +/– 0.2 FT.
- CROSS SECTIONAL AREA – 41 SQ. FT. +/– 2 SQ. FT.
- W/D RATIO 7.2 +/– 0.2 FT.

POOL DIMENSIONS:
- WIDTH – 27 FT. +/– 4 FT.
- MAX CONSTRUCTED DEPTH – 5.4 FT +/– 0.2 FT.
- CONSTRUCTED CROSS SECTIONAL AREA – 74 SQ. FT. +/– 10 SQ. FT.

PROPOSED STREAM SLOPE – 0.0008 FT/FT

STREAM PLAN DETAILS:
- PROPOSED SINUOSITY – 1.6 +/– 0.1
- PROPOSED CHANNEL LENGTH, 4,050 FT., EXISTING LENGTH 2,660 FT.
- MEAN MEANDER BELT WIDTH – 90 FT +/– 10 FT.
- MEAN MEANDER RADIUS OF CURVATURE – 28 FT.
- MEAN MEANDER LENGTH – 168 FT +/– 20 FT.
- MEAN LINEAR WAVELENGTH – 224 FT +/– 20 FT.

LEGEND
- APPROX. PROPERTY BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- GRADE CONTROL RIFFLE SEE DETAIL 1/D01
- TOE WOOD WITH VRSS BANK PROTECTION SEE DETAIL 1/D02
- BERM SEE DETAIL 5/D03

HOLD FOR:
- PROPOSED CONTOUR SURFACE UPDATES
- CHANNEL DETAILS
- QUANTITIES PROFILE
- DITCH FILL PROFILE
- CULVERT DETAILS

ISSUED FOR PERMIT
NOT FOR CONSTRUCTION

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Approved	

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SPIDER CREEK RESTORATION
NESS, MINNESOTA

PROPOSED PLAN – OVERVIEW

BARR PROJECT No. 23/69-1303
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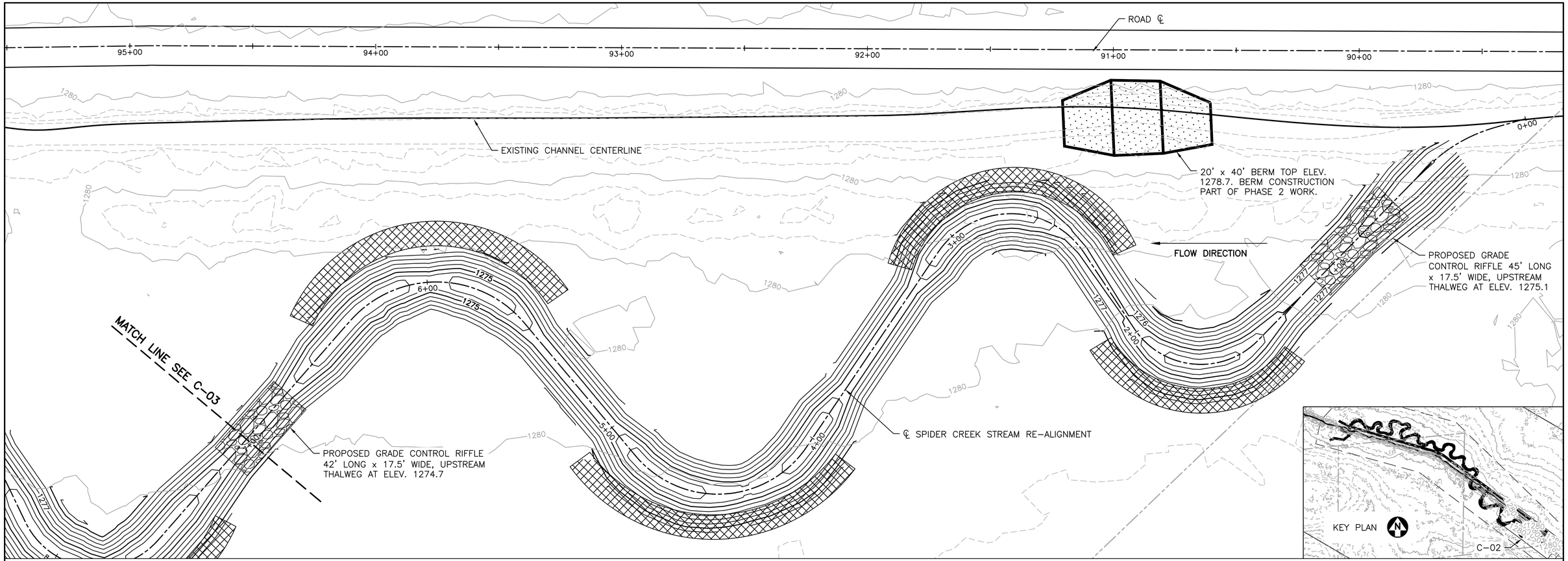
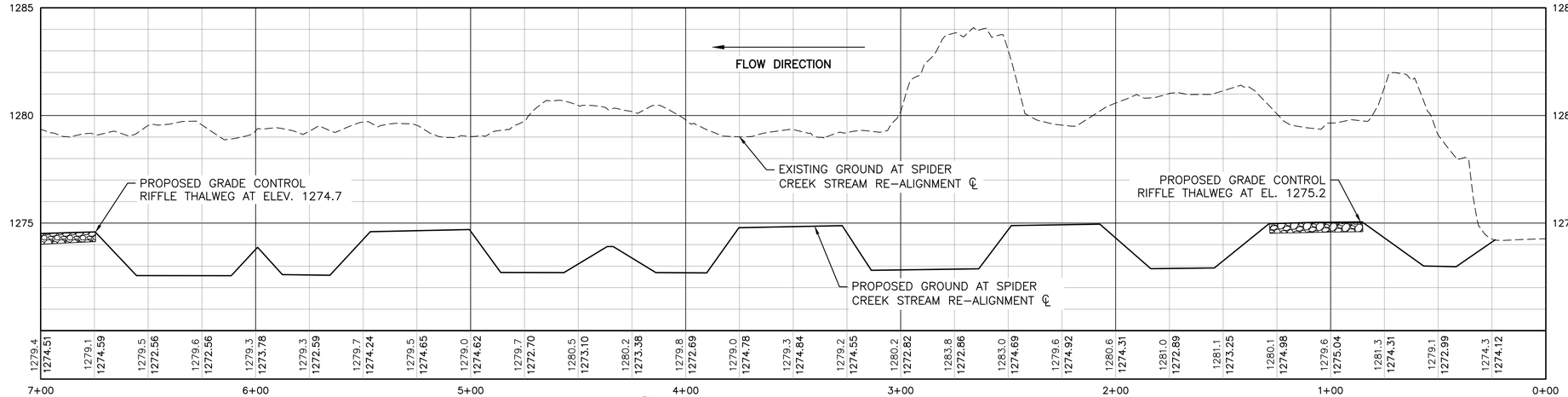


1 PLAN: SPIDER CREEK STREAM RE-ALIGNMENT

0 20 40
SCALE IN FEET

NOTES:
1. EXISTING CONTOURS REPRESENT 2012 LIDAR DATA ELEVATIONS MERGED WITH 2014 AND 2015 TOPOGRAPHIC SURVEY.
2. PROPOSED CHANNEL PROFILE ELEVATIONS AND CONTOURS REPRESENT AVERAGE FEATURE MAXIMUM DEPTHS.
3. FINAL CHANNEL DIMENSIONS, PATTERN AND PROFILE ELEVATIONS WILL VARY. SEE PROPOSED CHANNEL DETAILS ON SHEET C-01.



1 PROFILE: SPIDER CREEK STREAM RE-ALIGNMENT

0 30 60
HORIZONTAL SCALE IN FEET
0 3 6
VERTICAL SCALE IN FEET

LEGEND
- APPROX. PROPERTY BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- GRADE CONTROL RIFFLE SEE DETAIL 1/D01
- TOE WOOD WITH VRSS BANK PROTECTION SEE DETAIL 1/D02
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MOUNTAIN IRON, MINNESOTA

SPIDER CREEK RESTORATION
NESS, MINNESOTA

PLAN AND PROFILE STATIONS
0+00 TO 7+00

BARR PROJECT No. 23/69-1303
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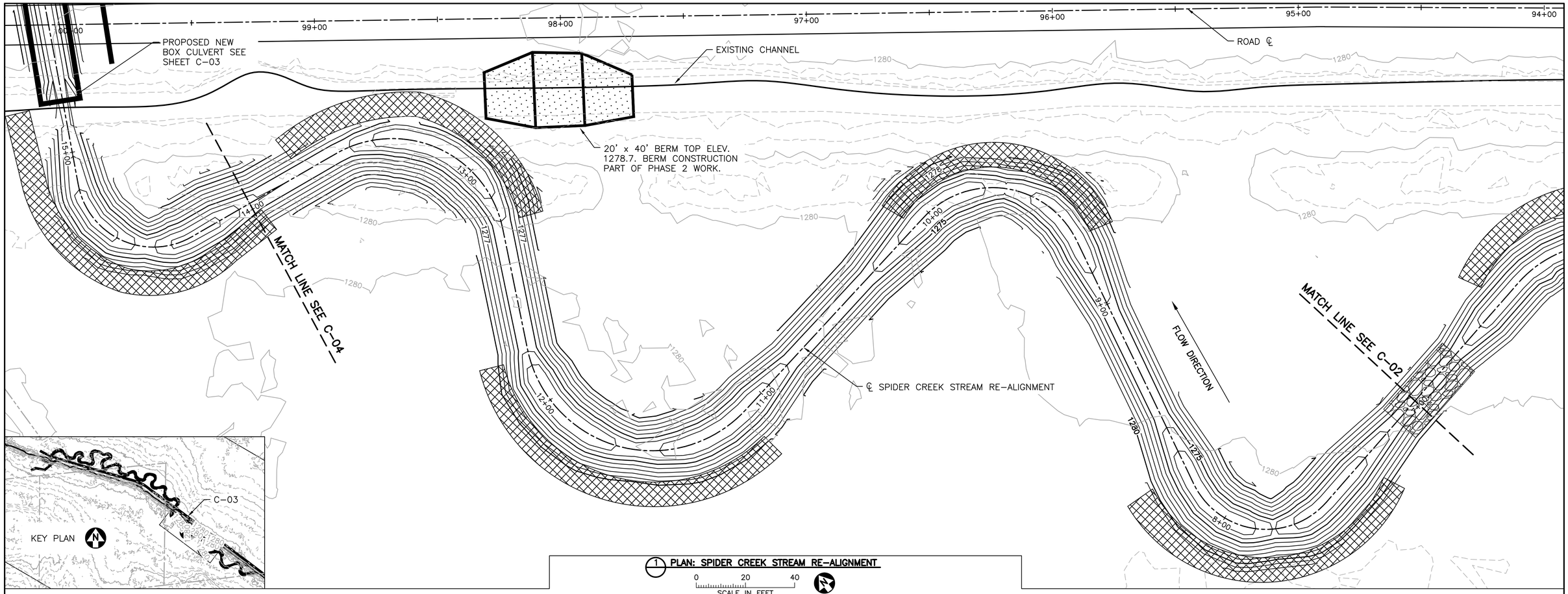
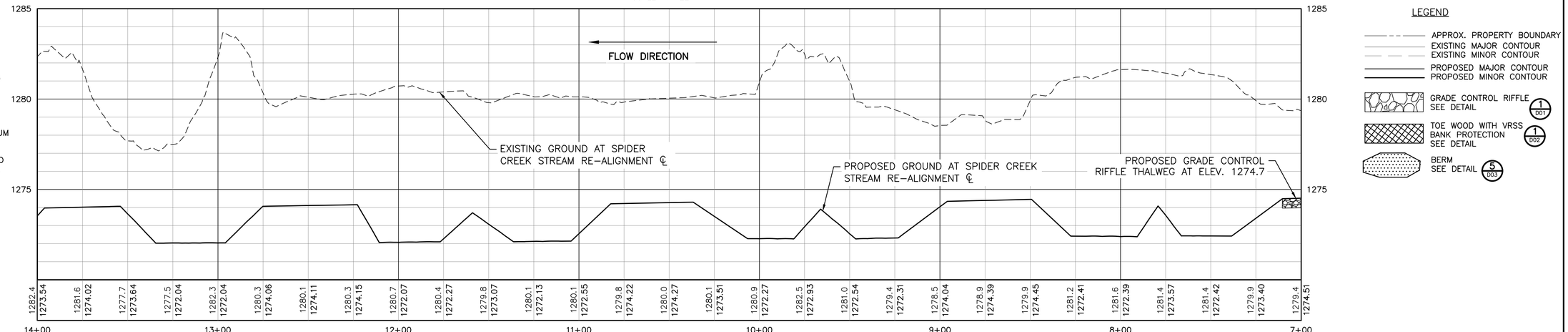


1 PLAN: SPIDER CREEK STREAM RE-ALIGNMENT

0 20 40

SCALE IN FEET



1 PROFILE: SPIDER CREEK STREAM RE-ALIGNMENT

0 30 60 0 3 6

HORIZONTAL SCALE IN FEET VERTICAL SCALE IN FEET

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LEGEND

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7+00 TO 14+00

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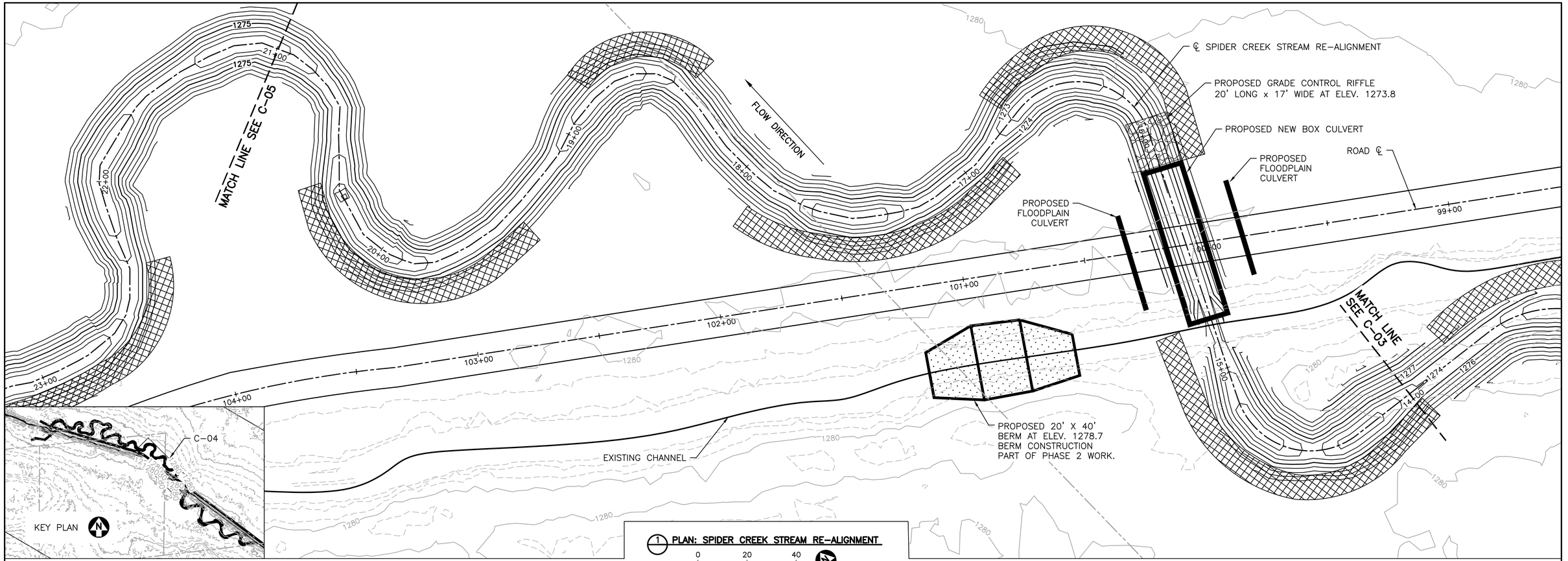

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0 20 40

SCALE IN FEET

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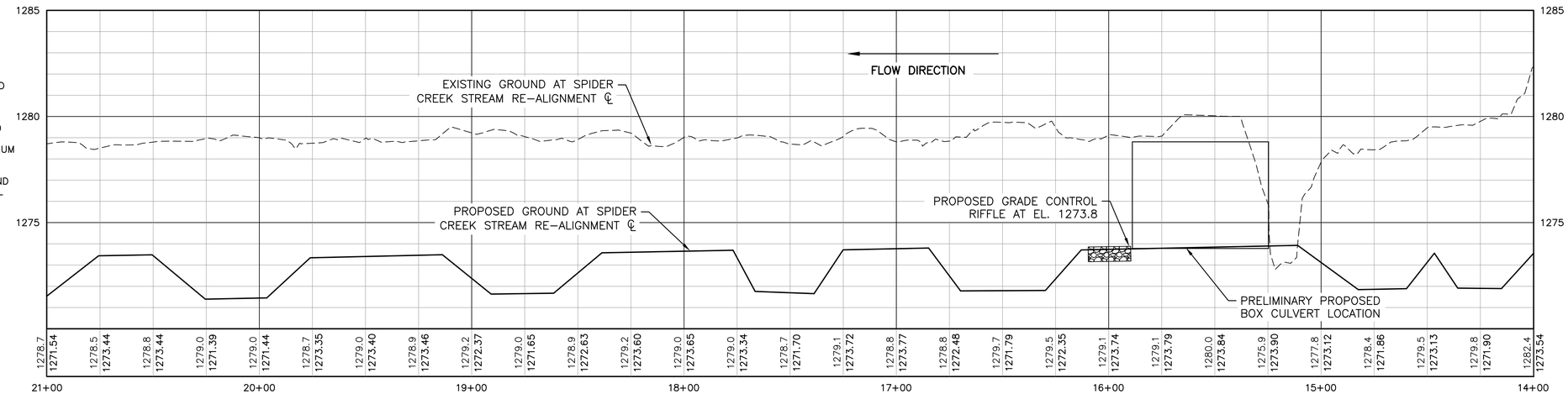

1 PROFILE: SPIDER CREEK STREAM RE-ALIGNMENT

0 30 60 HORIZONTAL SCALE IN FEET

0 3 6 VERTICAL SCALE IN FEET

LEGEND

- APPROX. PROPERTY BOUNDARY
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- EXISTING MINOR CONTOUR
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SPIDER CREEK RESTORATION
NESS, MINNESOTA

PLAN AND PROFILE STATIONS
14+00 TO 21+00

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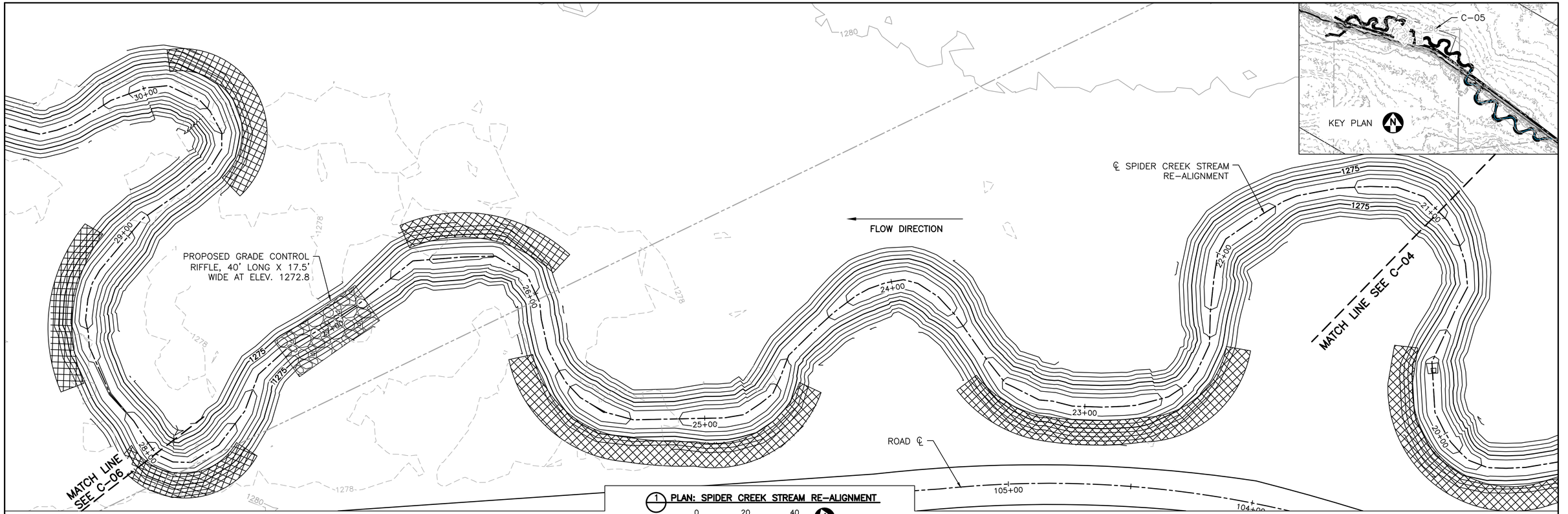

1 PLAN: SPIDER CREEK STREAM RE-ALIGNMENT

0 20 40 SCALE IN FEET

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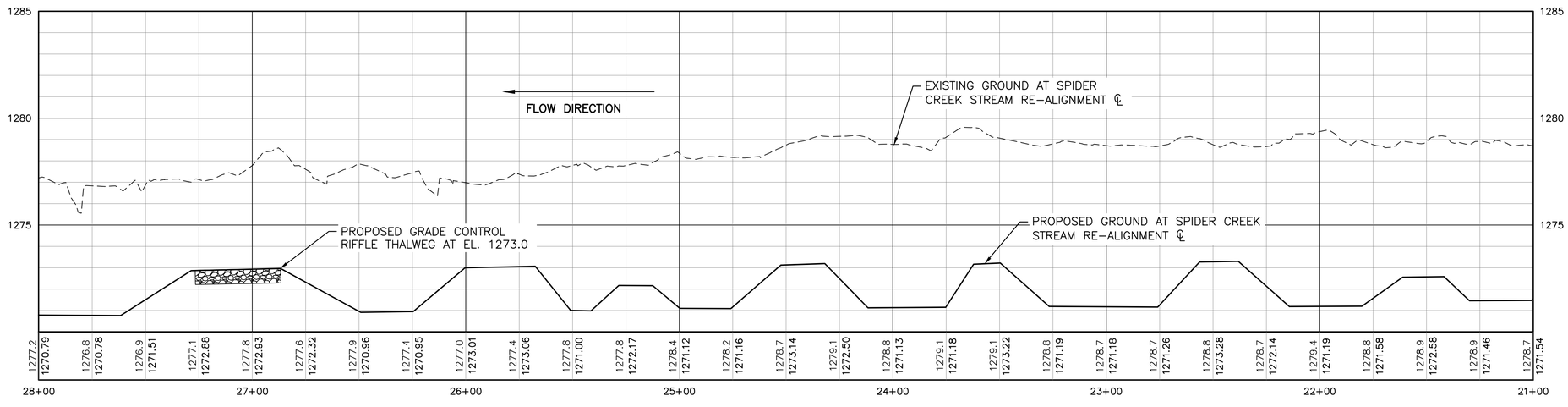

LEGEND

- APPROX. PROPERTY BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- GRADE CONTROL RIFFLE SEE DETAIL 1/D01
- TOE WOOD WITH VRSS BANK PROTECTION SEE DETAIL 1/D02
- BERM SEE DETAIL 5/D03

1 PROFILE: SPIDER CREEK STREAM RE-ALIGNMENT

0 30 60 HORIZONTAL SCALE IN FEET

0 3 6 VERTICAL SCALE IN FEET

ISSUED FOR PERMIT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION
B	RRR2	--	JCO	02/15/17	ISSUED FOR PERMIT
A	EPF	--	JCO	12/23/15	ISSUED FOR 60% REVIEW

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PRINTED NAME JESSICA C. L. OLSON

SIGNATURE

DATE 02/10/17 LICENSE # 43102

CLIENT	12-23-15
BID	
CONSTRUCTION	
PERMIT	02-15-17
RECORD	

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Scale	AS SHOWN
Date	5/26/15
Drawn	JDH2
Checked	JCO
Designed	JCO
Approved	

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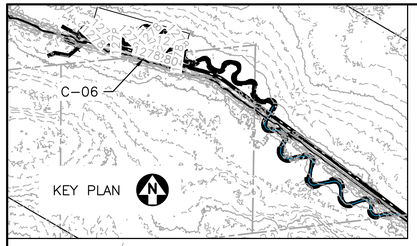
MOUNTAIN IRON, MINNESOTA

SPIDER CREEK RESTORATION
NESS, MINNESOTA

PLAN AND PROFILE STATIONS
21+00 TO 28+00

BARR PROJECT No. 23/69-1303
CLIENT PROJECT No.
DWG. No. C-05
REV. No. B



℄ SPIDER CREEK STREAM RE-ALIGNMENT

MATCH LINE SEE C-07

PROPOESD 20' X 17' GRADE CONTROL RIFFLE AT 1272.5

FLOW DIRECTION

MATCH LINE SEE C-05

ROAD ℄

1 PLAN: SPIDER CREEK STREAM RE-ALIGNMENT

0 20 40

SCALE IN FEET

NOTES:
1. EXISTING CONTOURS REPRESENT 2012 LIDAR DATA ELEVATIONS MERGED WITH 2014 AND 2015 TOPOGRAPHIC SURVEY.
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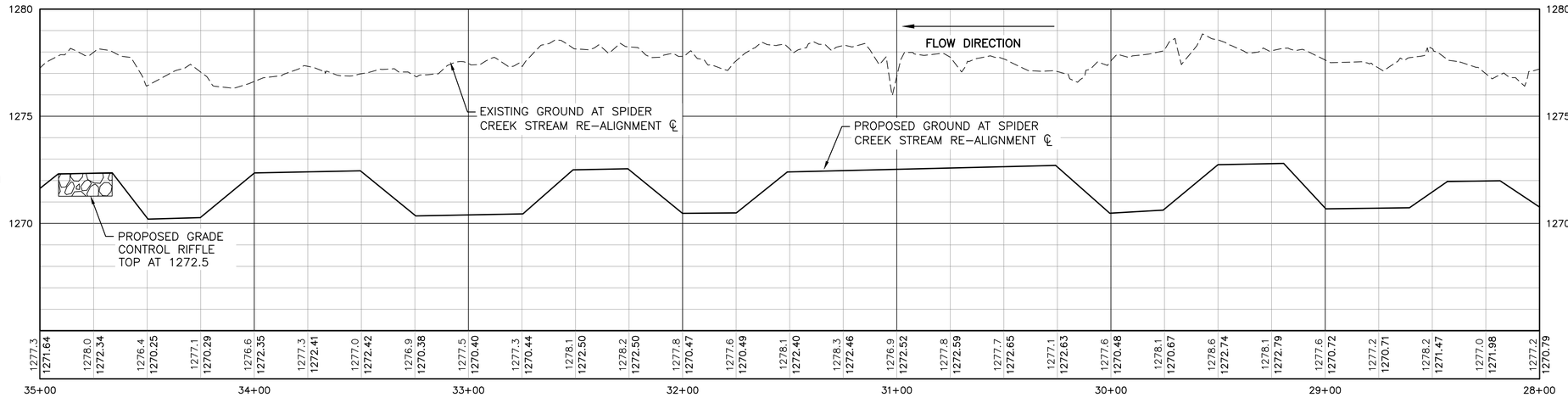

LEGEND

- APPROX. PROPERTY BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
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- PROPOSED MINOR CONTOUR
- GRADE CONTROL RIFFLE SEE DETAIL 1/D01
- TOE WOOD WITH VRSS BANK PROTECTION SEE DETAIL 1/D02
- BERM SEE DETAIL 5/D03

1 PROFILE: SPIDER CREEK STREAM RE-ALIGNMENT

0 30 60 HORIZONTAL SCALE IN FEET

0 3 6 VERTICAL SCALE IN FEET

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CONSTRUCTION	
PERMIT	02-15-17
RECORD	

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Designed	JCO
Approved	

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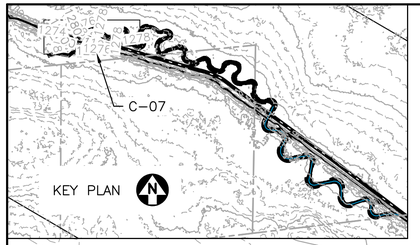
PLAN AND PROFILE STATIONS
28+00 TO 35+00

BARR PROJECT No. 23/69-1303
CLIENT PROJECT No.
DWG. No. C-06
REV. No. B



1 PLAN: SPIDER CREEK STREAM RE-ALIGNMENT

0 20 40

SCALE IN FEET

NOTES:
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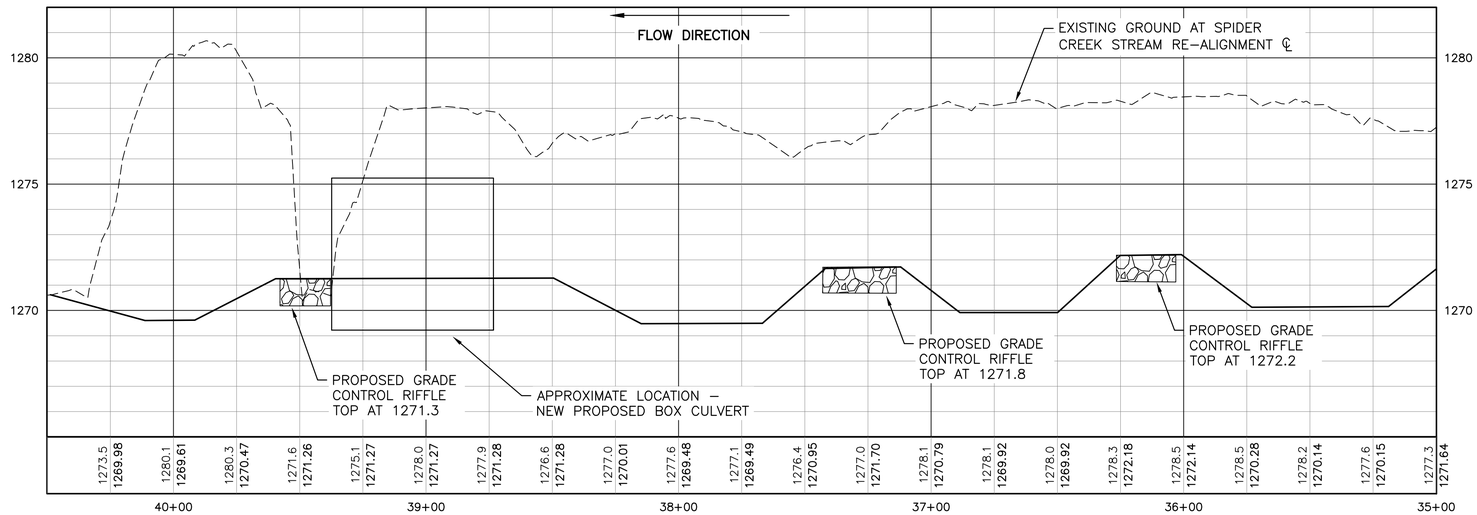

1 PROFILE: SPIDER CREEK STREAM RE-ALIGNMENT

0 30 60 0 3 6

HORIZONTAL SCALE IN FEET VERTICAL SCALE IN FEET

LEGEND

- APPROX. PROPERTY BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- GRADE CONTROL RIFFLE SEE DETAIL 1/D01
- TOE WOOD WITH VRSS BANK PROTECTION SEE DETAIL 1/D02
- BERM SEE DETAIL 5/D03

ISSUED FOR PERMIT
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DATE 6/15/15 LICENSE # 43102

CLIENT	12-23-15
BID	
CONSTRUCTION	
PERMIT	02-15-17
RECORD	

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A	B	C	0	1	2	3

DATE RELEASED

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Scale	AS SHOWN
Date	5/26/15
Drawn	JDH2
Checked	JCO
Designed	JCO
Approved	

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MINNTAC
MOUNTAIN IRON, MINNESOTA

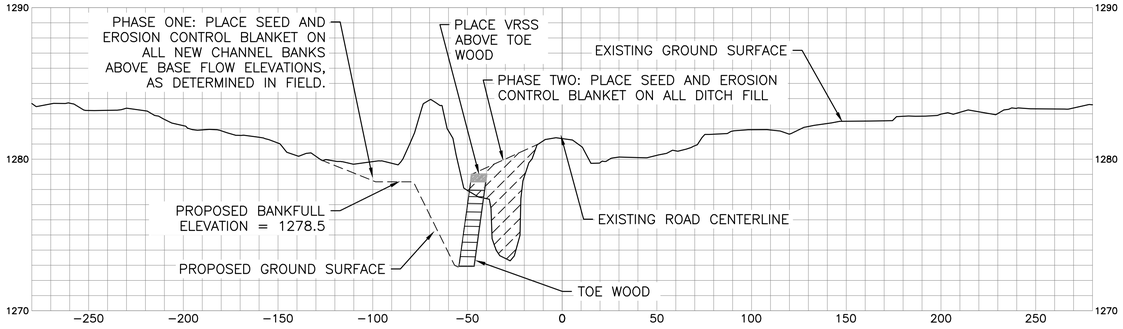
SPIDER CREEK RESTORATION
NESS, MINNESOTA

PLAN AND PROFILE STATIONS
35+00 TO 40+50

BARR PROJECT No. 23/69-1303
CLIENT PROJECT No.
DWG. No. C-07
REV. No. B

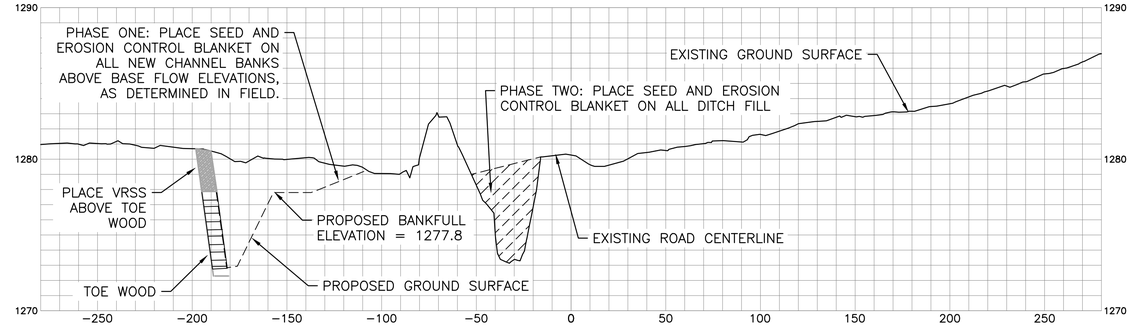
CL ROAD 91+40

STREAM RE-ALIGNMENT
STATION 2+74.00



CL ROAD 97+60

STREAM RE-ALIGNMENT
STATION 11+47.00

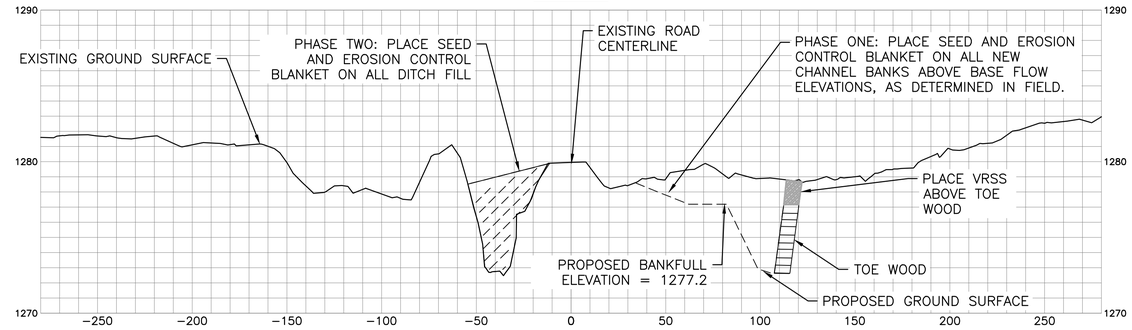


CL ROAD 93+80

STREAM RE-ALIGNMENT
STATION 6+00.00

CL ROAD 102+08

STREAM RE-ALIGNMENT
STATION 18+54.00



1 SECTIONS: EXISTING GROUND

0 40 80
HORIZONTAL SCALE IN FEET

0 5 10
VERTICAL SCALE IN FEET

NOTES:
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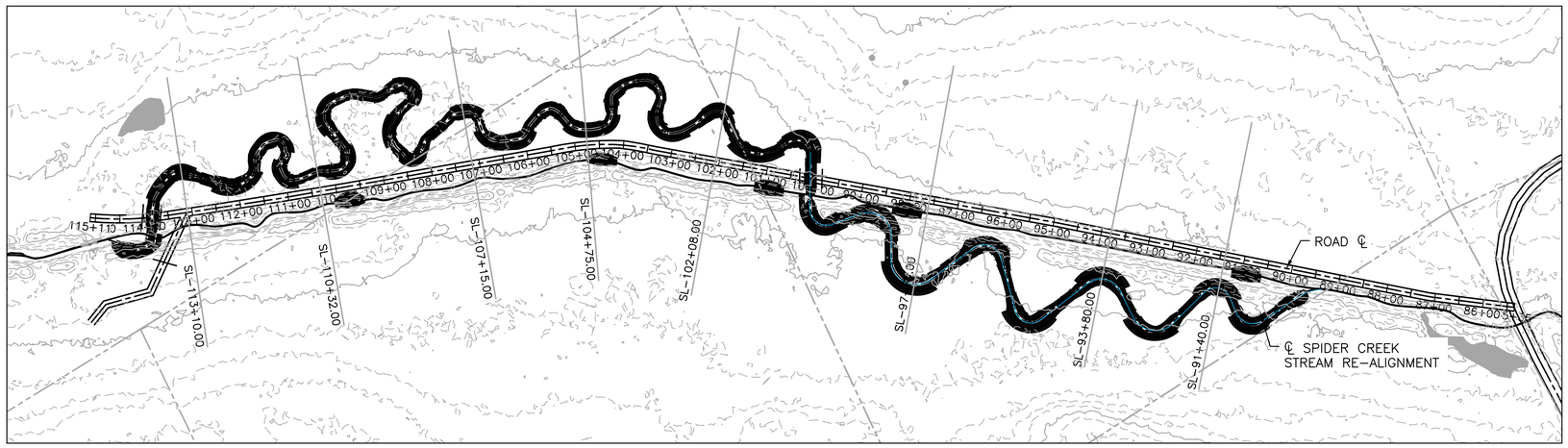

1 SECTION MAP: SPIDER CREEK STREAM RE-ALIGNMENT

0 150 300
SCALE IN FEET

LEGEND

- APPROX. PROPERTY BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
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- GRADE CONTROL RIFFLE SEE DETAIL 1/D01
- TOE WOOD WITH VRSS BANK PROTECTION SEE DETAIL 1/D02
- BERM SEE DETAIL 5/D03

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A	EPF	--	JCO	12/23/15	ISSUED FOR 60% REVIEW

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PRINTED NAME JESSICA C. L. OLSON
SIGNATURE
DATE 2/15/17 LICENSE # 43102

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CLIENT	12-23-15							
BID								
CONSTRUCTION								
PERMIT								
RECORD								

A	B	C	0	1	2	3

DATE RELEASED

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Scale	AS SHOWN
Date	5/26/15
Drawn	JDH2
Checked	JCO
Designed	JCO
Approved	

UNITED STATES STEEL CORPORATION
MINNESOTA ORE OPERATIONS – MINNTAC
MOUNTAIN IRON, MINNESOTA

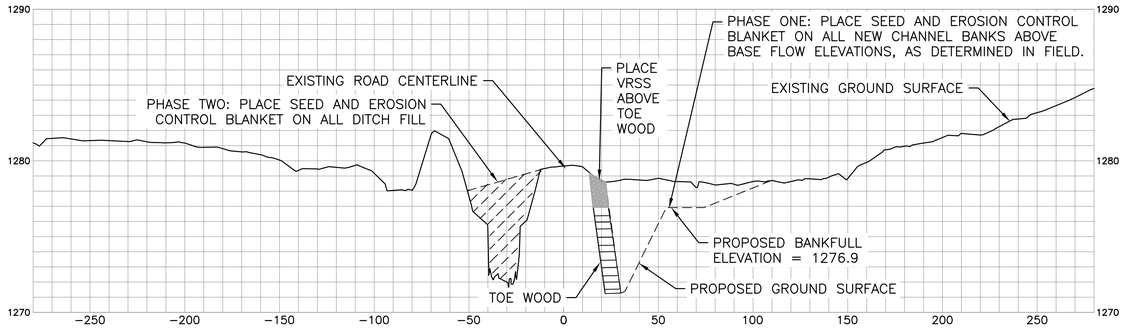
SPIDER CREEK RESTORATION
NESS, MINNESOTA

DESIGN CROSS SECTIONS

BARR PROJECT No. 23/69-1303
CLIENT PROJECT No.
DWG. No. C-08
REV. No. B

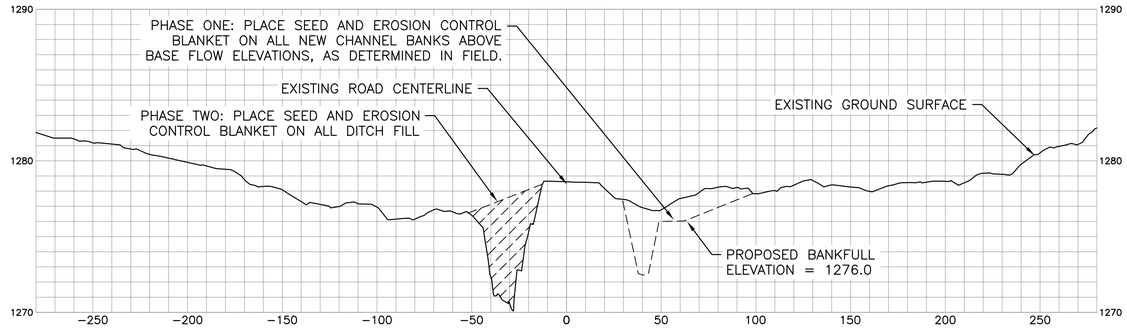
CL ROAD 104+75

STREAM RE–ALIGNMENT STATION 23+07.00



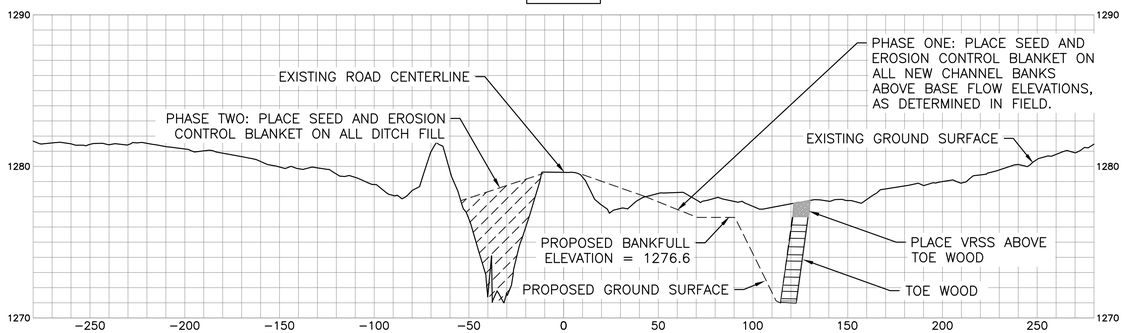
CL ROAD 110+32

STREAM RE–ALIGNMENT STATION 33+58.00



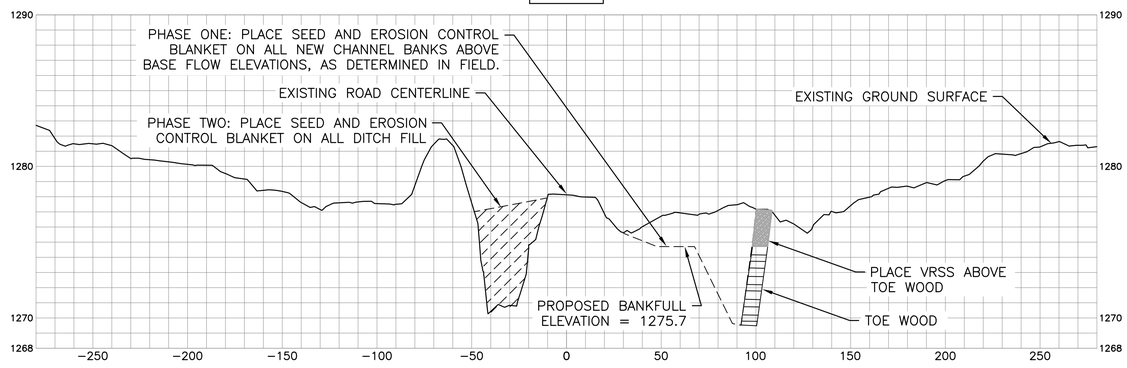
CL ROAD 107+15

STREAM RE–ALIGNMENT STATION 26+39.00



CL ROAD 113+10

STREAM RE–ALIGNMENT STATION 37+80.00



1 SECTIONS: EXISTING GROUND

0 40 80
HORIZONTAL SCALE IN FEET

0 5 10
VERTICAL SCALE IN FEET

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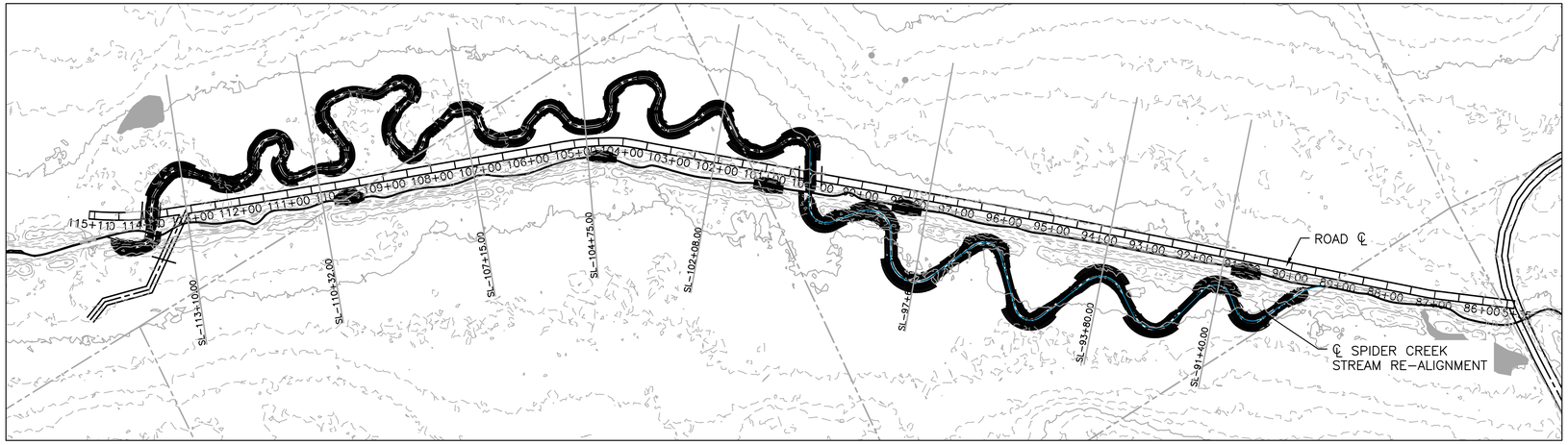

1 SECTION MAP: SPIDER CREEK STREAM RE–ALIGNMENT

0 150 300
SCALE IN FEET

LEGEND

- APPROX. PROPERTY BOUNDARY
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ISSUED FOR PERMIT
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A	FSS	—	JCO	12/07/15	ISSUED FOR COM'T REVIEW

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CLIENT	12-23-15										
BID											
CONSTRUCTION											
PERMIT	02-15-17										
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		A	B	0	0	1	0	1	0	1	7

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Scale	AS SHOWN
Date	5/26/15
Drawn	JDH2
Checked	JCO
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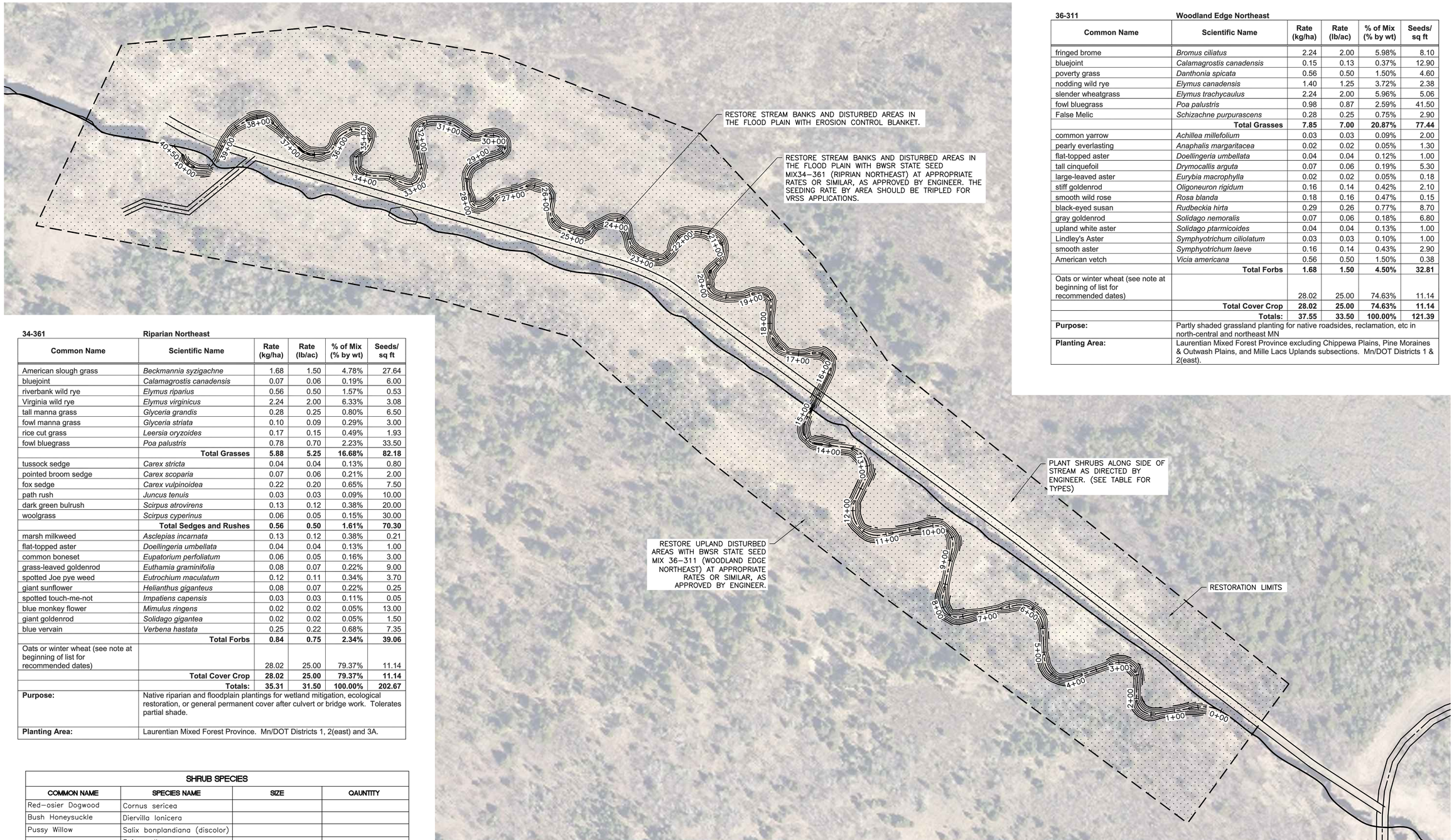
SPIDER CREEK RESTORATION
NESS, MINNESOTA

DESIGN CROSS SECTIONS

BARR PROJECT No. 23/69–1303
CLIENT PROJECT No.
DWG No. C–09 REV. B



34-361 **Riparian Northeast**

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
American slough grass	*Beckmannia syzigachne*	1.68	1.50	4.78%	27.64
bluejoint	*Calamagrostis canadensis*	0.07	0.06	0.19%	6.00
riverbank wild rye	*Elymus riparius*	0.56	0.50	1.57%	0.53
Virginia wild rye	*Elymus virginicus*	2.24	2.00	6.33%	3.08
tall manna grass	*Glyceria grandis*	0.28	0.25	0.80%	6.50
fowl manna grass	*Glyceria striata*	0.10	0.09	0.29%	3.00
rice cut grass	*Leersia oryzoides*	0.17	0.15	0.49%	1.93
fowl bluegrass	*Poa palustris*	0.78	0.70	2.23%	33.50
	Total Grasses	**5.88**	**5.25**	**16.68%**	**82.18**
tussock sedge	*Carex stricta*	0.04	0.04	0.13%	0.80
pointed broom sedge	*Carex scoparia*	0.07	0.06	0.21%	2.00
fox sedge	*Carex vulpinoidea*	0.22	0.20	0.65%	7.50
path rush	*Juncus tenuis*	0.03	0.03	0.09%	10.00
dark green bulrush	*Scirpus atrovirens*	0.13	0.12	0.38%	20.00
woolgrass	*Scirpus cyperinus*	0.06	0.05	0.15%	30.00
	Total Sedges and Rushes	**0.56**	**0.50**	**1.61%**	**70.30**
marsh milkweed	*Asclepias incarnata*	0.13	0.12	0.38%	0.21
flat-topped aster	*Doellingeria umbellata*	0.04	0.04	0.13%	1.00
common boneset	*Eupatorium perfoliatum*	0.06	0.05	0.16%	3.00
grass-leaved goldenrod	*Euthamia graminifolia*	0.08	0.07	0.22%	9.00
spotted Joe pye weed	*Eutrochium maculatum*	0.12	0.11	0.34%	3.70
giant sunflower	*Helianthus giganteus*	0.08	0.07	0.22%	0.25
spotted touch-me-not	*Impatiens capensis*	0.03	0.03	0.11%	0.05
blue monkey flower	*Mimulus ringens*	0.02	0.02	0.05%	13.00
giant goldenrod	*Solidago gigantea*	0.02	0.02	0.05%	1.50
blue vervain	*Verbena hastata*	0.25	0.22	0.68%	7.35
	Total Forbs	**0.84**	**0.75**	**2.34%**	**39.06**
Oats or winter wheat (see note at beginning of list for recommended dates)		28.02	25.00	79.37%	11.14
	Total Cover Crop	**28.02**	**25.00**	**79.37%**	**11.14**
	Totals:	**35.31**	**31.50**	**100.00%**	**202.67**
Purpose:	Native riparian and floodplain plantings for wetland mitigation, ecological restoration, or general permanent cover after culvert or bridge work. Tolerates partial shade.				
Planting Area:	Laurentian Mixed Forest Province. Mn/DOT Districts 1, 2(east) and 3A.				

36-311 **Woodland Edge Northeast**

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
fringed brome	*Bromus ciliatus*	2.24	2.00	5.98%	8.10
bluejoint	*Calamagrostis canadensis*	0.15	0.13	0.37%	12.90
poverty grass	*Danthonia spicata*	0.56	0.50	1.50%	4.60
nodding wild rye	*Elymus canadensis*	1.40	1.25	3.72%	2.38
slender wheatgrass	*Elymus trachycaulus*	2.24	2.00	5.96%	5.06
fowl bluegrass	*Poa palustris*	0.98	0.87	2.59%	41.50
False Melic	*Schizachne purpurascens*	0.28	0.25	0.75%	2.90
	Total Grasses	**7.85**	**7.00**	**20.87%**	**77.44**
common yarrow	*Achillea millefolium*	0.03	0.03	0.09%	2.00
pearly everlasting	*Anaphalis margaritacea*	0.02	0.02	0.05%	1.30
flat-topped aster	*Doellingeria umbellata*	0.04	0.04	0.12%	1.00
tall cinquefoil	*Drymocallis arguta*	0.07	0.06	0.19%	5.30
large-leaved aster	*Eurybia macrophylla*	0.02	0.02	0.05%	0.18
stiff goldenrod	*Oligoneuron rigidum*	0.16	0.14	0.42%	2.10
smooth wild rose	*Rosa blanda*	0.18	0.16	0.47%	0.15
black-eyed susan	*Rudbeckia hirta*	0.29	0.26	0.77%	8.70
gray goldenrod	*Solidago nemoralis*	0.07	0.06	0.18%	6.80
upland white aster	*Solidago ptarmicoides*	0.04	0.04	0.13%	1.00
Lindley's Aster	*Symphyotrichum ciliolatum*	0.03	0.03	0.10%	1.00
smooth aster	*Symphyotrichum laeve*	0.16	0.14	0.43%	2.90
American vetch	*Vicia americana*	0.56	0.50	1.50%	0.38
	Total Forbs	**1.68**	**1.50**	**4.50%**	**32.81**
Oats or winter wheat (see note at beginning of list for recommended dates)		28.02	25.00	74.63%	11.14
	Total Cover Crop	**28.02**	**25.00**	**74.63%**	**11.14**
	Totals:	**37.55**	**33.50**	**100.00%**	**121.39**
Purpose:	Partly shaded grassland planting for native roadsides, reclamation, etc in north-central and northeast MN				
Planting Area:	Laurentian Mixed Forest Province excluding Chippewa Plains, Pine Moraines & Outwash Plains, and Mille Lacs Uplands subsections. Mn/DOT Districts 1 & 2(east).				

SHRUB SPECIES			
COMMON NAME	SPECIES NAME	SIZE	QAUNTITY
Red–osier Dogwood	Cornus sericea		
Bush Honeysuckle	Diervilla lonicera		
Pussy Willow	Salix bonplandiana (discolor)		
Meadowsweet	Spirea alba		
		TOTAL SHRUBS	

1 – PLAN: SPIDER CREEK BANK STABILIZATION
1"=100'–0"

0 100 200
SCALE IN FEET

ISSUED FOR PERMIT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION
B	RRR2	--	JCO	02/15/17	ISSUED FOR PERMIT
A	EPF	--	JCO	12/23/15	ISSUED FOR 60% REVIEW

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PRINTED NAME JESSICA C. L. OLSON
SIGNATURE
DATE 2/15/17 LICENSE # 43102

RELEASED TO/FOR	A	B	C	0	1	2	3
	DATE RELEASED						

CLIENT	12-23-15						
BID							
CONSTRUCTION							
PERMIT		2-15-17					
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BARR
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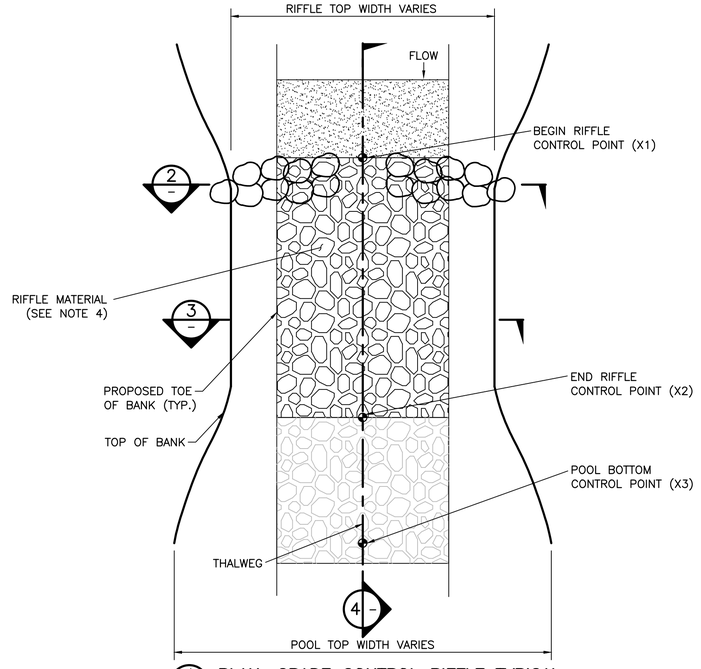
Scale	AS SHOWN
Date	12/23/15
Drawn	RRR2
Checked	JCO
Designed	JCO
Approved	

UNITED STATES STEEL CORPORATION
MINNESOTA ORE OPERATIONS – MINNTAC
MOUNTAIN IRON, MINNESOTA

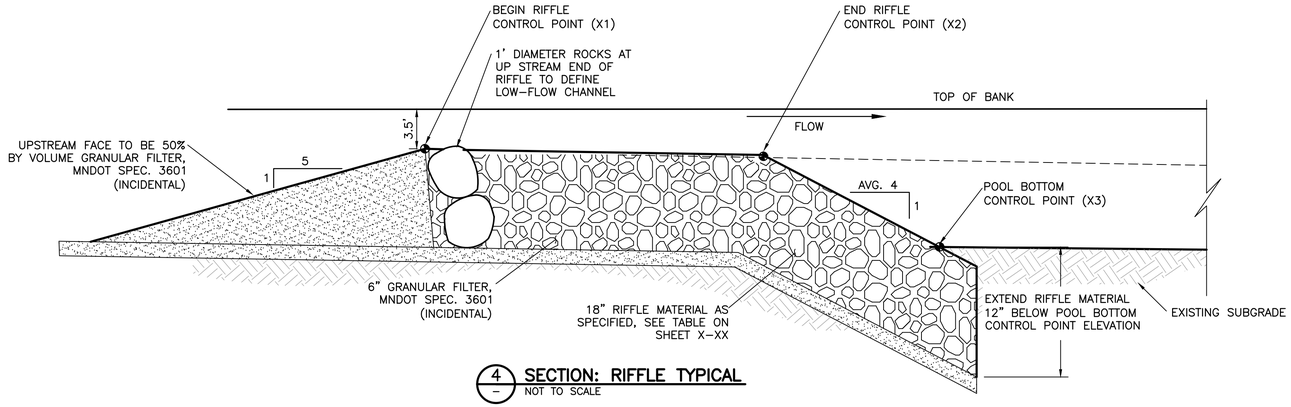
SPIDER CREEK RESTORATION
NESS, MINNESOTA

RESTORATION AND REVEGETATION PLAN

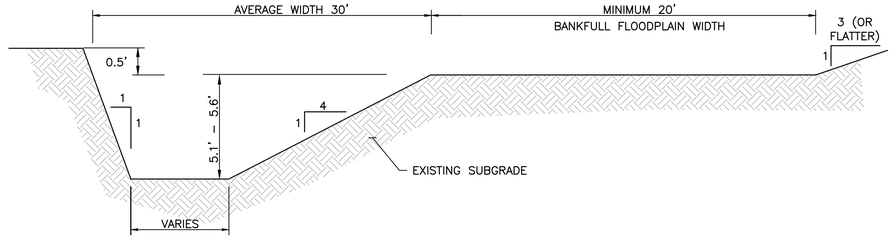
BARR PROJECT No. 23/69–1303
CLIENT PROJECT No.
DWG. No. C–10
REV. No. B



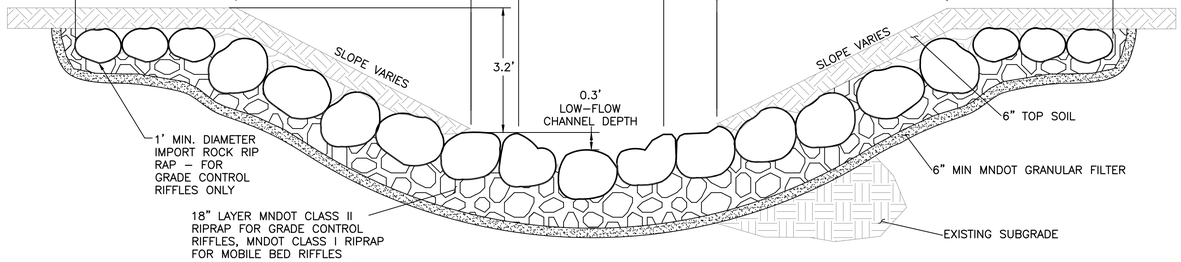
1 – PLAN: GRADE CONTROL RIFFLE TYPICAL
NOT TO SCALE



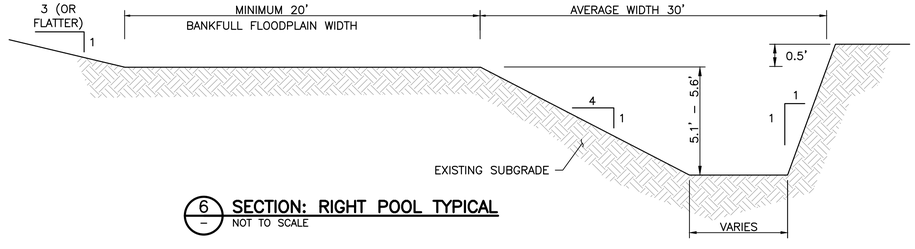
4 – SECTION: RIFFLE TYPICAL
NOT TO SCALE



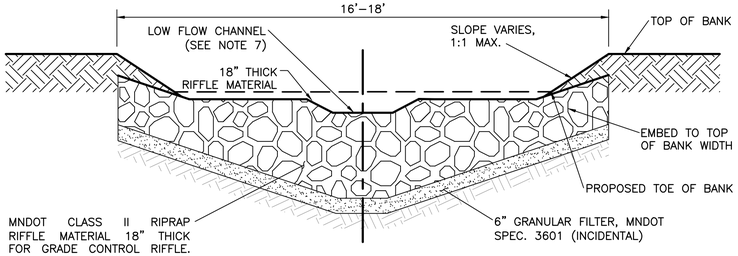
5 – SECTION: LEFT POOL TYPICAL
NOT TO SCALE



2 – SECTION: GRADE CONTROL RIFFLE FOR 'E' CHANNEL
NOT TO SCALE



6 – SECTION: RIGHT POOL TYPICAL
NOT TO SCALE



3 – SECTION: RIFFLE TYPICAL
NOT TO SCALE

NOTES:
1. CONSTRUCTION RIFFLES SHALL BE INSTALLED IN NEWLY GRADED CHANNEL SECTION.
2. ELEVATION CONTROL POINTS SHALL BE DESIGNATED AT THE BEGINNING AND END OF RIFFLE POINTS TO ESTABLISH PART OF THE PROFILE OF THE CHANNEL. SURVEY OF CONTROL POINTS SHALL BE REQUIRED TO ESTABLISH ACCURATE RIFFLE INSTALLATION.
3. RIFFLE MATERIAL SHALL BE OF A TYPE, SIZE, AND GRADATION AS SPECIFIED.
4. THE FACE OF THE RIFFLE UPSTREAM OF THE BEGIN RIFFLE CONTROL POINT SHALL BE 50% BY VOLUME GRANULAR FILTER AGGREGATE (MnDOT SPEC 3601) TO REDUCE VOID SPACES. FILTER AGGREGATE SHALL BE INCIDENTAL TO THE RIFFLE MATERIAL.
5. THE PLACEMENT OF BACKFILL AND/OR RIFFLE MATERIAL SHALL BE DONE IN A MANNER TO CREATE A SMOOTH PROFILE, WITH NO ABRUPT 'JUMP' (TRANSITION) BETWEEN THE UPSTREAM POOL-GLIDE AND THE RIFFLE, AND LIKEWISE NO ABRUPT 'DROP' (TRANSITION) BETWEEN THE RIFFLE AND THE DOWNSTREAM RUN-POOL. ALSO A THALWEG SHALL BE FASHIONED WITHIN THE RIFFLE WIDTH SO THAT THE FINISHED CROSS SECTION OF THE RIFFLE MATERIAL MATCHES THE SHAPE AND DIMENSIONS SHOWN ON THE RIFFLE TYPICAL SECTION.
6. SEE THE STREAM RESTORATION STRUCTURES TABLE ON SHEET G-02 FOR STATIONING AND ELEVATIONS.
7. SEE RIFFLE SECTIONS FOR BANKFULL AND LOW-FLOW CHANNEL DIMENSIONS.
8. FEATURE WIDTHS AND DEPTHS WILL VARY THROUGHOUT THE RESTORATION REACH. SEE PROPOSED CHANNEL DETAILS ON SHEET C-01 FOR DESIGN RANGES.
9. ALL EXPOSED SLOPES ABOVE FIELD-DETERMINED BASE-FLOW ELEVATION WILL BE STABILIZED WITH SEED AND EROSION CONTROL BLANKET UPON CONSTRUCTION COMPLETION.

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Scale	AS SHOWN
Date	5/26/15
Drawn	EPF
Checked	JCO
Designed	JCO
Approved	

UNITED STATES STEEL CORPORATION
MINNESOTA ORE OPERATIONS - MINNTAC
MOUNTAIN IRON, MINNESOTA

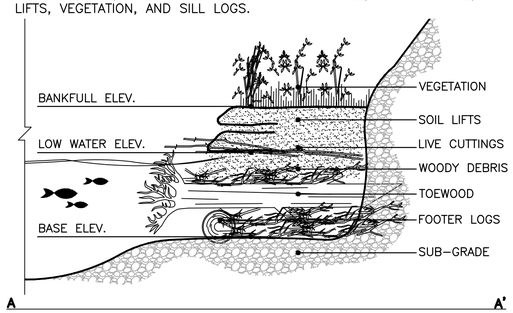
SPIDER CREEK RESTORATION
NESS, MINNESOTA

DETAILS
SHEET 1 OF 4

BARR PROJECT No. 23/69-1303
CLIENT PROJECT No.
DWG. No. D-01
REV. No. B

1 D-02 TOEWOOD INSTALLATION SUMMARY

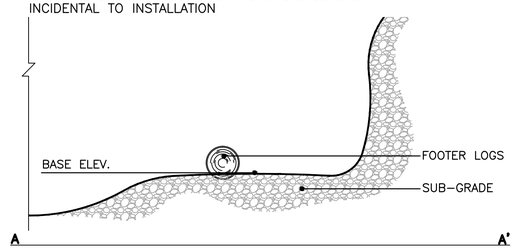
–TOEWOOD BENCH CONSTRUCTION WILL BE DONE IN DRY WEATHER CONDITIONS AFTER SITE HAS BEEN DE–WATERED.
–ENGINEER MUST BE PRESENT FOR INSTALLATION OF TOEWOOD BENCH.
–THE DRAWINGS ON THIS PAGE ARE NOT TO SCALE.
–SEE TABLE ON SHEET C–03 FOR TOEWOOD ELEVATIONS AND STATIONING.
–ALL TOEWOOD MATERIALS INCLUDED IN THIS DETAIL ARE INCIDENTAL TO THE TOEWOOD INSTALLATION. THIS INCLUDES, BUT IS NOT LIMITED TO THE FOLLOWING: SUBGRADE AND FOOTER LOGS, ROOT WADS & LARGE WOODY DEBRIS, WOODY DEBRIS AND GRANULAR FILL, LIVE CUTTINGS, SOIL LIFTS, VEGETATION, AND SILL LOGS.

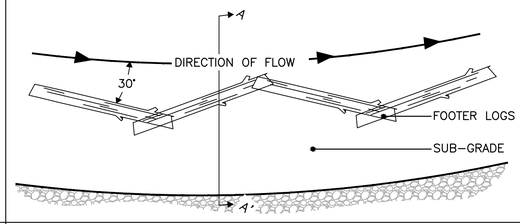


2 D-02 SUBGRADE AND FOOTER LOGS

FOOTER LOGS SPECIFICATION:
–8" TO 1' DIAMETER
–LIMBS REMOVED
–APPROX 10' LENGTH

PLACEMENT:
–EXCAVATE TO BASE ELEVATION – CONTRACTOR SHALL MAKE EFFORT TO SEPARATE GRANULAR AND FINE FILL NATIVE MATERIAL FOR USE IN STEPS 4 AND 6.
–PLACE FOOTER LOGS 30 DEGREES FROM PARALLEL TO STREAM FLOW WITH ENDS STACKED CREATING A ZIG ZAG PATTERN (PLAN VIEW BELOW)
–MAINTAIN AVERAGE ELEV. OF 1' ABOVE BASE ELEV.
–MATERIAL EXCAVATION AND OFF–SITE DISPOSAL IS INCIDENTAL TO INSTALLATION



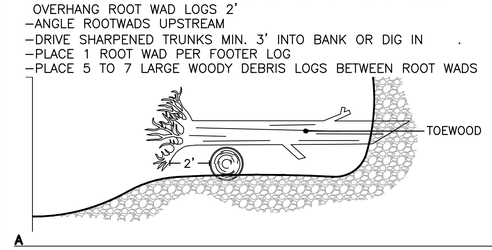


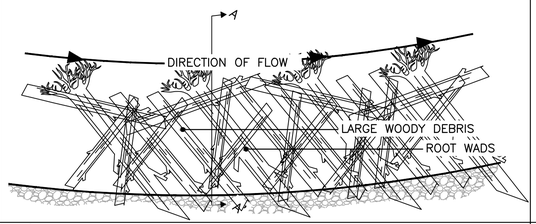
3 D-02 ROOT WADS & LARGE WOODY DEBRIS

ROOT WAD SPECIFICATION:
–10" MIN DIAMETER
–LENGTH INDICATED IN DESIGN CROSS SECTION OR 10' MIN.
–LIMBS REMOVED
–ROOT WADS LEFT INTACT
–ENDS SHARPENED TO A POINT

LARGE WOODY DEBRIS SPECIFICATION:
–8" MIN DIAMETER
–LIMB INTACT

PLACEMENT:
–PLACE ROOT WADS HORIZONTALLY ON TOP OF FOOTER LOGS, OVERHANG ROOT WAD LOGS 2'
–ANGLE ROOTWADS UPSTREAM
–DRIVE SHARPENED TRUNKS MIN. 3' INTO BANK OR DIG IN .
–PLACE 1 ROOT WAD PER FOOTER LOG
–PLACE 5 TO 7 LARGE WOODY DEBRIS LOGS BETWEEN ROOT WADS

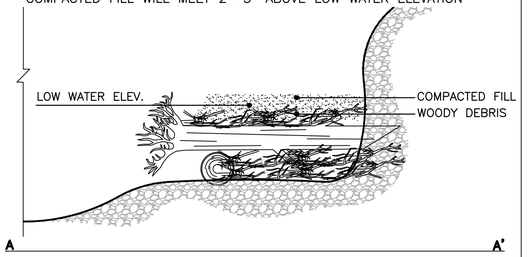


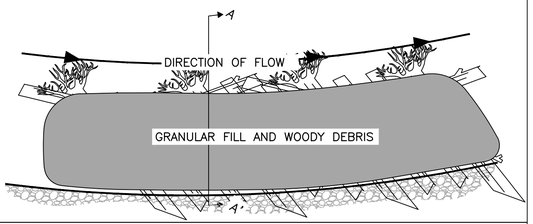


4 D-02 WOODY DEBRIS & GRANULAR FILL

WOODY DEBRIS AND GRANULAR FILL SPECIFICATION:
–WOODY MATERIAL (COMPOSED OF SMALL LIMBS AND BRANCHES, APPROX. 4" MAX DIAMETER AND SMALLER)
–DO NOT USE ROTTEN WOODY MATERIAL
–NATIVE GRANULAR FILL

PLACEMENT:
–FILL BETWEEN FOOTER LOGS AND ROOT WAD WITH WOODY DEBRIS
–STACK WOODY DEBRIS TO LOW WATER ELEVATION
–LAYER NATIVE GRANULAR FILL ON TOP OF WOODY DEBRIS
–COMPACT SO THAT SETTLING OF FILL IS MINIMIZED BUT DEBRIS IS NOT DISPLACED
–COMPACTED FILL WILL MEET 2"–5" ABOVE LOW WATER ELEVATION

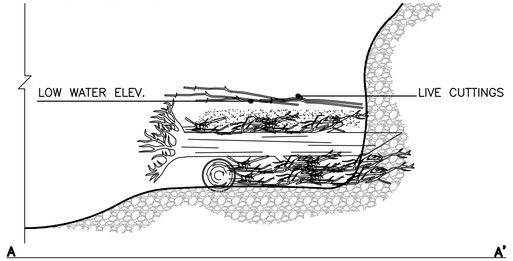


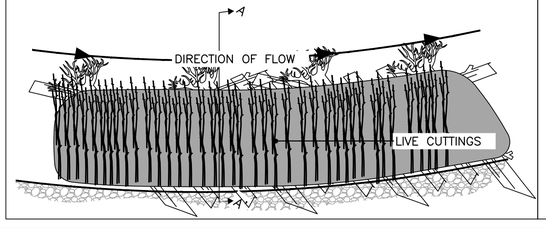


5 D-02 LIVE CUTTINGS

LIVE CUTTINGS SPECIFICATION:
–1/2" DIAMETER MIN. WILLOW (SALIX SP.) DOGWOOD, OR APPROVED EQUAL
–STAKES AND CUTTINGS SHALL BE HARVESTED WHEN DORMANT (SPRING OR FALL) AND KEPT COOL AND MOIST UNTIL INSTALLATION, WHICH SHALL BE WITHIN TWO WEEKS OF HARVESTING.

PLACEMENT:
–LAY CUTTINGS WITH A DENSITY OF 10 CUTTINGS PER LINEAL FOOT
–TOPS OF CUTTING WILL POINT TOWARD CHANNEL SEE SECTION BELOW
–TRIM EXPOSED ENDS OF CUTTINGS, LEAVE NO MORE THAN 6" EXPOSED
–DEPOSIT NATIVE FILL OVER CUTTINGS AND WATER LIBERALLY, COMPRESS FILL TO 2"– 4"

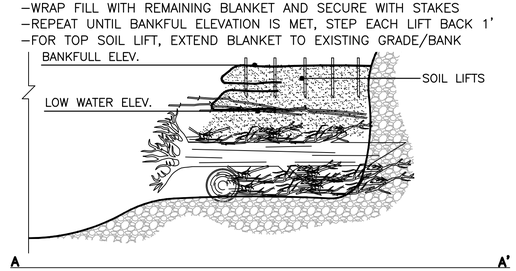


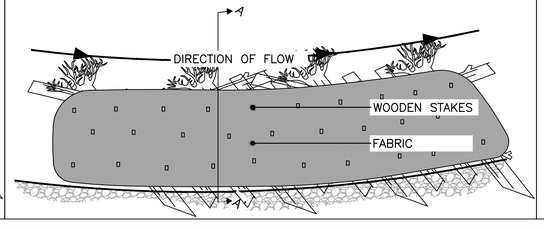


6 D-02 SOIL LIFTS

SOIL LIFTS SPECIFICATION:
–NATIVE FILL (FINE)
–1' FORMS
–MIN 6.5' WIDE ROLANKA BIOD–MAT 70, GEOCOIR 700, OR EQUAL LINED WITH MNDOT CAT II EROSION CONTROL BLANKET WITH NATURAL NETTING
–18" WOODEN STAKES (2X4 CUT AT ANGLE), PLACED AT 3' SPACING

PLACEMENT:
–PLACE FORM
–LAY MIN 2.5' OF FABRIC (COCONUT BLANKET AND LINER) ALONG BENCH
–PLACE 1' OF FILL ON TOP OF MAT AND COMPACT
–WRAP FILL WITH REMAINING BLANKET AND SECURE WITH STAKES
–REPEAT UNTIL BANKFUL ELEVATION IS MET, STEP EACH LIFT BACK 1'
–FOR TOP SOIL LIFT, EXTEND BLANKET TO EXISTING GRADE/BANK

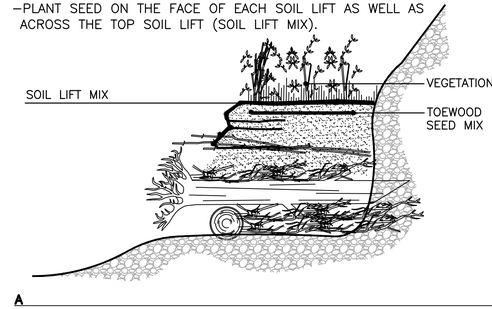


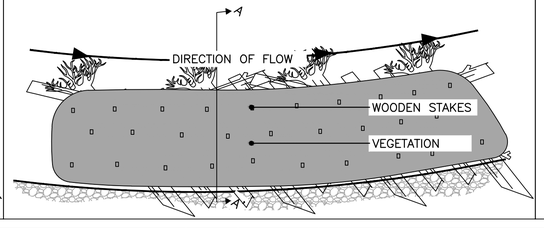


7 D-02 VEGETATION

SPECIFICATION:
–SEE LIVE STAKES DETAIL ON SHEET D–03
–TOEWOOD SEED MIX
–SOIL LIFT SEED MIX

PLACEMENT:.
–PLANT LIVE STAKES IN TOP SOIL LIFT IN BETWEEN 18" WOODEN STAKES.
–PLANT SEED (TOEWOOD MIX) INSIDE OF SOIL LIFT PRIOR TO COVERING WITH FABRIC.
–PLANT SEED ON THE FACE OF EACH SOIL LIFT AS WELL AS ACROSS THE TOP SOIL LIFT (SOIL LIFT MIX).

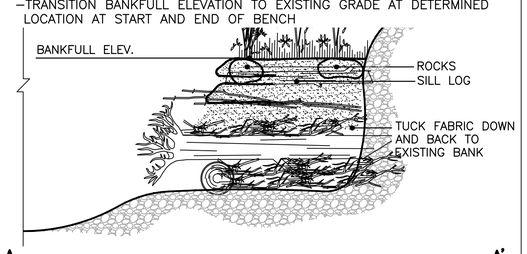


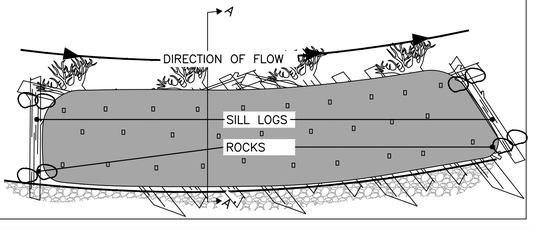


8 D-02 SILL LOGS & TERMINATION

SPECIFICATION:
–10" MIN DIAMETER LOGS
–LIMBS REMOVED
–LENGTH DETERMINED BY WIDTH OF TOEWOOD BENCH
–ROCKS

PLACEMENT:
–PLACE ONE SILL LOG AT THE START AND END OF THE TOEWOOD BENCH PERPENDICULAR TO THE DIRECTION OF FLOW.
–PLACE LARGE ROCKS ON TOP OF SILL LOG, TOP OF ROCK WILL MEET BANKFULL ELEVATION
–TUCK SOIL LIFT BLANKET DOWN AND BACK TOWARDS EXISTING BANK
–TRANSITION BANKFULL ELEVATION TO EXISTING GRADE AT DETERMINED LOCATION AT START AND END OF BENCH





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Checked	JCO
Designed	JCO
Approved	

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MOUNTAIN IRON, MINNESOTA

SPIDER CREEK RESTORATION
NESS, MINNESOTA

DETAILS
SHEET 2 OF 4

BARR PROJECT No.	
23/69–1303	
CLIENT PROJECT No.	
DWG. No.	REV. No.
D–02	B

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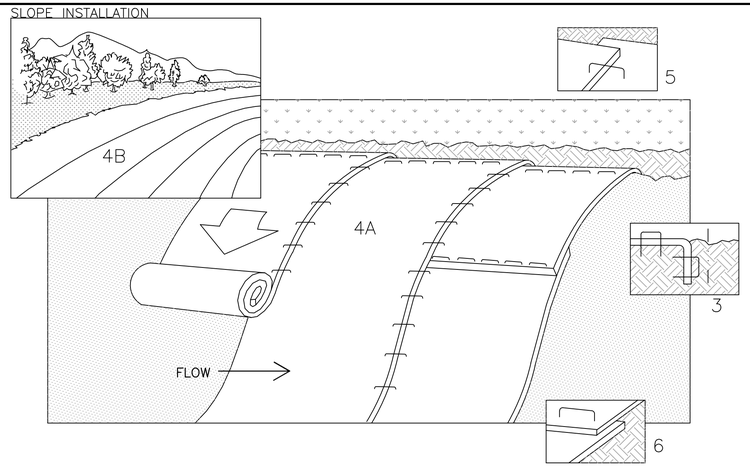
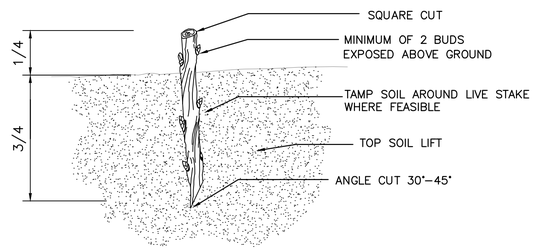


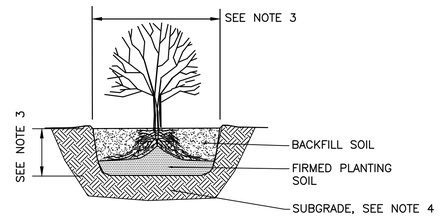
1. REFER TO GENERAL STAPLE PATTERN GUIDE FOR CORRECT STAPLE PATTERN RECOMMENDATIONS FOR SLOPE INSTALLATIONS.
2. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING APPLICATION OF LIME, FERTILIZER, AND SLOPE SEED MIX (WOODLAND EDGE). NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
3. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE BLANKET IN 6" DEEP X 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
4. ROLL THE BLANKETS (A) DOWN OR (B) HORIZONTALLY ACROSS THE SLOPE.
5. THE EDGES OF PARALLEL BLANKETS MUST BE STAPLED WITH APPROXIMATELY 6" OVERLAP, WITH THE UPHILL BLANKET ON TOP.
6. WHEN BLANKETS MUST BE SPLICED DOWN THE SLOPE, PLACE BLANKETS END OVER END (SHINGLE STYLE) WITH APPROXIMATELY 6" OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" APART.

1 D-03 **DETAIL: TEMPORARY EROSION CONTROL BLANKET**
NOT TO SCALE



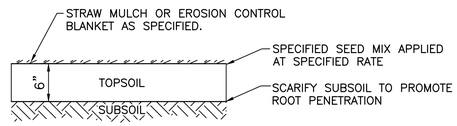
LIVE STAKE AND CUTTING NOTES:
1. LIVE STAKE PLANTED PERPENDICULAR TO GROUND SURFACE.
2. LIVE STAKES TO BE WILLOW, (SALIX SP.), DOGWOOD, OR APPROVED EQUIVALENT.
3. LIVE STAKES – 1" DIAMETER MINIMUM.
4. PLANT LIVE STAKES 2' APART, STARTING AT EDGE OF BANKFULL BENCH.
5. STAKES SHALL BE HARVESTED WHEN DORMANT (SPRING OR FALL) AND KEPT COOL AND MOIST UNTIL INSTALLATION, WHICH SHALL BE WITHIN TWO WEEKS OF HARVESTING.

2 D-03 **DETAIL: LIVE STAKES AND LIVE CUTTINGS**
NOT TO SCALE



BARE ROOT PLANTING NOTES:
1. PROVIDE AND INSTALL PLANT MATERIAL THAT MEET SPECIFICATIONS.
2. SOAK ROOTS IN WATER MINIMUM OF ONE HOUR PRIOR TO PLANTING.
3. PLANTING HOLE DIMENSIONS:
   18" TALL SHRUB: MIN 30" WIDE, MIN. 8" DEEP
4. SCARIFY SIDES AND BOTTOM OF PLANTING HOLE PRIOR TO PLANTING.
5. TRANSFER PLANT DIRECTLY FROM WATER TO HOLE, SET PLANT AT SAME DEPTH AS IT WAS GROWN IN NURSERY.
6. SET PLUMB AND IMMEDIATELY BACKFILL WITH PLANTING SOIL. DO NOT LEAVE PLANT IN PLANTING HOLE UNCOVERED. LIGHTLY FIRM SOIL TO MAINTAIN PLUMB POSITION.
7. APPLY WATER TO SETTLE PLANTS AND FILL VOIDS THEN CONSTRUCT 3" DEPTH WATERING BASIN.
8. WATER THOROUGHLY WITHIN 2 HOURS (1ST WATERING).

3 D-03 **DETAIL: BARE ROOT SHRUB STOCK PLANTING**
NOT TO SCALE



(WHERE REQUIRED, PLANT TREES AND SHRUBS ACCORDING TO PLAN)

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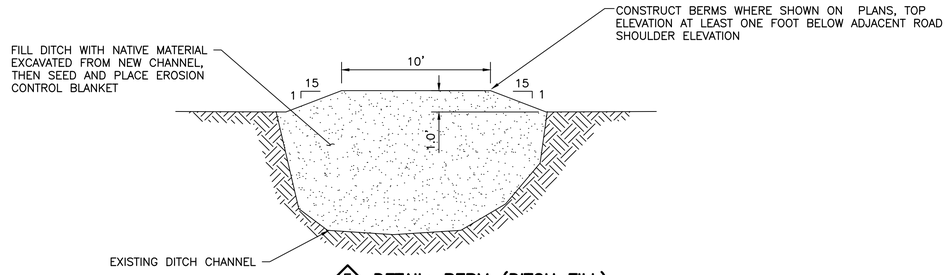

5 D-03 **DETAIL: BERM (DITCH FILL)**
NOT TO SCALE

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NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION
B	RRR2	JCO	JCO	02/15/17	ISSUED FOR PERMIT
A	JCO	JCO	JCO	12/23/15	ISSUED FOR 60% REVIEW

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 JESSICA C. L. OLSON
SIGNATURE
DATE 2/15/17 LICENSE # 43102

CLIENT	12-23-15							
BID								
CONSTRUCTION								
RELEASED TO/FOR	A	B	C	0	1	2	3	
DATE RELEASED								

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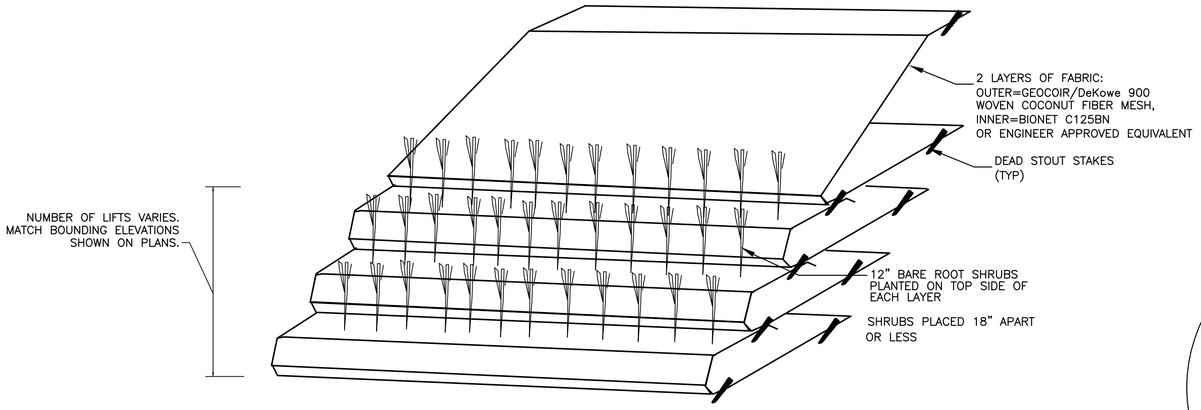
Scale	AS SHOWN
Date	12/21/15
Drawn	RRR2
Checked	JCO
Designed	JCO
Approved	

UNITED STATES STEEL CORPORATION
MINNESOTA ORE OPERATIONS –
MINNTAC
MOUNTAIN IRON, MINNESOTA

SPIDER CREEK RESTORATION
NESS, MINNESOTA

DETAILS
SHEET 3 OF 4

BARR PROJECT No. 23/69-1303
CLIENT PROJECT No.
DWG. No. D-03
REV. No. B



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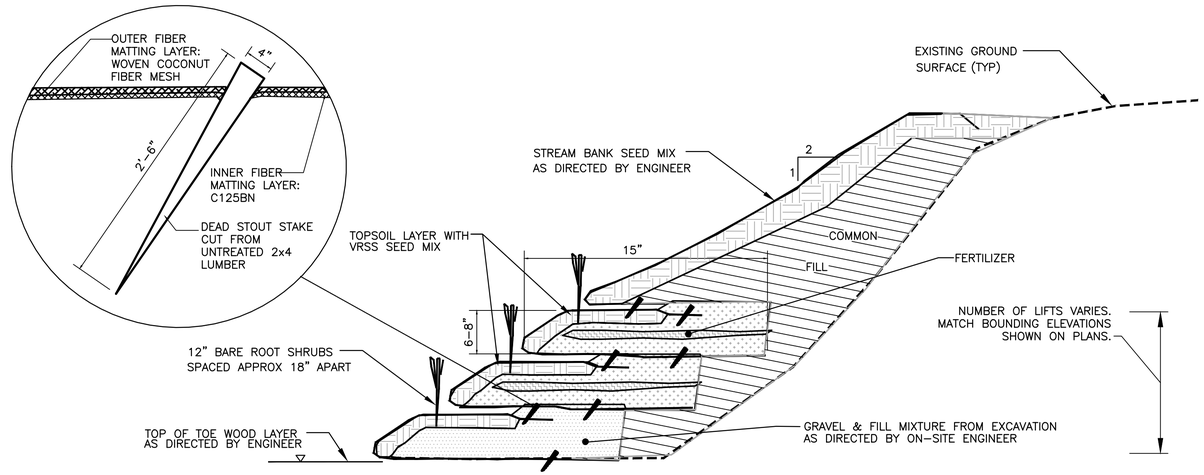

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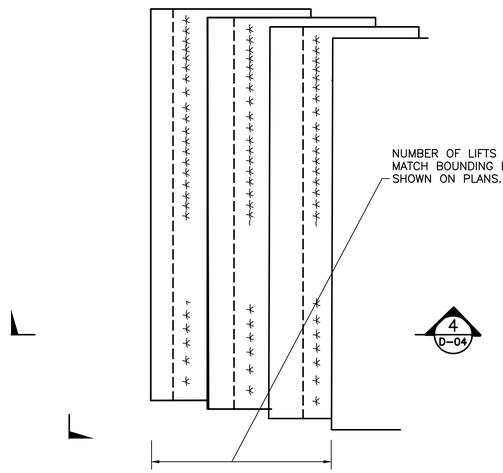
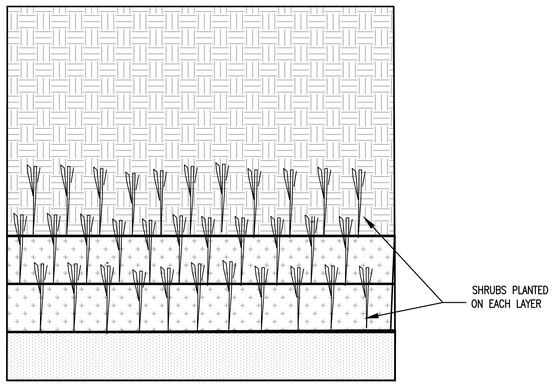
NOT TO SCALE

3 D-04





2 D-04 **PLAN: LIVE PLANT VEGETATED REINFORCED SOIL SLOPE (V.R.S.S.)**
NOT TO SCALE

3 D-04 ELEVATION: LIVE PLANT VEGETATED REINFORCED SOIL SLOPE (V.R.S.S.)
NOT TO SCALE

GENERAL NOTES ON V.R.S.S.

1. The ENGINEER must be notified at least 3 days prior to root wad installation and must be on site during installation.
2. Soak dormant cuttings for a minimum of 24 hours in flowing water before planting. Soaking for 5–7 days is considered ideal. The dormant cuttings should only be installed during the dormant season, after leaf drop in the fall and before bud break in the Spring. Dormant cuttings stored in cold storage with NO visible sign of bud break may be used into late Spring.
3. Install riprap and granular filter aggregate as specified in Section 02375 and as shown on the Drawings.
4. Excavate the existing streambank slope shoreward from and level with the top of the riprap to form a stable, undisturbed surface. A flat bench should be created from the toe of the stable cut slope to the toe of the proposed stream bank riprap.
5. Dormant cuttings are to be placed on top of the riprap excavated bench at 3 branches per linear foot; the basal end of the cuttings should extend at least 2 foot past the back of the riprap. No more than 6 inches of the budding end of the live branch should extend past the front of the riprap. Cover the dormant cuttings with topsoil to create an even surface for the construction of the first soil lift.
6. Lay natural fiber matting on bottom of the bench, overlapping adjacent matting by 1 foot. The outer exposed fiber matting layer of each soil lift shall be GEOCOIR/DeKowe 900 woven coconut fiber mesh, BioD-MatTM 90, or an ENGINEER approved equivalent.
7. The inner layer of each soil lift shall be BioNet C125BN or an ENGINEER approved equivalent. Lay the inner layer of BioNet on top of natural fiber matting of each soil lift. Fabric should be installed smooth with no unnecessary folds or wrinkles. Stake the shoreward end of the fiber matting in place with wooden stakes spaced every three feet as shown on the Drawings.
8. The first 6 to 8 inches of the bottom soil lift shall be filled with gravel and sand material excavated from the stream bed. The top 6 to 8 inches on the front of surface layer should be comprised of topsoil mix as shown on the Drawings.
9. The topsoil layer shall be seeded with the VRSS seed mix at 0.7 pounds per 1,000 square feet of lift surface area as shown on the Drawings.
10. Fold the fiber matting over the fill material and stake in place so the fabric is taut and smooth with no unnecessary folds or wrinkles. Backfill behind the bottom soil lift with granular filter material to meet the existing slope as shown on the Drawings.

ISSUED FOR PERMIT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION
A	RRR2	JCO	JCO	12/23/15	ISSUED FOR PERMIT

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 JESSICA C. L. OLSON
SIGNATURE
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CLIENT								
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CONSTRUCTION								
PERMIT	02-15-17							
RECORD								
RELEASED TO/FOR	A	B	C	0	1	2	3	
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Scale	AS SHOWN
Date	12/21/15
Drawn	RRR2
Checked	JCO
Designed	JCO
Approved	

UNITED STATES STEEL CORPORATION
MINNESOTA ORE OPERATIONS – MINNTAC
MOUNTAIN IRON, MINNESOTA

SPIDER CREEK RESTORATION
NESS, MINNESOTA

DETAILS
SHEET 4 OF 4

BARR PROJECT No. 23/69-1303
CLIENT PROJECT No.
DWG. No. D-04
REV. No. A

Attachment B: Spider Creek Wetland Delineation Report

Wetland Delineation Report
Spider Creek Stream Mitigation Project

Prepared for:

Minnesota Ore Operations - Minntac
United States Steel Corporation

October 2016

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Minneapolis, MN 55435
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Wetland Delineation Report
Spider Creek Stream Mitigation Project

October 2016

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1.0 Introduction

Barr Engineering Company (Barr) conducted a wetland delineation at the proposed restoration area for the Spider Creek Stream Mitigation Project (Project). The delineation was conducted in an investigation area of approximately 32.5 acres. The field delineation was completed on August 3, 2016.

The proposed Project is a stream restoration on a segment of Spider Creek. The Project is located near the intersection of County Road 166 and County Road 167 in Ness Township (Section 24, Township 52 North, Range 19 West) of St. Louis County, Minnesota (Figure 1). Spider Creek runs southeast to northwest through the investigation area.

2.0 Wetland Delineation and Classification Methods

The wetland delineation was conducted according to guidance from the USACE, including the Routine On-Site Determination Method as specified in the *1987 U.S. Army Corps of Engineers Wetlands Delineation Manual* (USACE 1987), the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0)* (USACE 2012), and the *Guidance for Submittal of Delineation Reports to the St. Paul District Corps of Engineers and Wetland Conservation Act Local Governmental Units in Minnesota, Version 2.0* (USACE 2015).

Wetland boundaries were defined by sampling in a wetland and an adjacent upland in a series of paired plots. The observations at each sampling plot were recorded using wetland determination data forms. Site data was collected for soils, vegetation, and hydrology at each sample plot. Soils were examined to a depth of at least 30 inches below the ground surface. Representative soil samples from each boring were examined for color, texture, and the presence of hydric soil indicators. Soil colors (e.g., 7.5YR 4/2.) were determined using Munsell® soil color charts, and soil textures were classified by feel. The NRCS hydric soil indicators (Version 7.0, 2010) were used to identify hydric soils. Hydrologic conditions were evaluated at each sample plot by documenting the presence or absence of primary (e.g. surface water) and/or secondary (e.g. water stained leaves) hydrology indicators. Plant species at each sample plot were identified, and percent areal cover was estimated. Dominant species were determined using the 50/20 rule (USACE 1987), and the corresponding wetland indicator status of each plant species was recorded using the current National Wetland Plant List (USACE 2016). A determination of hydrophytic vegetation status was made using the rapid test, dominance test, and prevalence index (USACE 1987). Photographs were collected of the study area and at the sample plots to document site conditions.

Wetland boundaries were collected on site using a Trimble GeoXH 6000 Global Positioning System (GPS) Unit, capable of recording positions with sub-foot horizontal accuracy. Wetland boundaries were later digitized in ArcView© 10.3 Geographic Information System (GIS) software.

Delineated wetlands were classified using the U.S. Fish and Wildlife Service (USFWS) Circular 39 System (Minnesota BWRS), the USFWS Cowardin System (Cowardin et al. 1979), and the Eggers and Reed Plant Community Classification System (Eggers and Reed 2011). A comparison of these classification systems is provided in Table 1.

3.0 Background Information

Prior to conducting the wetland delineation on August 3, 2016, the following background information was consulted to determine general site characteristics and to evaluate the probability and locations of potential wetlands within the investigation area.

3.1 Geology and Topography

The bedrock geology in the area is mapped as the early Proterozoic Animikie Group, where the primary rocks are shale and siltstone (Morey and Meints, 2000). The depth to bedrock is approximately 150 to 200 feet along this reach of Spider Creek (Minnesota Geological Survey, 2012). The glacial deposits in the area are mapped as lake-modified till of the Des Moines Lobe, specifically associated with the Culver moraine. The stream flows, generally, within an old outwash channel, typically composed of unsorted coarser materials (Hobbs and Goebel, 1982).

The U.S. Geological Survey (USGS) topographic map displays relatively flat topography within the investigation area (Figure 2). The surrounding area shows a gentle slope from the east and south towards the investigation area.

3.2 Antecedent Precipitation

Monthly precipitation data provided by the Minnesota Department of Natural Resources (MDNR) Division of Ecological and Water Resources State Climatology Office from a gridded database of monthly precipitation was compared with historical WETS table precipitation data from a 30-year dataset (Table 2) to determine if normal hydrologic and climatic conditions were present on-site during the delineation. When compared to the 1981-2010 summary statistics from the gridded database, the recorded precipitation data from 90 days prior to the delineation indicated normal precipitation for the periods 60-90 days and 30-60 days prior to the site visit and wetter than normal conditions 0-30 days prior to the site visit (Table 3). As a result of the historical precipitation data, Barr determined that wetter than normal hydrologic conditions were present at the time of the wetland delineation.

3.3 Hydrology and Floodplain

Spider Creek is a 2nd order perennial stream located within the Spider Creek watershed (MDNR Level 7 Minor Watershed #3036) and the St. Louis River major watershed (#3). It is a tributary of the Little Whiteface River. The existing immediate floodplain along Spider Creek is low-gradient, consisting primarily of grasses and shrubs. The stream channel was channelized and straightened. Previous studies indicate that the channelization has led to an incised channel that has become disconnected from its original, natural floodplain (Barr 2015).

3.4 Wetland and Waterway Mapping

The National Wetland Inventory (NWI) data shows the majority of the investigation area as a freshwater forested/shrub wetland (Figure 3). Spider Creek is listed as a MDNR Public Water (Figure 4). There are no Public Water Inventory Basins within the investigation area.

3.5 Mapped Soils

The U. S. Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS) *Soil Survey of St. Louis County* identified five soil types within the investigation area (Figure 5). A detailed description of each NRCS mapped soil type can be found in Table 4. Multiple soil borings were taken within the investigation area. Further information on the soil borings can be found in Section 4 and Figure 5.

4.0 Wetland Delineation Results and Discussion

Barr inspected the investigation area on August 3, 2016. A total of 0.26 acres of wetland was identified during the delineation, comprising 0.8 percent of the approximately 32.5 acre investigation area. A description of the identified wetlands, associated sample plots, and other site conditions is provided below. The locations of the wetland determination plots and wetland boundaries can be found in Figure 6.

4.1 Wetland 1

Wetland 1 is located at the northwest end of the investigation area on the north side of the road; it is classified as alder thicket wetland. The wetland is depressional, and does not appear to have a surface water connected to Spider Creek, though it is located within the apparent floodplain.

At the wetland sample point (W1), the dominant plant species were speckled alder (*Alnus incana)*, balsam poplar (*Populus balsamifera),* American red raspberry (*Rubus ideaus)*, and Canada bluejoint grass (*Calamagrostis canadensis)*. The observed soil texture was loam over sandy loam; 40 percent prominent redox concentrations are present beginning at 4 inches below the surface. Thus, the soil met the requirements to fulfil the redox depressions (F8) hydric soil indicator. Wetland hydrology was indicated by two secondary indicators, geomorphic position and a positive FAC-neutral test. Soil saturation and water table were not present within the upper 30 inches of the soil surface.

Documentation of hydrophytic vegetation, wetland hydrology, hydric soils, and other site conditions are described in the data sheets for sample plot W1 (Appendix A). Representative photographs are provided in Appendix B.

At the paired upland plot (U1), the dominant plant species was smooth brome (*Bromus inermis*). Soil was black loam in the upper 10 inches, over 2 inches of fine sand. Beginning at 12 inches was a layer of clay loam that is a depleted matrix, with 10 percent redox down to 32 inches. Water table and soil saturation were not observed down to 36 inches below the surface.

4.2 Wetland 2

Wetland 2 is located at the southeast end of the investigation area on the south side of County Road 167; it is classified as shrub-carr and hardwood swamp type wetland. The wetland is depressional; it was likely connected to Spider Creek historically, but has been cut-off from the channel by a berm on the south side of the creek.

At the wetland sample point (W2), the dominant species were speckled alder, black ash (*Fraxinus nigra*), sensitive fern (*Onoclea sensibilis),* and Canada bluejoint grass. The observed soil texture was a black mucky loam in the upper 18 inches over 6 inches of light brown coarse sand. A layer of peat was observed from 24 inches to the bottom of the pit (36 inches) indicating previous soil disturbance in this area. The soil met the requirements to fulfil the loamy mucky loam (F1) hydric soil indicator. Wetland hydrology was indicated by saturation within 12 inches, dry season water table, geomorphic position, and a positive FAC-neutral test.

Documentation of hydrophytic vegetation, wetland hydrology, hydric soils, and other site conditions are described in the data sheets for sample plot W2 (Appendix A). Representative photographs are provided in Appendix B.

At the paired upland plot (U2), the dominant plant species was reed canary grass (*Phalaris arundinacea*). Soil was dark brown sandy loam in the upper 15 inches, over 13 inches of loamy sand. Beginning at 28 inches was a later of sandy loam with 15 percent redox down to 32 inches. Neither hydric soil nor wetland hydrology indicators were observed.

4.3 Disturbed Conditions

Soils and hydrology within the investigation area have apparently been altered due to the channelization and spoil berms of this segment of Spider Creek. A majority of the investigation area was dominated by hydrophytic vegetation but did not meet hydric soil nor wetland hydrology indicator(s). Several soil borings were taken throughout the investigation area; most did not meet hydric soil criteria. Summary information for the vegetation, hydrology, and soil characteristics at the soil boring locations can be found in Table 5. It is likely that the majority of the investigation area was formerly within a wetland in the floodplain of Spider Creek. The creek channelization and incised channel conditions appear to have lowered the water table in the area and disconnected the floodplain from flooding in the creek.

An aerial photo from 1939 is included in Figure 7 and shows the historical conditions at this site. The photo occurred after Spider Creek had been channelized and indicates that much of the investigation area was cultivated as part of a small farm; including several buildings and a road. This indicates that portions of this former floodplain were previously dry enough for farming and buildings.

4.4 Summary

Two small wetland areas were mapped within the investigation area along Spider Creek. These wetlands occur in small depressions in the area that was likely a former floodplain of Spider Creek. The majority of this floodplain was found to be non-wetland, though much of it was formerly wetland.

5.0 References

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Tables

Table 1. Wetland Classifications

Wetland Plant Community Types (Eggers and Reed)	Classification of Wetlands and Deep Water Habitats of the United States (Cowardin et al. 1979)	Fish and Wildlife Service Circular 39 (Shaw and Fredine 1971)
Shallow, Open Water	Palustrine or lacustrine, littoral; aquatic bed; submergent, floating, and floating-leaved	Type 5: Inland open fresh water
Deep Marsh	Palustrine or lacustrine, littoral; aquatic bed; submergent, floating, and floating-leaved; and emergent; persistent and nonpersistent	Type 4: Inland deep fresh marsh
Shallow Marsh	Palustrine; emergent; persistent and nonpersistent	Type 3: Inland shallow fresh marsh
Sedge Meadow	Palustrine; emergent; narrow-leaved persistent	Type 2: Inland fresh meadow
Fresh (Wet) Meadow	Palustrine; emergent; broad- and narrow-leaved persistent	Type 1: Seasonally flooded basin or flat;
		Type 2: Inland fresh meadow
Wet to Wet-Mesic Prairie	Palustrine; emergent; broad- and narrow-leaved persistent	Type 1: Seasonally flooded basin or flat;
		Type 2: Inland fresh meadow
Calcareous Fen	Palustrine; emergent; narrow-leaved persistent; and scrub/shrub, broad leaved deciduous	Type 2: Inland fresh meadow
Open Bog	Palustrine; moss/lichen; and scrub/shrub; broad-leaved evergreen	Type 8: Bog
Coniferous Bog	Palustrine; forested: needle-leaved evergreen and deciduous	Type 8: Bog
Shrub - Carr	Palustrine; scrub/shrub; broad-leaved deciduous	Type 6: Shrub swamp
Alder Thicket	Palustrine; scrub/shrub; broad-leaved deciduous	Type 6: Shrub swamp
Hardwood Swamp	Palustrine; forested; broad-leaved deciduous	Type 7: Wooded swamp
Coniferous Swamp	Palustrine; forested; needle-leaved deciduous and evergreen	Type 7: Wooded swamp
Floodplain Forest	Palustrine; forested; broad-leaved deciduous	Type 1: Seasonally flooded basin or flat
Seasonally Flooded Basin	Palustrine; flat; emergent; persistent and non-persistent	Type 1: Seasonally flooded basin or flat

Table 2. Historical Precipitation Data
Spider Creek Stream Mitigation Wetland Delineation
St. Louis County, MN

Precipitation data for target wetland location:

county: **Saint Louis**
township name: **Ness**
nearest community: **Prosit**
township number: **52N**
range number: **19W**
section number: **24**

precipitation totals are in inches

color key:
total is in lowest 30th percentile of the period-of-record distribution
total is => 30th and <= 70th percentile
total is in highest 30th percentile of the period-of-record distribution

multi-month totals:
WARM = warm season (May thru September)
ANN = calendar year (January thru December)
WAT = water year (Oct. previous year thru Sep. present year)

A 'R' following a monthly total indicates a provisional value derived from radar-based estimates.

Period-of-Record Summary Statistics

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WARM	ANN	WAT
30%	0.48	0.38	0.77	1.41	2.37	2.85	2.89	2.44	2.19	1.29	0.80	0.61	16.25	24.97	24.68
70%	1.10	0.87	1.61	2.35	3.81	5.04	4.16	4.13	4.19	2.80	1.92	1.17	19.98	30.33	29.81
mean	0.85	0.72	1.27	2.09	3.12	4.09	3.87	3.60	3.29	2.24	1.42	0.96	17.97	27.48	27.47

1981-2010 Summary Statistics

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WARM	ANN	WAT
30%	0.56	0.39	0.84	1.56	2.39	3.30	3.06	2.40	2.84	1.71	1.07	0.76	17.36	27.62	27.25
70%	1.13	0.83	1.58	2.48	3.61	5.47	4.67	3.97	4.70	3.54	2.10	1.36	20.50	31.67	30.30
mean	0.87	0.70	1.29	2.25	3.02	4.25	4.18	3.48	3.79	2.78	1.72	1.09	18.73	29.42	29.28

Year-to-Year Data

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WARM	ANN	WAT
2016	0.81	0.98	3.49	2.14	2.1	5.13	5.08								
2015	0.45	0.41	0.87	0.99	4.32	4.00	1.86	3.97	7.94	2.10	2.46	2.82	22.09	32.19	28.75
2014	0.67	1.59	1.09	3.13	4.93	5.39	3.09	4.13	2.37	1.81	0.99	1.14	19.91	30.33	33.59
2013	0.99	0.82	1.73	3.77	3.48	6.06	3.22	3.39	1.68	4.19	0.68	2.33	17.83	32.34	28.53
2012	0.35	0.85	1.41	2.89	8.22	11.49	3.91	1.77	0.60	1.56	1.01	0.82	25.99	34.88	33.72
2011	1.11	0.21	0.49	2.51	2.98	3.90	3.40	6.81	1.24	1.22	0.65	0.36	18.33	24.88	29.90
2010	0.84	0.25	0.80	0.64	2.03	5.45	2.30	6.92	3.92	3.65	1.63	1.97	20.62	30.40	29.71
2009	0.50	0.87	2.83	1.33	1.33	1.85	3.87	4.08	0.38	4.13	1.08	1.35	11.51	23.60	22.75
2008	0.08	0.31	0.50	3.62	2.65	5.02	3.12	2.24	3.67	2.98	1.10	1.63	16.70	26.92	29.79
2007	0.55	0.77	1.85	3.09	3.28	3.35	3.40	2.28	5.08	6.01	0.50	2.07	17.39	32.23	27.70
2006	0.24	0.75	1.17	1.58	3.32	2.07	2.23	1.33	1.51	1.62	1.04	1.39	10.46	18.25	22.75
2005	1.63	0.78	0.66	0.96	3.67	5.64	2.35	0.78	2.85	4.26	3.28	1.01	15.29	27.87	24.54
2004	0.84	1.26	1.60	1.18	4.39	1.86	3.52	3.79	4.70	2.80	0.55	1.87	18.26	28.36	26.37
2003	0.15	0.21	0.86	1.50	2.56	2.66	5.13	2.62	5.02	1.39	1.37	0.47	17.99	23.94	24.23
2002	0.36	0.45	1.49	2.01	1.60	6.06	7.06	3.92	4.52	2.63	0.28	0.61	23.16	30.99	33.60
2001	0.89	1.87	0.62	6.57	5.08	2.89	1.61	4.41	1.34	3.05	2.50	0.58	15.33	31.41	30.98
2000	0.60	1.13	2.35	1.38	3.65	3.78	3.50	3.87	1.65	2.79	2.16	0.75	16.45	27.61	24.00
1999	0.77	0.54	0.98	2.73	4.70	3.19	7.59	5.78	5.01	1.54	0.36	0.19	26.27	33.38	37.93
1998	0.91	1.42	1.36	1.85	2.80	7.63	2.33	1.66	4.70	3.49	2.08	1.07	19.12	31.30	28.44
1997	1.91	0.21	1.73	0.68	1.80	5.54	4.47	2.44	3.04	2.20	1.17	0.41	17.29	25.60	30.16
1996	1.48	1.44	0.53	2.12	1.91	4.11	6.70	2.49	3.41	2.84	3.94	1.56	18.62	32.53	30.64
1995	1.08	0.77	1.09	1.68	2.42	1.15	8.54	5.60	2.81	3.82	1.32	1.31	20.52	31.59	29.30
1994	1.39	0.64	1.17	3.70	2.62	5.42	3.73	2.29	4.16	2.34	1.46	0.36	18.22	29.28	29.24
1993	1.29	0.05	0.39	2.37	3.59	5.51	5.40	3.73	2.28	0.75	2.53	0.84	20.51	28.73	28.25
1992	0.57	0.81	0.63	2.14	2.98	4.88	3.99	4.97	2.78	0.81	1.65	1.18	19.60	27.39	30.03
1991	0.53	0.87	1.91	2.17	3.74	5.77	7.18	1.46	5.68	1.75	3.75	0.78	23.83	35.59	35.02
1990	0.70	0.63	2.47	3.34	1.41	4.33	2.92	2.65	7.70	4.20	0.75	0.76	19.01	31.86	29.32
1989	1.63	0.32	1.66	1.78	2.88	3.82	1.70	3.19	3.48	1.75	0.78	0.64	15.07	23.63	25.37
1988	1.24	0.14	2.70	0.25	2.40	3.46	2.23	8.00	3.87	0.92	2.91	1.08	19.96	29.20	27.17
1987	0.81	0.30	0.90	0.55	5.71	1.47	7.71	2.28	3.84	0.95	1.11	0.82	21.01	26.45	27.06
1986	0.73	0.97	1.11	4.53	2.98	5.73	4.04	3.67	6.62	0.96	2.07	0.46	23.04	33.87	35.78
1985	0.36	0.53	1.08	2.81	3.88	4.92	3.91	2.95	4.84	1.50	2.08	1.82	20.50	30.68	32.28
1984	0.56	0.55	0.58	1.91	2.38	8.00	1.88	2.00	2.76	3.95	0.76	2.29	17.02	27.62	28.77
1983	1.62	0.35	1.26	2.33	2.12	3.60	3.56	5.87	4.46	2.92	3.83	1.40	19.61	33.32	34.56
1982	1.50	0.40	1.57	2.26	5.44	2.76	5.79	3.05	4.95	5.36	2.88	1.15	21.99	37.11	35.25
1981	0.34	1.44	0.73	4.57	1.24	5.71	3.69	4.21	2.57	6.15	0.55	0.83	17.42	32.03	27.28
1980	1.43	0.51	0.88	0.95	1.23	2.64	3.36	5.47	4.20	1.08	0.86	0.84	16.90	23.45	24.48
1979	0.88	1.65	3.25	1.45	4.40	4.56	6.11	2.16	2.59	2.80	0.88	0.13	19.82	30.86	31.21
1978	0.42	0.62	0.74	1.91	2.57	3.71	5.78	8.04	2.60	1.81	1.45	0.90	22.70	30.55	33.26
1977	0.69	0.36	2.73	1.18	4.29	4.17	3.48	3.44	4.85	2.56	3.00	1.31	20.23	32.06	26.98
1976	0.90	0.49	1.81	0.69	0.44	7.32	3.13	1.87	0.84	0.88	0.17	0.74	13.60	19.28	22.33
1975	3.11	0.44	1.68	1.99	1.86	5.68	3.10	2.98	2.33	1.68	2.62	0.54	15.95	28.01	27.12
1974	0.46	0.34	0.77	2.12	3.64	2.44	5.66	5.23	1.10	1.18	2.05	0.72	18.07	25.71	27.39
1973	0.56	0.13	1.04	1.97	4.09	3.57	3.37	4.71	4.24	3.88	0.89	0.86	19.98	29.31	27.52
1972	1.23	0.66	1.30	1.71	2.46	2.62	6.58	5.85	4.26	1.27	1.34	1.23	21.77	30.51	36.58
1971	0.91	1.86	1.33	1.20	2.86	5.46	3.40	5.02	2.26	6.65	2.59	0.67	19.00	34.21	35.50

Table 3. Antecedent Precipitation Data
Spider Creek Stream Mitigation Wetland Delineation
St. Louis County, MN

Precipitation Worksheet Using Gridded Database

Precipitation data for target wetland location:	
county: **Saint Louis**	township number: **52N**
township name: **Ness**	range number: **19W**
nearest community: **Prosit**	section number: **24**

Site visit date:
Wednesday, August 03, 2016

Score using 1981-2010 normal period

values are in inches	first prior 30 days: (7/4-8/3)	30-60 days prior: (6/4-7/3)	60-90 days prior: (5/4-6/3)
estimated precipitation total for this location:	5.08	4.10	3.13
there is a 30% chance this location will have less than:	2.90	3.27	2.41
there is a 30% chance this location will have more than:	4.45	5.37	3.69
type of month: dry normal wet	wet	normal	normal
monthly score	3 * 3 = 9	2 * 2 = 4	2 * 2 = 4
multi-month score: 6 to 9 (dry) 10 to 14 (normal) 15 to 18 (wet)	17 (Wet)		

Table 4. NRCS Mapped Soil Units within the Investigation Area.

Soil Symbol	Soil Name	Texture	Percent Hydric Components	Drainage Class	Depth to Water Table	Frequency of Flooding and Ponding	Associated Sample plots and Soil Borings	Percent of Investigation Area
1020A	Bowstring and Fluvaquents, loamy, 0-2% slopes, frequently flooded	Muck; Stratified fine sand to loamy fine sand; muck	100%	Very poorly drained	0 inches	Frequent; none	U1; W1; U2; W2; SB1-9; SB11-12	75.8%
B143B	Dinham-Dusler complex, 1-8% slopes	Sandy loam; sand; clay loam	5%	Moderately well drained	32 inches	None; none	SB10	9.8%
B101A	Schisler-Ellsburg-Baden depressional, complex, 0-2% slopes	Fine sandy loam; Stratified fine sand to loamy fine sand; clay loam; loam	85%	Poorly drained	0	None; none	SB13-14	11.1%
B103A	Melrude-Schisler-Baden, depressional, complex, 0-2% slopes	Loam; stratified loamy sand to silt loam; loam	95%	Poorly drained	0 inches	None; none	**None**	2.9%
B122A	Tacoosh mucky peat, Duluth catena, 0-1% slopes	Mucky peat; muck; stratified sandy loam to silty clay loam; loam	100%	Very poorly drained	0 inches	None; frequent	**None**	0.4%
							Total	**100%**

Table 5
Additional Soil, Hydrology, and Vegetation Data
Spider Creek Mitigation Site

Photo/ Soil Point #	Photo #s	Soil Notes	Depth to Saturation/ Water Table	General Observations	Dominant Vegetation	Vegetation Indicator Status
1	1	Sandy loam, no redox to 30".	No saturation/water to 30"	Forested	*Populus tremuloides*	FACU
					Thalictrum dasycarpum	FACW
2	2	Sandy loam, depleted matrix/redox starting at 16".	No saturation/water to 40"	Remnant floodplain	*Phalaris arundinacea*	FACW
3	4	Loam, loamy fine sand, clay loam, redox starting at 10".	No saturation/water to 24"	Forested Depression	*Salix bebbiana*	FACW
					Urtica dioica	FAC
					Impatiens capensis	FACW
					Populus balsamifera	FACW
					Ulmus americana	FACW
					Phalaris arundinacea	FACW
					Echinocystis lobata	FACW
4	5	Loam, fine sand, redox starting at 23".	No saturation/water to 24"	Shrubby Depression	*Salix interior*	FACW
					Populus balsamifera	FACW
					Carex lacustris	OBL
					Phalaris arundinacea	FACW
					Mentha arvensis	FACW
					Urtica dioica	FAC
5	6	Loam, depleted matrix/redox starting at 22".	Soil damp at 24"	Remnant meander	*Salix interior*	FACW
					Salix discolor	FACW
					Urtica dioica	FAC
					Impatiens capensis	FACW
					Mentha arvensis	FACW
					Thalictrum dasycarpum	FACW
					Glyceria canadensis	OBL
6	7	Loam, sandy loam, fine sand, depeted matrix/redox starting at 22".	Saturated at 22"	Open meadow	*Phalaris arundinacea*	FACW
7	8	Loam, sandy loam, fine sand, depeted matrix/redox starting at 22".	No saturation/water to 22"	Open meadow	*Salix interior*	FACW
					Spirea alba	FACW
					Echinocystis lobata	FACW
					Phalaris arundinacea	FACW
					Carex lacustris	OBL
8	10	Loam, clay loam, fine sand, coarse sand, depleted matrix/redox starting at 14".	No saturation/water to 22"	Shrubby area	*Salix interior*	FACW
					Thalictrum dasycarpum	FACW
					Calamagrostis canadensis	OBL

Table 5
Additional Soil, Hydrology, and Vegetation Data
Spider Creek Mitigation Site

Photo/ Soil Point #	Photo #s	Meets Hydric Soil Criteria?	Meets Hydric Vegetation Criteria?	Exhibits Hydrology? (Notes)	Community Type	Stratigraphy	
						depth (inches)	soil details
1	1	No	No	No	Upland Forest	0-30	sandy loam
2	2	No	Yes	No	Remnant floodplain	0-16	sandy loam
						16-40	sandy loam w/ redox
3	4	No	Yes	No	Wooded Swamp/ Depression	0-10	loam
						10-24	loamy fine sand, some redox
						24+	clay loam
4	5	No	Yes	No	Shrub-scrub/ Depression	0-23	loam
						23+	fine sand w/ redox
5	6	No	Yes	No	Shrub-scrub/ Meander	0-22	loam
				Moist at 24"		22+	loam w/ depleted matrix, 40% redox
6	7	No	Yes	No	Reed canary grass meadow, adjacent to Shrub-scrub	0-12	loam
				Sat. @ 20"		12-22	sandy loam
7	8	No	Yes	No	Reed canary grass meadow	0-12	loam
						12-22	sandy loam
						22+	fine sand w/ depleted matrix, redox
8	10	No	Yes	No	Shrub-scrub	0-11	loam
						11-14	clay loam w/ sand
						14-22	fine sand, depleted, w/ redox

Table 5
Additional Soil, Hydrology, and Vegetation Data
Spider Creek Mitigation Site

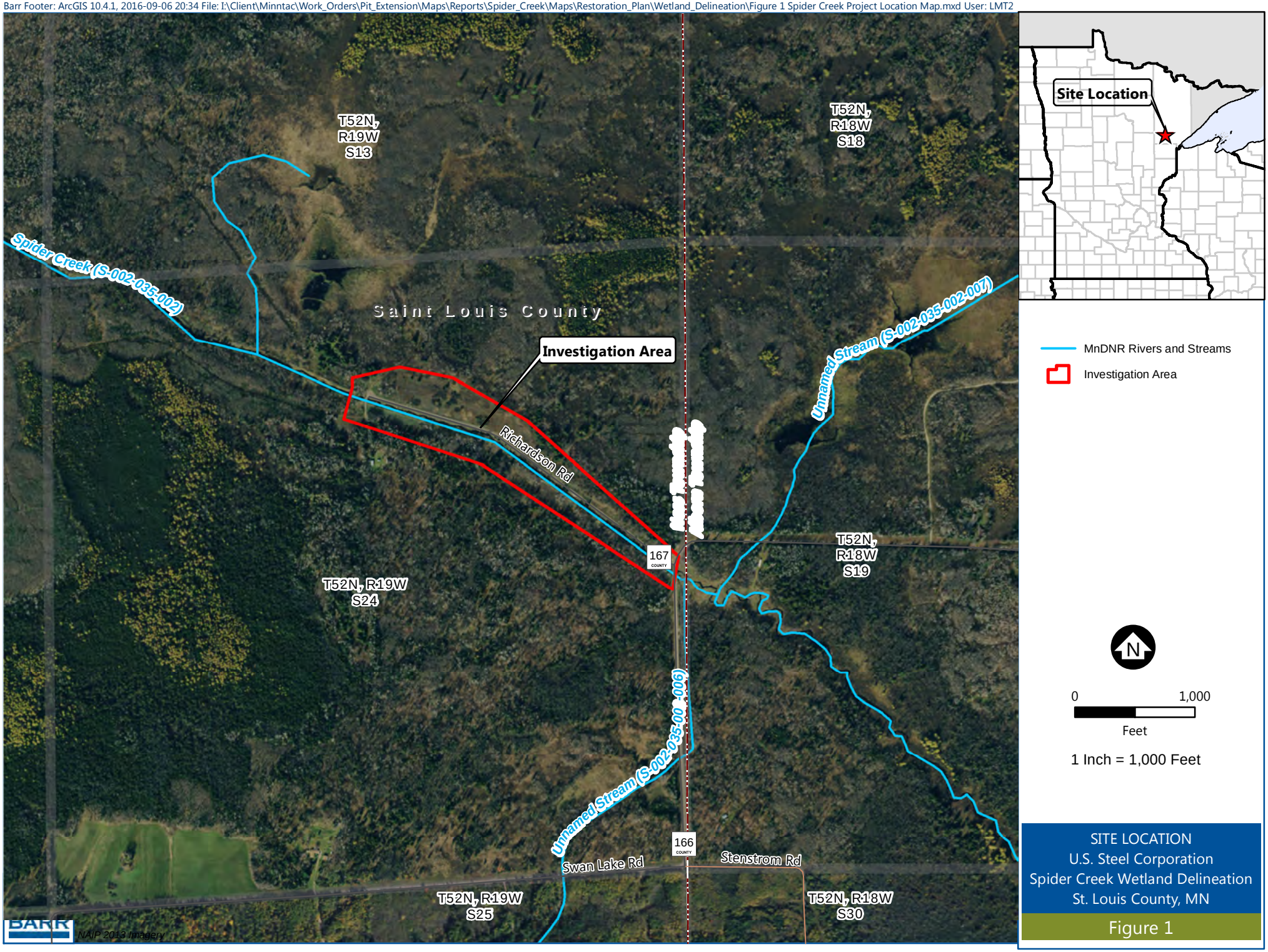
Photo/ Soil Point #	Photo #s	Soil Notes	Depth to Saturation/ Water Table	General Observations	Dominant Vegetation	Vegetation Indicator Status
9	**11**	Loam, coarse sand with gravel, no redox to 26".	No saturation/water to 26"	Depression	*Phalaris arundinacea*	FACW
					Calamagrostis canadensis	OBL
					Populus balsamifera	FACW
					Mentha arvensis	FACW
					Thalictrum dasycarpum	FACW
10	**12**	Loam, coarse sand, fine sand, fine sandy loamy clay, fine sand, depleted matrix/redox starting at 18".	No saturation/water to 26"	Low area, connected to creek	*Populus balsamifera*	FACW
					Salix interior	FACW
					Urtica dioica	FAC
					Thalictrum dasycarpum	FACW
11	**13**	Loam, coarse sand with rocks, no redox to 24".	Saturated at 20"	Wooded area	*Ulmus americana*	FACW
					Thuja occidentalis	FACW
					Osmundastrum cinnamomeum	FACW
					Laportea canadensis	FACW
					Fraxinus nigra	FACW
					Thalictrum dasycarpum	FACW
12	**16**	Loam, loamy sand, fine sandy clay, depleted matrix/redox starting at 35".	Moist at 20"	Open meadow	*Carex lacustris*	OBL
					Cirsium arvense	FACU
					Mentha arvensis	FACW
					Urtica dioica	FAC
13	**17**	Silty loam, silty clay, no redox to 11+".	No saturation/water to 11+"	Wooded area	*Fraxinus nigra*	FACW
					Thalictrum dasycarpum	FACW
					Fragaria virginiana	FACU
					Cornus alba	FACW
					Populus balsamifera	FACW
					Betula papyrifera	FACU
					Picea mariana	FACW
14	**18**	Clay loam, coarse sand/clay loam, fine sand, depletex matrix, no redox to 24".	No saturation/water to 24"	Wooded area	*Thuja occidentalis*	FACW
					Rubus ideaus	FACU
					Thalictrum dasycarpum	FACW
					Osmundastrum cinnamomeum	FACW
					Populus balsamifera	FACW
					Fraxinus nigra	FACW

Table 5
Additional Soil, Hydrology, and Vegetation Data
Spider Creek Mitigation Site

Photo/ Soil Point #	Photo #s	Meets Hydric Soil Criteria?	Meets Hydric Vegetation Criteria?	Exhibits Hydrology? (Notes)	Community Type	Stratigraphy	
						depth (inches)	soil details
9	**11**	No	Yes	No	Wooded swamp, depression	0-24	loam
						24-26	coarse sand w/ gravel
10	**12**	No	Yes	No	Shrub-scrub, Wooded swamp, connected to river	0-15	loam
						15-18	coarse sand
						18-20	fine sand, depleted w/ redox
						20-26	fine sandy loamy clay
11	**13**	No	Yes	No	Cedar Swamp/ Wooded Swamp	0-20	loam
						20-24	coarse sand w/ rocks
12	**16**	No	Yes	No, moist at 20"	Wet meadow	0-20	loam
						20-35	loamy sand
						35+	fine sandy clay, depleted with redox
13	**17**	No	Yes	No	Wooded swamp	0-11	silty loam
						11+	silty clay
14	**18**	No	Yes	No	Cedar/ Wooded swamp	0-22	clay loam
						22-24	coarse sand/ clay loam
						24+	fine sand, depleted, no redox

Figures

Barr Footer: ArcGIS 10.4.1, 2016-09-06 20:34 File: I:\Client\Minntac\Work_Orders\Pit_Extension\Maps\Reports\Spider_Creek\Maps\Restoration_Plan\Wetland_Delineation\Figure 1 Spider Creek Project Location Map.mxd User: LMT2



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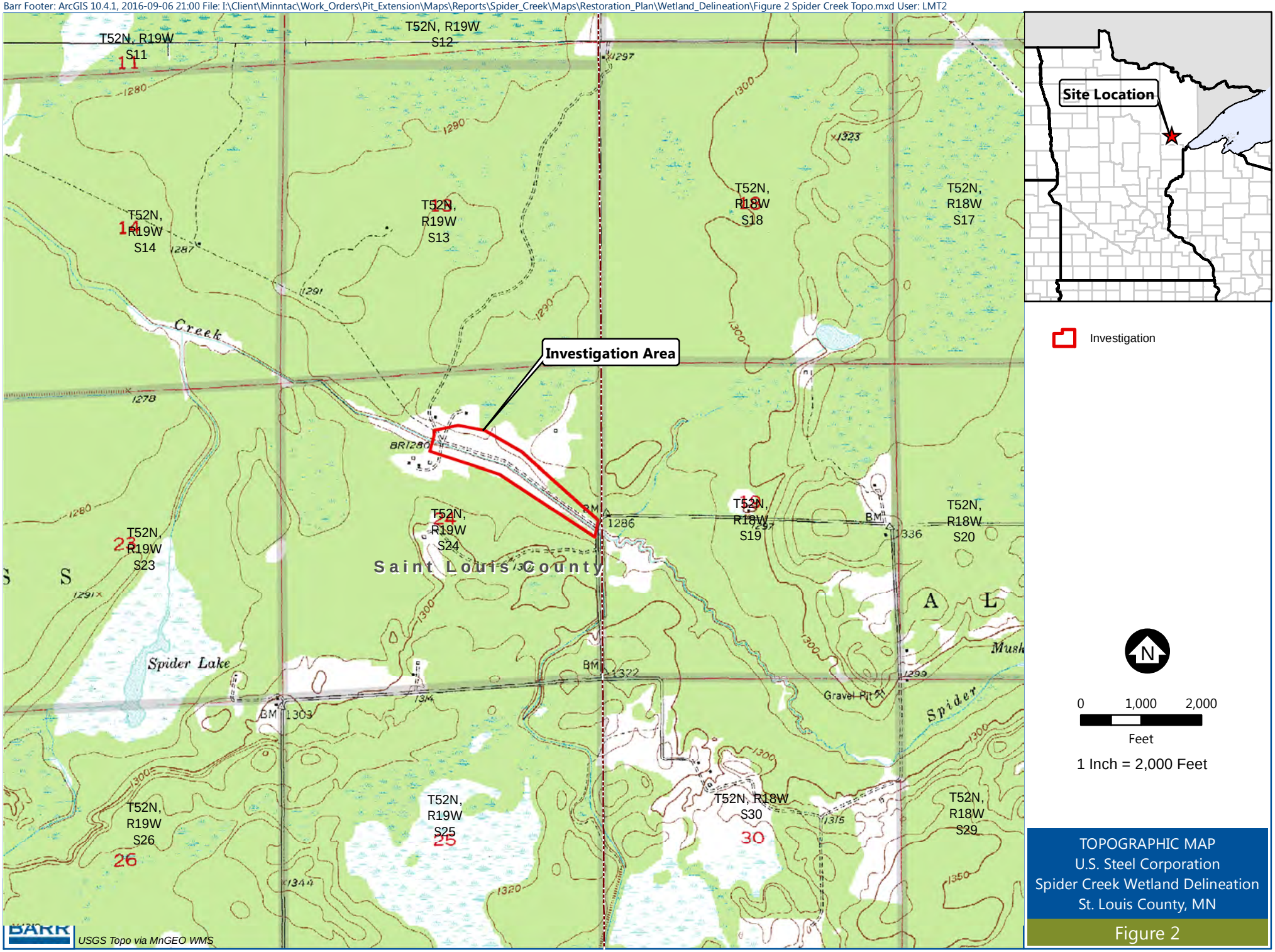
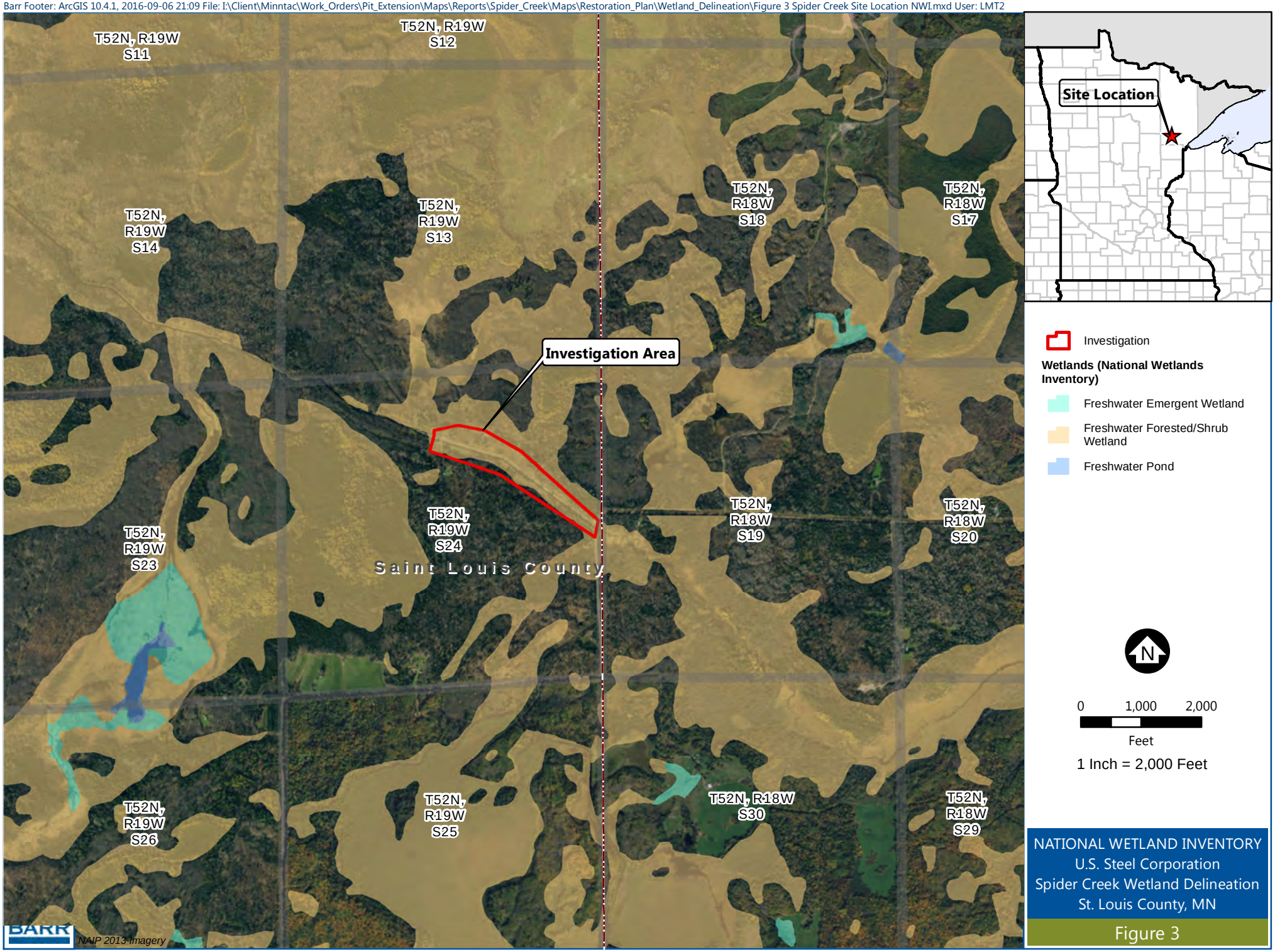


USGS Topo via MnGEO WMS

TOPOGRAPHIC MAP
U.S. Steel Corporation
Spider Creek Wetland Delineation
St. Louis County, MN

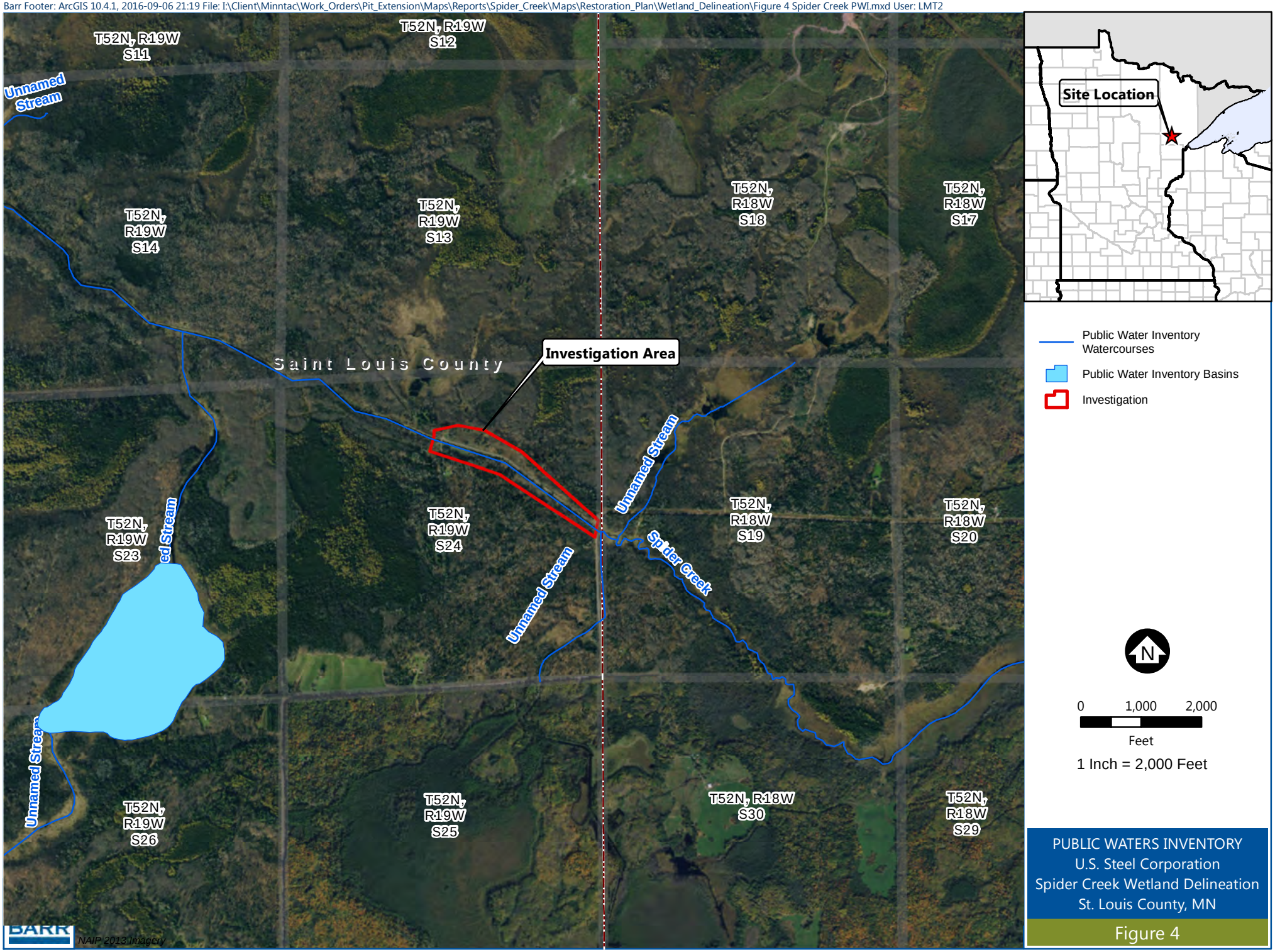
Figure 2

Barr Footer: ArcGIS 10.4.1, 2016-09-06 21:09 File: I:\Client\Minntac\Work_Orders\Pit_Extension\Maps\Reports\Spider_Creek\Maps\Restoration_Plan\Wetland_Delineation\Figure 3 Spider Creek Site Location NWI.mxd User: LMT2



NATIONAL WETLAND INVENTORY
U.S. Steel Corporation
Spider Creek Wetland Delineation
St. Louis County, MN

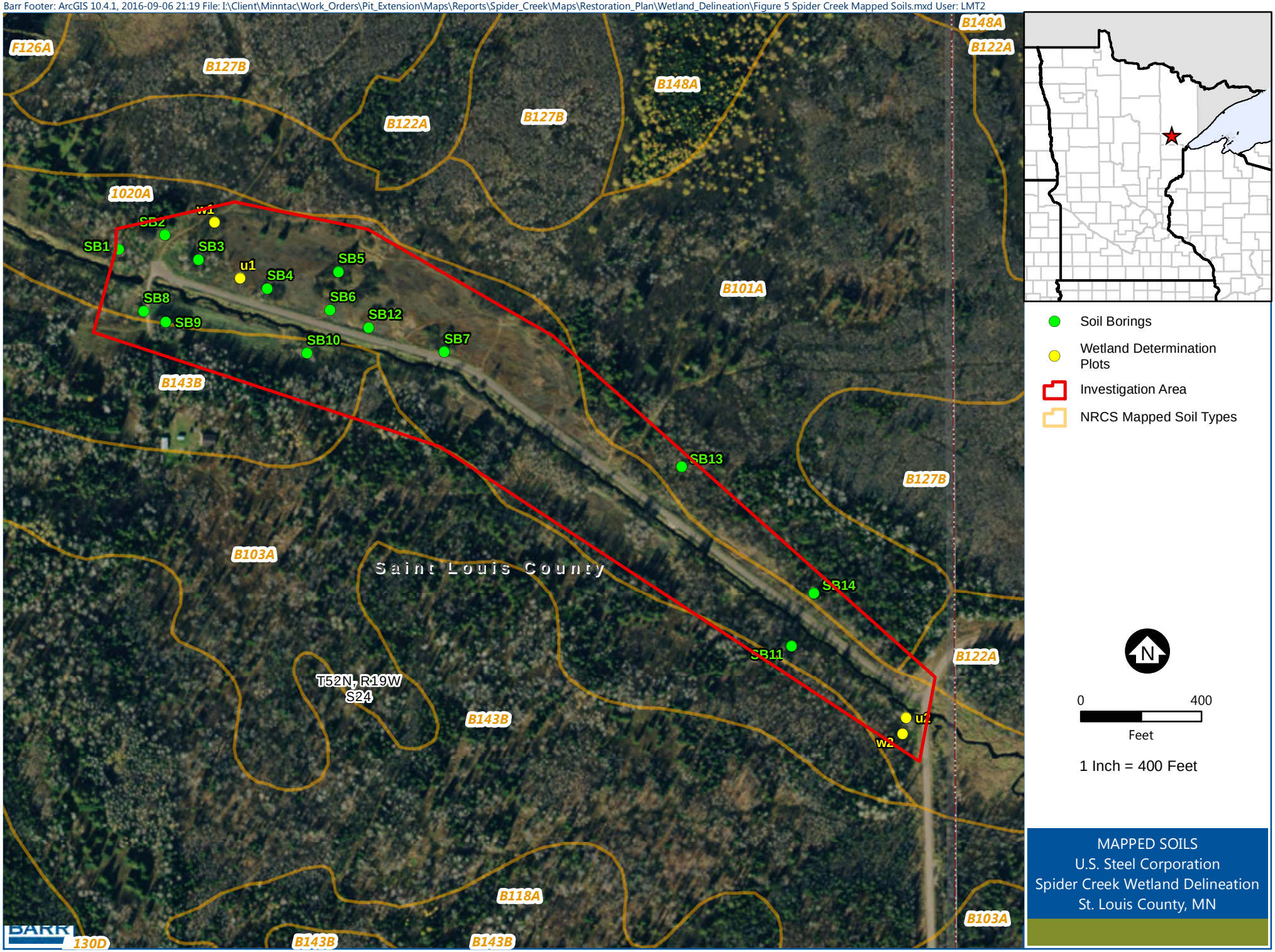
Figure 3

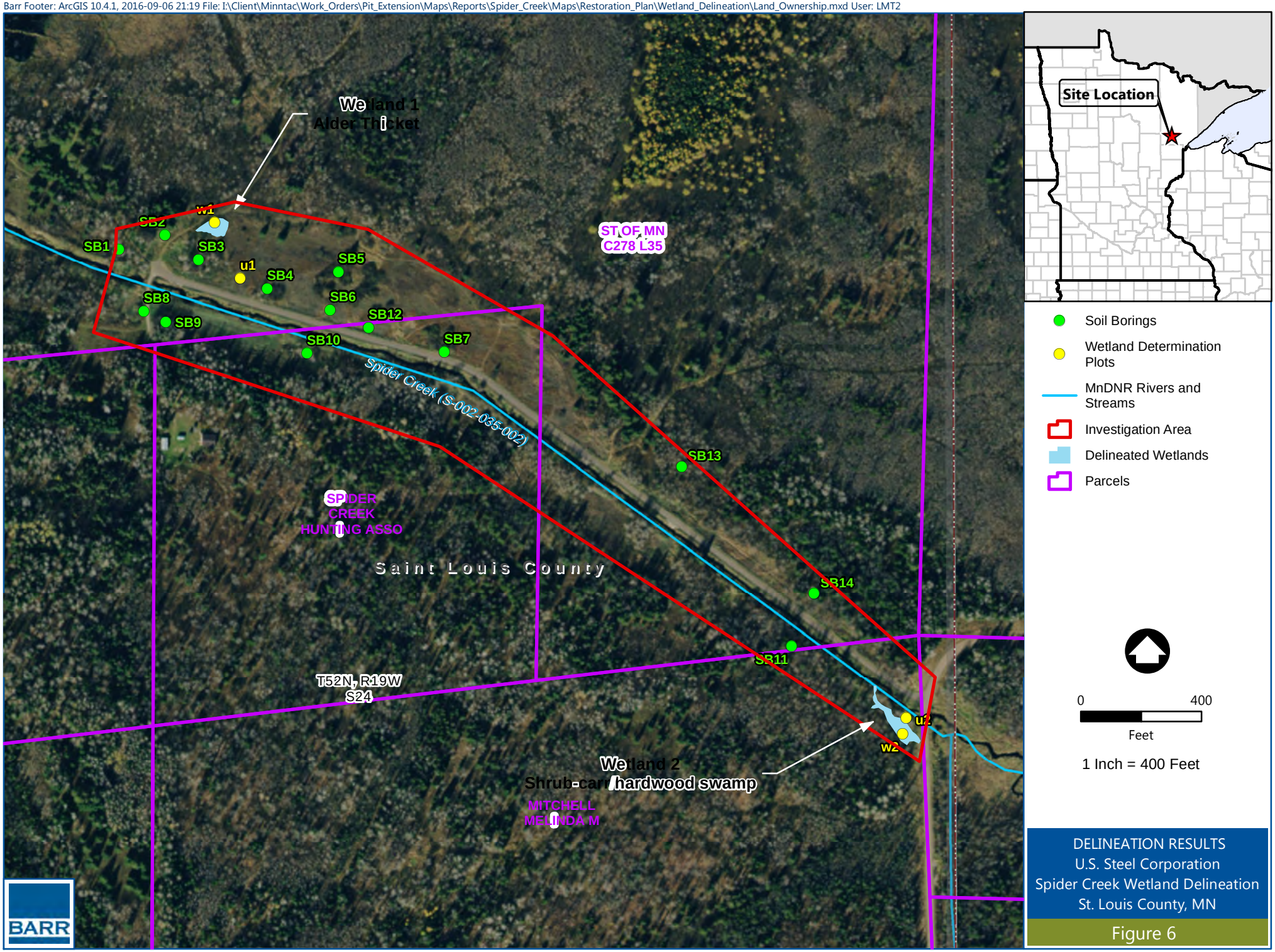


PUBLIC WATERS INVENTORY
U.S. Steel Corporation
Spider Creek Wetland Delineation
St. Louis County, MN

Figure 4

Barr Footer: ArcGIS 10.4.1, 2016-09-06 21:19 File: I:\Client\Minntac\Work_Orders\Pit_Extension\Maps\Reports\Spider_Creek\Maps\Restoration_Plan\Wetland_Delineation\Figure 5 Spider Creek Mapped Soils.mxd User: LMT2





DELINEATION RESULTS
U.S. Steel Corporation
Spider Creek Wetland Delineation
St. Louis County, MN

Figure 6

Investigation

N

0 400

Feet

1 Inch = 400 Feet

BARR

NAIP 2013 Imagery

1939 AERIAL PHOTO
U.S. Steel Corporation
Spider Creek Wetland Delineation
St. Louis County, MN

Figure 7

Appendix A

Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Spider Creek | Applicant/Owner: U.S. Steel Corp. - Minntac | City/County: Mt. Iron | State: MN | Sampling Date: 08/03/16

Investigator(s): LMT, KMS2 | Section: 52 | Township: 19 | Range: 24 | Sampling Point: U1

Land Form: Shoulder | Local Relief: Linear | Slope %: 0 | Soil Map Unit Name: Bowstring and Fluvaquents

Subregion (LRR): K | Latitude: 5203000 | Longitude: 524000 | Datum: NAD 83

Cowardin Classification: Upland | Circular 39 Classification: Upland | Mapped NWI Classification:

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (If no, explain in remarks)

Are vegetation No Soil No Hydrology No significantly disturbed? Are "normal circumstances" present? Yes

Are vegetation No Soil No Hydrology No naturally problematic?

Eggers & Reed (primary): Upland
Eggers & Reed (secondary):
Eggers & Reed (tertiary):
Eggers & Reed (quaternary):

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic vegetation present?	No	General Remarks (explain any answers if needed): This upland plot is paired with Wetland 1 (W1) Located in level area near channelized, incised stream.
Hydric soil present?	Yes	
Indicators of wetland hydrology present?	No	
Is the sampled area within a wetland?	No	If yes, optional Wetland Site ID:

VEGETATION

	Tree Stratum (Plot Size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
3.		0		
4.		0		
	Total Cover:	0		
	Sapling/Shrub Stratum (Plot Size: 15 ft)			
1.		0		
2.		0		
3.		0		
4.		0		
5.		0		
	Total Cover:	0		
	Herb Stratum (Plot Size: 5 ft)			
1.	Bromus inermis	90	Yes	UPL
2.	Cirsium arvense	15	No	FACU
3.	Elymus repens	15	No	FACU
4.	Ranunculus acris	3	No	FAC
5.		0		
6.		0		
7.		0		
8.		0		
	Total Cover:	123		
	Woody Vine Stratum (Plot Size: 30 ft)			
1.		0		
2.		0		
	Total Cover:	0		

% Bare Ground in Herb Stratum: | % Sphagnum Moss Cover:

Vegetation Remarks: (include photo numbers here or on a separate sheet)

50/20 Thresholds:	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	24.6	61.5
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC: **0** (A)

Total Number of Dominant Species Across All Strata: **1** (B)

Percent of Dominant Species That Are OBL, FACW or FAC: **0.00%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:		
OBL Species	0	X 1	0	
FACW Species	0	X 2	0	
FAC Species	3	X 3	9	
FACU Species	30	X 4	120	
UPL Species	90	X 5	450	
Column Totals:	**123**	(A)	**579**	(B)

Prevalence Index = B/A = **4.71**

Hydrophytic Vegetation Indicators:

- No — Rapid Test for Hydrophytic Vegetation
- No — Dominance Test is >50%
- No — Prevalence Index ≤ 3.0 [1]
- No — Morphological Adaptations [1] (provide supporting data in vegetation remarks or on a separate sheet)
- No — Problematic Hydrophytic Vegetation [1] (Explain)

[1] Indicators of hydric soil & wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic vegetation present? No

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

SOIL

Sampling Point: U1

Profile Description: (Describe to the depth needed to document the indicator or confirm the abscence of indicators).

	Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type [1]	Redox Features Loc [2]	Texture	Remarks
1.	0 - 10	10YR 2/1	100					loam	
2.	10 - 12	2.5Y 4/2	100					fine sand	
3.	12 - 32	2.5Y 4/2	90	10YR 5/8	10	C		clay loam	
4.	32 - 36	2.5Y 4/2	75	10YR 5/8	25	C		clay loam	
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (applicable to all LRRs, unless otherwise noted)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☑ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) (LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils [3]:

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (explain in soil remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present): **Type:** _____ **Depth (inches):** _____

Hydric soil present? Yes

Soil Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (explain in remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

- Surface water present? ☐ Surface Water Depth (inches): _____
- Water table present? ☐ Water Table Depth (inches): _____
- Saturation present? (includes capillary fringe) ☐ Saturation Depth (inches): _____

Indicators of wetland hydrology present? No

Describe Recorded Data:

Recorded Data: ☐ Aerial Photo ☐ Monitoring Well ☐ Stream Gauge ☐ Previous Inspections

Hydrology Remarks: No water or saturation down to 36 inches BGS; Precipitation has been wetter than normal in previous 30 days - 5.08 inches of rain.

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Spider Creek | Applicant/Owner: U.S. Steel Corp. - Minntac | City/County: Mt. Iron | State: MN | Sampling Date: 08/03/16

Investigator(s): LMT, KMS2 | Section: 52 | Township: 19 | Range: 24 | Sampling Point: W1

Land Form: Depression | Local Relief: Concave | Slope %: 0 | Soil Map Unit Name: Bowstring and Fluvaquents

Subregion (LRR): K | Latitude: 5203000 | Longitude: 524000 | Datum: NAD 83

Cowardin Classification: PSS1 | Circular 39 Classification: Type 6 | Mapped NWI Classification:

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (If no, explain in remarks)

Are vegetation No Soil No Hydrology No significantly disturbed? Are "normal circumstances" present? Yes

Are vegetation No Soil No Hydrology No naturally problematic?

Eggers & Reed (primary): Alder Thicket
Eggers & Reed (secondary):
Eggers & Reed (tertiary):
Eggers & Reed (quaternary):

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic vegetation present? Yes
Hydric soil present? Yes
Indicators of wetland hydrology present? Yes
Is the sampled area within a wetland? Yes

General Remarks (explain any answers if needed):

If yes, optional Wetland Site ID: Wetland 1

VEGETATION

	Tree Stratum (Plot Size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.	Populus balsamifera	10	Yes	FACW
2.		0		
3.		0		
4.		0		
	Total Cover:	10		
	Sapling/Shrub Stratum (Plot Size: 15 ft)			
1.	Alnus incana	80	Yes	FACW
2.	Salix interior	15	No	FACW
3.		0		
4.		0		
5.		0		
	Total Cover:	95		
	Herb Stratum (Plot Size: 5 ft)			
1.	Rubus idaeus	30	Yes	FAC
2.	Calamagrostis canadensis	20	Yes	OBL
3.	Solidago canadensis	5	No	FACU
4.	Fragaria virginiana	5	No	FACU
5.	Equisetum arvense	3	No	FAC
6.	Thalictrum dasycarpum	3	No	FACW
7.		0		
8.		0		
	Total Cover:	66		
	Woody Vine Stratum (Plot Size: 30 ft)			
1.		0		
2.		0		
	Total Cover:	0		

% Bare Ground in Herb Stratum:

% Sphagnum Moss Cover:

Vegetation Remarks: (include photo numbers here or on a separate sheet)

50/20 Thresholds:	20%	50%
Tree Stratum	2	5
Sapling/Shrub Stratum	19	47.5
Herb Stratum	13.2	33
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC: **4** (A)

Total Number of Dominant Species Across All Strata: **4** (B)

Percent of Dominant Species That Are OBL, FACW or FAC: **100.00%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:		
OBL Species	20	X 1	20	
FACW Species	108	X 2	216	
FAC Species	33	X 3	99	
FACU Species	10	X 4	40	
UPL Species	0	X 5	0	
Column Totals:	**171**	(A)	**375**	(B)

Prevalence Index = B/A = **2.19**

Hydrophytic Vegetation Indicators:

- No — Rapid Test for Hydrophytic Vegetation
- Yes — Dominance Test is >50%
- Yes — Prevalence Index ≤ 3.0 [1]
- No — Morphological Adaptations [1] (provide supporting data in vegetation remarks or on a separate sheet)
- No — Problematic Hydrophytic Vegetation [1] (Explain)

[1] Indicators of hydric soil & wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic vegetation present? Yes

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

SOIL

Sampling Point: W1

Profile Description: (Describe to the depth needed to document the indicator or confirm the abscence of indicators).

	Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type [1]	Redox Features Loc [2]	Texture	Remarks
1.	0 - 4	7.5YR 2.5/3	100					loam	
2.	4 - 12	7.5YR 2.5/3	30	10YR 4/6	40	C		sandy loam	
3.	-	10YR 4/4	30						
4.	12 - 30	10YR 4/4	40	10YR 4/6	30	C		loamy fine sand	
5.	-	10YR 5/3	30						
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (applicable to all LRRs, unless otherwise noted)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) (LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☑ Redox Depressions (F8)

Indicators for Problematic Hydric Soils [3]:

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (explain in soil remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present): **Type:** _____ **Depth (inches):** _____

Hydric soil present? Yes

Soil Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (explain in remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-Neutral Test (D5)

Field Observations:

Surface water present? ☐ Surface Water Depth (inches): _____

Water table present? ☐ Water Table Depth (inches): _____

Saturation present? (includes capillary fringe) ☐ Saturation Depth (inches): _____

Indicators of wetland hydrology present? Yes

Describe Recorded Data:

Recorded Data: ☐ Aerial Photo ☐ Monitoring Well ☐ Stream Gauge ☐ Previous Inspections

Hydrology Remarks: No saturation or water table observed down to 30 inches below ground surface.

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Spider Creek | Applicant/Owner: U.S. Steel Corp. - Minntac | City/County: Mt. Iron | State: MN | Sampling Date: 08/03/16

Investigator(s): LMT, KMS2 | Section: 52 | Township: 19 | Range: 24 | Sampling Point: U2

Land Form: Footslope | Local Relief: Concave | Slope %: 0 | Soil Map Unit Name: Bowstring and Fluvaquents

Subregion (LRR): K | Latitude: 5203000 | Longitude: 524000 | Datum: NAD 83

Cowardin Classification: Upland | Circular 39 Classification: Upland | Mapped NWI Classification:

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (If no, explain in remarks)

Are vegetation No Soil Yes Hydrology No significantly disturbed? Are "normal circumstances" present? Yes

Are vegetation No Soil No Hydrology No naturally problematic?

Eggers & Reed (primary): Upland
Eggers & Reed (secondary):
Eggers & Reed (tertiary):
Eggers & Reed (quaternary):

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic vegetation present?	Yes	General Remarks (explain any answers if needed): This upland is paired with Wetland 2 (W2)
Hydric soil present?	No	
Indicators of wetland hydrology present?	No	
Is the sampled area within a wetland?	No	If yes, optional Wetland Site ID:

VEGETATION

	Tree Stratum (Plot Size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
3.		0		
4.		0		
	Total Cover:	0		
	Sapling/Shrub Stratum (Plot Size: 15 ft)			
1.		0		
2.		0		
3.		0		
4.		0		
5.		0		
	Total Cover:	0		
	Herb Stratum (Plot Size: 5 ft)			
1.	Phalaris arundinacea	90	Yes	FACW
2.	Urtica dioica	10	No	FAC
3.		0		
4.		0		
5.		0		
6.		0		
7.		0		
8.		0		
	Total Cover:	100		
	Woody Vine Stratum (Plot Size: 30 ft)			
1.		0		
2.		0		
	Total Cover:	0		

% Bare Ground in Herb Stratum: | % Sphagnum Moss Cover:

Vegetation Remarks: (include photo numbers here or on a separate sheet)

50/20 Thresholds:	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	20	50
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW or FAC: 100.00% (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:		
OBL Species	0	X 1	0	
FACW Species	90	X 2	180	
FAC Species	10	X 3	30	
FACU Species	0	X 4	0	
UPL Species	0	X 5	0	
Column Totals:	100	(A)	210	(B)

Prevalence Index = B/A = 2.10

Hydrophytic Vegetation Indicators:

- No — Rapid Test for Hydrophytic Vegetation
- Yes — Dominance Test is >50%
- Yes — Prevalence Index ≤ 3.0 [1]
- No — Morphological Adaptations [1] (provide supporting data in vegetation remarks or on a separate sheet)
- No — Problematic Hydrophytic Vegetation [1] (Explain)

[1] Indicators of hydric soil & wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic vegetation present? Yes

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

SOIL

Sampling Point: U2

Profile Description: (Describe to the depth needed to document the indicator or confirm the abscence of indicators).

	Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type [1]	Redox Features Loc [2]	Texture	Remarks
1.	0 - 15	10YR 2/2	100					sandy loam	
2.	15 - 20	10YR 3/2	95	7.5YR 5/8	5	C		loamy sand	
3.	20 - 28	10YR 4/4	80	7.5YR 5/8	15	C		loamy sand	
4.	28 - 32	10YR 2/2	95	2.5YR 4/8	5	C		sandy loam	
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (applicable to all LRRs, unless otherwise noted)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☐ Loamy Mucky Mineral (F1) (LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils [3]:

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (explain in soil remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present): **Type:** _____ **Depth (inches):** _____

Hydric soil present? No

Soil Remarks: Appears to be a buried A-horizon. Possible buried under ditch spoils from stream channelization.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (explain in remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface water present? ☐ Surface Water Depth (inches): _____

Water table present? ☐ Water Table Depth (inches): _____

Saturation present? (includes capillary fringe) ☐ Saturation Depth (inches): _____

Indicators of wetland hydrology present? No

Describe Recorded Data:

Recorded Data: ☐ Aerial Photo ☐ Monitoring Well ☐ Stream Gauge ☐ Previous Inspections

Hydrology Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Spider Creek | Applicant/Owner: U.S. Steel Corp. - Minntac | City/County: Mt. Iron | State: MN | Sampling Date: 08/03/16

Investigator(s): LMT, KMS2 | Section: 52 | Township: 19 | Range: 24 | Sampling Point: W2

Land Form: Footslope | Local Relief: Concave | Slope %: 0 | Soil Map Unit Name: Bowstring and Fluvaquents

Subregion (LRR): K | Latitude: 5203000 | Longitude: 524000 | Datum: NAD 83

Cowardin Classification: PSS1 | Circular 39 Classification: Type 6 | Mapped NWI Classification:

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (If no, explain in remarks)

Are vegetation No Soil Yes Hydrology No significantly disturbed? Are "normal circumstances" present? Yes

Are vegetation No Soil No Hydrology No naturally problematic?

Eggers & Reed (primary): Shrub-Carr
Eggers & Reed (secondary): Hardwood Swamp
Eggers & Reed (tertiary):
Eggers & Reed (quaternary):

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic vegetation present? Yes
Hydric soil present? Yes
Indicators of wetland hydrology present? Yes
Is the sampled area within a wetland? Yes

General Remarks (explain any answers if needed): Soil profile shows a buried peat layer, possibly under ditch spoils.

If yes, optional Wetland Site ID: Wetland 2

VEGETATION

	Tree Stratum (Plot Size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
3.		0		
4.		0		
	Total Cover:	0		
	Sapling/Shrub Stratum (Plot Size: 15 ft)			
1.	Alnus incana	40	Yes	FACW
2.	Fraxinus nigra	40	Yes	FACW
3.	Populus balsamifera	10	No	FACW
4.		0		
5.		0		
	Total Cover:	90		
	Herb Stratum (Plot Size: 5 ft)			
1.	Onoclea sensibilis	30	Yes	FACW
2.	Calamagrostis canadensis	20	Yes	OBL
3.	Carex lacustris	10	No	OBL
4.	Glyceria canadensis	10	No	OBL
5.	Spiraea alba	5	No	FACW
6.	Rubus idaeus	5	No	FAC
7.		0		
8.		0		
	Total Cover:	80		
	Woody Vine Stratum (Plot Size: 30 ft)			
1.		0		
2.		0		
	Total Cover:	0		

% Bare Ground in Herb Stratum: | % Sphagnum Moss Cover:

Vegetation Remarks: (include photo numbers here or on a separate sheet)

50/20 Thresholds:	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	18	45
Herb Stratum	16	40
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW or FAC: 100.00% (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:		
OBL Species	40	X 1	40	
FACW Species	125	X 2	250	
FAC Species	5	X 3	15	
FACU Species	0	X 4	0	
UPL Species	0	X 5	0	
Column Totals:	170	(A)	305	(B)

Prevalence Index = B/A = 1.79

Hydrophytic Vegetation Indicators:

- No — Rapid Test for Hydrophytic Vegetation
- Yes — Dominance Test is >50%
- Yes — Prevalence Index ≤ 3.0 [1]
- No — Morphological Adaptations [1] (provide supporting data in vegetation remarks or on a separate sheet)
- No — Problematic Hydrophytic Vegetation [1] (Explain)

[1] Indicators of hydric soil & wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic vegetation present? Yes

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

SOIL

Sampling Point: W2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators).

	Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type [1]	Redox Features Loc [2]	Texture	Remarks
1.	0 - 18	10YR 2/1	100					mucky mineral	
2.	18 - 24	10YR 4/2	100					coarse sand	
3.	24 - 36	10YR 2/1	100					peat	
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (applicable to all LRRs, unless otherwise noted)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR R, MLRA 149B)
- ☐ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ☐ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ☑ Loamy Mucky Mineral (F1) (LRR K, L)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils [3]:

- ☐ 2 cm Muck (A10) (LRR K, L, MLRA 149B)
- ☐ Coast Prairie Redox (A16) (LRR K, L, R)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ☐ Dark Surface (S7) (LRR K, L)
- ☐ Polyvalue Below Surface (S8) (LRR K, L)
- ☐ Thin Dark Surface (S9) (LRR K, L)
- ☐ Iron-Manganese Masses (F12) (LRR K, L, R)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ☐ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (explain in soil remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present): **Type:** _____ **Depth (inches):** _____

Hydric soil present? Yes

Soil Remarks: Buried peat layer.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (explain in remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☑ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface water present? ☐ Surface Water Depth (inches): _____

Water table present? ☑ Water Table Depth (inches): 14

Saturation present? (includes capillary fringe) ☑ Saturation Depth (inches): 10

Indicators of wetland hydrology present? Yes

Describe Recorded Data:

Recorded Data: ☐ Aerial Photo ☐ Monitoring Well ☐ Stream Gauge ☐ Previous Inspections

Hydrology Remarks:

Appendix B

Photo Log of Wetland Delineation

Appendix B: Photo Log Of Wetland Delineation.

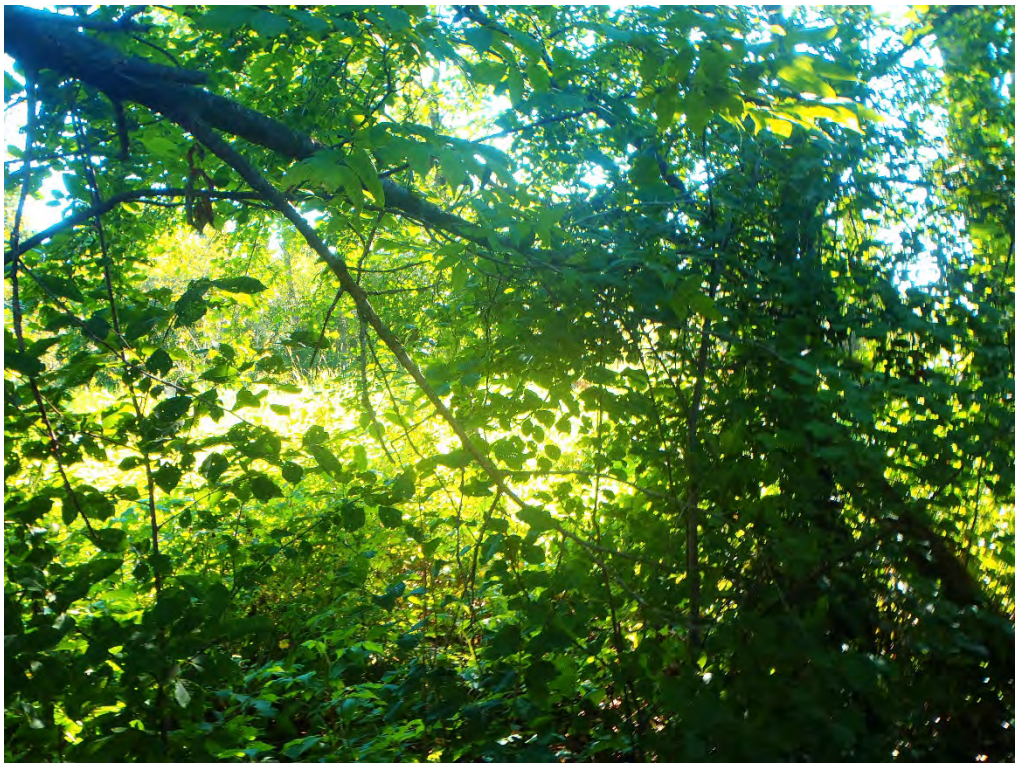


Photo 1: Soil boring 1 location, view N.

Photo 2: Soil boring 2 location, view W.

Appendix B: Photo Log Of Wetland Delineation.

Photo 3: W1 plot within wetland 1, view W.

Photo 4: Soil boring 3 location, view SW.

Appendix B: Photo Log Of Wetland Delineation.

Photo 5: Soil boring 4 location, view E.

Photo 6: Soil boring 5 location, view SE.

Appendix B: Photo Log Of Wetland Delineation.

Photo 7: Soil boring 6 location, view SW.

Photo 8: Soil boring 7 location, view N.

Appendix B: Photo Log Of Wetland Delineation.

Photo 9: U1 data plot, near wetland 1, view N.

Photo 10: Soil boring 8 location, view SW.

Appendix B: Photo Log Of Wetland Delineation.

Photo 11: Soil boring 9 location, view S.

Photo 12: Soil boring 10 location, view SE.

Appendix B: Photo Log Of Wetland Delineation.

Photo 13: Soil boring 11 location, view E.

Photo 14: W2 data plot, within wetland 2, view N.

Appendix B: Photo Log Of Wetland Delineation.

Photo 15: U2 data plot, near wetland 2, view SE.

Photo 16: Soil boring 12 location, view N.

Appendix B: Photo Log Of Wetland Delineation.

Photo 17: Soil boring 13 location, view N.

Photo 18: Soil boring 14 location, view S.

Attachment C: Spider Creek 2015 Aquatic Biota Assessment

Spider Creek 2015 Aquatic Biota Assessment

Prepared for
U. S. Steel, Minnesota Ore Operations -- Minntac

January 2016

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Spider Creek 2015 Aquatic Biota Assessment

January 2016

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1.0 Introduction

United States Steel Corporation (U. S. Steel), Minnesota Ore Operations – Minntac (Minntac) has received U. S. Army Corps of Engineers (USACE) authorization (MVP-2012-00415-JCB) for the Minntac Mine Pit Extension project, which includes extension of the Minntac East Pit in Mountain Iron, Minnesota. The project will impact 3,697 linear feet of Parkville Creek. Special Condition 11 of the USACE permit requires that U. S. Steel provide mitigation for the unavoidable loss of Parkville Creek. The proposed stream mitigation would occur in Spider Creek in St. Louis County, near Alborn, Minnesota (Figure 1-1). The Minnesota Pollution Control Agency (MPCA) has provided the 401 Water Quality Certification for the USACE permit. One of the conditions of the water quality certification required that U. S. Steel conduct aquatic biota monitoring to support stream mitigation activities in Spider Creek. Barr Engineering Co. (Barr), on behalf of U. S. Steel, conducted aquatic biota sampling in Spider Creek in 2015. This report details the results of the 2015 aquatic biota monitoring conducted in Spider Creek.

The proposed stream mitigation is located in the northeast quarter of Section 24, Township 52 North, Range 19 West, St. Louis County, near Alborn, Minnesota (Figure 1-1). The mitigation would occur entirely on Spider Creek within parcels owned by the State of Minnesota (tax-forfeited real estate) and Spider Creek Hunting Association, Parcel Identification numbers 470-0010-03830 and 470-0010-03850, respectively. The proposed restoration reach begins just downstream (northwest) of the crossing of County Road (CR) 166 near station 8500 and ends near a culvert crossing at the northwest end of CR 167. Spider Creek is a second order perennial stream, with only small perennial tributaries feeding the channelized segment. The creek is a tributary of the Little Whiteface River, located in St. Louis County, Minnesota. The stream was considered a designated trout stream until 2008, when the MDNR de-listed it. The MPCA is proposing to reclassify Spider Creek as a Class 2B (warm water/cool water) stream (MPCA 2014). It is currently classified as a Class 2A (cold water) stream

The aquatic biota monitoring documented in this report consisted of macroinvertebrate sample collections in June and September; electrofishing in August; water quality monitoring; and completion of MPCA aquatic biota habitat assessment worksheets. Aquatic biota monitoring was conducted within 3 separate reaches on Spider Creek, as shown on Figure 1-1. Reach #1 is located upstream of the proposed restoration reach, and was selected as a reference reach. Reach #2 is located downstream of the proposed restoration reach within a section of the creek that was previously considered for stream mitigation; Reach #2 was only sampled for the June macroinvertebrate sampling visit. Subsequent to the June sampling, the site selection for stream mitigation moved upstream, and aquatic biota monitoring Reach #3 was created within the channelized section of Spider Creek that is currently proposed for mitigation activities.

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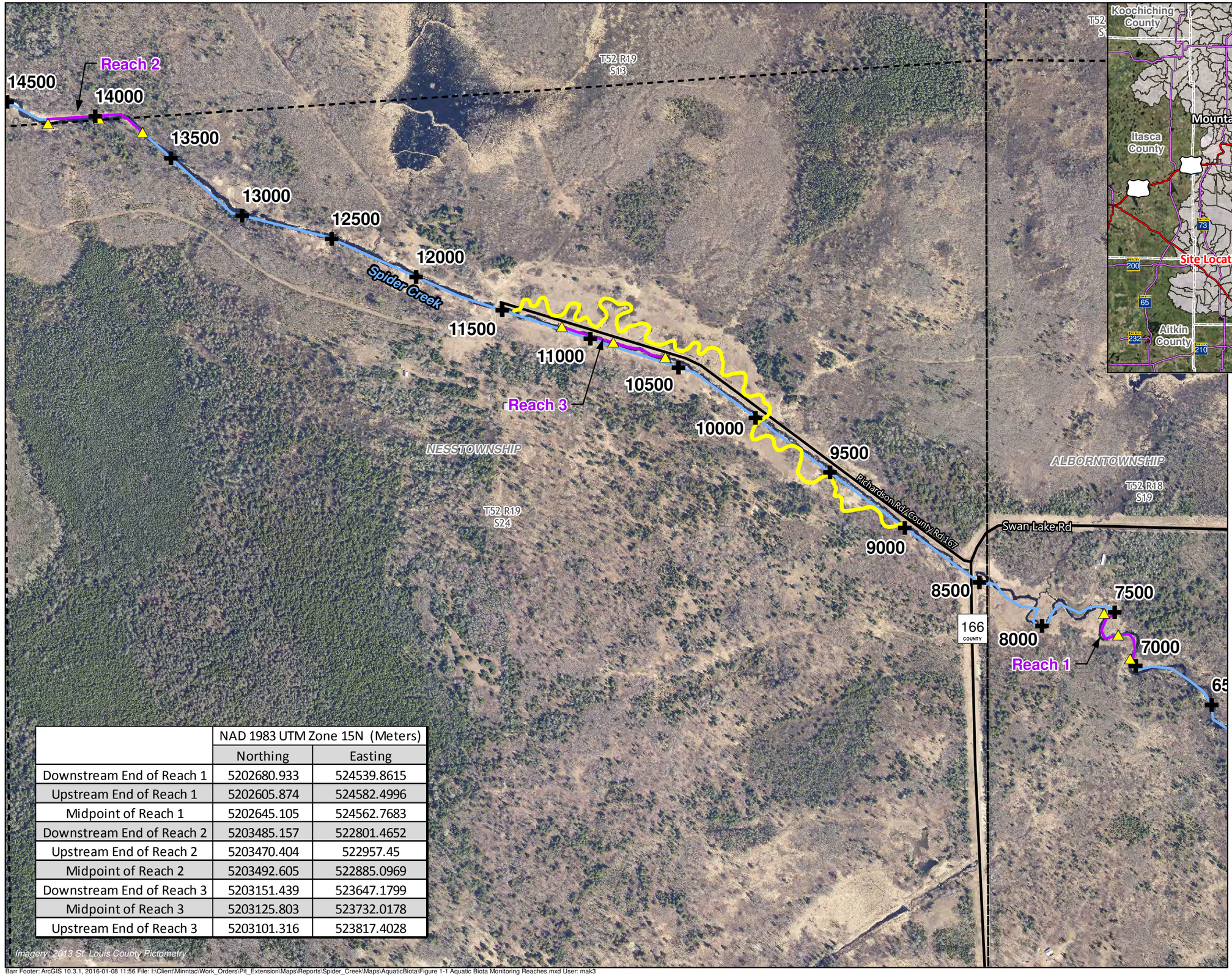
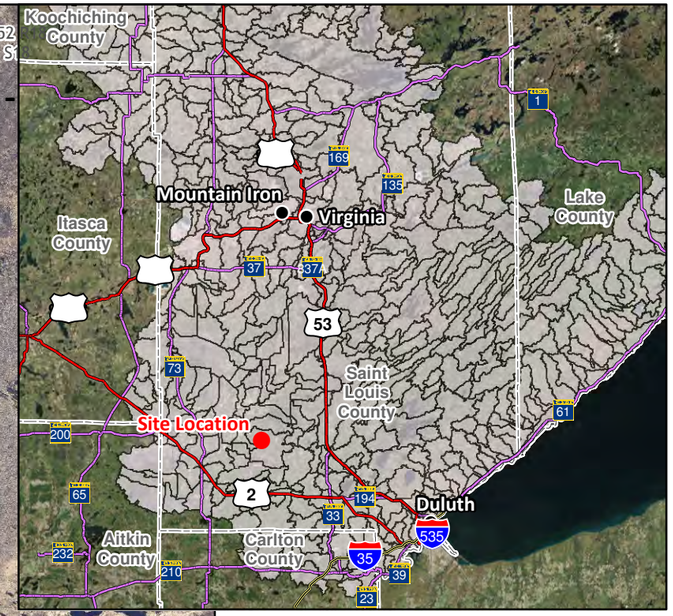




	NAD 1983 UTM Zone 15N (Meters)	
	Northing	Easting
Downstream End of Reach 1	5202680.933	524539.8615
Upstream End of Reach 1	5202605.874	524582.4996
Midpoint of Reach 1	5202645.105	524562.7683
Downstream End of Reach 2	5203485.157	522801.4652
Upstream End of Reach 2	5203470.404	522957.45
Midpoint of Reach 2	5203492.605	522885.0969
Downstream End of Reach 3	5203151.439	523647.1799
Midpoint of Reach 3	5203125.803	523732.0178
Upstream End of Reach 3	5203101.316	523817.4028

- Reference Point
- Proposed Restoration Reach
- Aquatic Biota Reach
- Spider Creek

Station Points

- 500 ft Increments

N

0 200 400 600 Feet

0 50 100 150 200 Meters

1:6,000

Figure 1-1

SPIDER CREEK AQUATIC BIOTA MONITORING REACHES

Spider Creek 2015 Aquatic Biota Assessment
Minntac Mine Extension Stream Mitigation
U. S. Steel
St. Louis County

BARR

Barr Footer: ArcGIS 10.3.1, 2016-01-08 11:56 File: I:\Client\Minntac\Work_Orders\Pit_Extension\Maps\Reports\Spider_Creek\Maps\AquaticBiota\Figure 1-1 Aquatic Biota Monitoring Reaches.mxd User: mak3

2.0 Methodology

The aquatic biota surveys conducted on Spider Creek in 2015 followed MPCA standard operating procedures (SOP)s for aquatic biota monitoring of fish and macroinvertebrate communities, as well as MPCA SOPs for physical habitat assessment (MPCA 2014a, MPCA 2014b, MPCA 2014c, MPCA 2014d, MPCA 2014e). Monitoring Reach #1 and Reach #2 were 150 meters in length (492 feet) (Figure 1-1). Reach #3 was 180 meters (591 feet) in length. GPS coordinates were collected for the upstream endpoint, midpoint, and downstream endpoint of the reaches. The presence of suitable aquatic biota habitats, such as rock riffles, undercut banks, and woody debris, were considered while selecting the locations for the survey reach.

2.1 Macroinvertebrate Sampling Methodology

Aquatic macroinvertebrates were sampled following the MPCA SOP for invertebrate sampling (MPCA 2014b). Macroinvertebrates were collected using D frame dip nets. Large pieces of debris (large twigs, leaves, plants, rocks, etc.) were washed with stream water to dislodge organisms and were visually inspected before being discarded. Collected macroinvertebrates were composited in a 1 liter plastic bottle and preserved in 85 percent reagent alcohol.

Macroinvertebrates were sorted and identified by Rithron Associates, a taxonomic laboratory located in Missoula, Montana. Rithron Associates sorted and identified the samples using methodologies consistent with MPCA SOPs for macroinvertebrate sample processing (MPCA 2004). Macroinvertebrates were identified to the genus or species level for most organisms.

2.2 Fish Electroshock Survey Methodology

The fish survey was conducted by Barr staff on August 6, 2015, using methodology consistent with the *MPCA Fish Community Sampling Protocol for Stream Monitoring Sites* (MPCA 2014a). A Minnesota Department of Natural Resources (MDNR) collection permit (Special Permit No. 20533) was obtained on May 3, 2015.

The fish survey was conducted using a Smith-Root brand "LR 24" backpack electro-fisher while walking in an upstream direction and weaving between habitat types. All habitat types were sampled in the proportion that they existed in the stream reach. Fish less than 25 mm in total length were excluded from the sampling effort. Fish over 25 mm were either collected as a voucher specimen or counted and returned to the stream.

The composite fish sample was sorted to the species level for all individuals. For each species group, information was recorded for the length range in millimeters (mm); total weight of all individuals of the same species in grams (g); abundance; and anomalies (i.e., parasites, lesions, popeye, etc.). A representative voucher specimen was collected for each species. Voucher specimens were also collected for identification if the species was unknown in the field. All fish collected as voucher specimens were preserved in 10% formalin solution, and were sent to Andrew Simons, Ph.D., Department of Fisheries and

Wildlife, University of Minnesota for identification. Voucher specimen identifications completed by Dr. Simons agreed with field identifications for all voucher specimens.

2.3 Water Chemistry Methodology

Water quality field parameters were measured using a YSI brand multi-parameter probe during the fish and macroinvertebrate field visits. Field parameters measured with the probe included dissolved oxygen (DO), temperature, pH, and specific conductance. Turbidity was also measured during field visits using a LaMotte brand "2020e" portable turbidity meter.

An In-Situ brand "Troll 9500XP" water quality probe was deployed at Reach #3 in order to collect continuous measurements at 30 minute intervals of water quality field measurements for a 2 week or longer interval. The probe included sensors for temperature, conductivity, pH, DO, and turbidity. The probe was first deployed on August 6, but malfunctioned after 4 days of measurements. The probe was redeployed from August 31 through September 18 to collect continuous data for a period of 2 weeks or more. When the probe was retrieved, there were a number of caddisflies attached to it, as well as other biofouling and thin coating of fine sediment. It appears biofouling and/or sediment sticking to the turbidity sensor interfered with collection of representative turbidity data; therefore, turbidity data was not reported.

Water samples were collected for laboratory analyses at Reach #1 and Reach #3 prior to conducting the fish surveys on August 6, 2015. Water samples were collected by inverting a clean sample bottle provided by the laboratory below the water surface, while facing upstream. A clean unpreserved bottle was used as a transfer bottle to fill bottles that contained preservative. Water samples were sent to Pace Analytical, Inc. in Minneapolis for the following analyses, with National Environmental Methods Index (NEMI) methodology shown:

- Total suspended solids (TSS) – Method SM 2540D
- Total phosphorus – Method EPA 365.1
- Ammonia – Method EPA 350.1
- Nitrate + nitrite – Method EPA 353.2

2.4 Habitat Assessment Methodology

The MPCA's aquatic biota monitoring habitat assessment worksheets were completed for the aquatic biota survey reaches. The MPCA's Stream Habitat Assessment worksheet is a qualitative assessment that results in a score from 0 to 100, with a higher score indicating more favorable conditions for aquatic biota. The MPCA's quantitative habitat assessment worksheet (MPCA 2014c) involves recording physical measurements (depth, substrate, vegetation, etc.) at 13 stream transects spaced equally along the aquatic biota monitoring reach. The habitat assessment worksheets are part of the MPCA's stream habitat assessment protocol (MPCA 2014d).

3.0 Aquatic biota assessment results

The results of aquatic biota survey activities conducted in Spider Creek in 2015 (Table 3-1) are described in the following sections. Macroinvertebrate sampling was conducted at Reach #1 (Spider Creek reference reach) and Reach #2 (initial planned restoration reach) on June 11. Subsequent to the June sampling, and prior to the electrofishing survey, the anticipated section of Spider Creek planned for restoration changed. A new monitoring reach (Reach #3) was established within the channelized section now proposed for restoration. Electrofishing surveys were conducted at Reach #1 and Reach #3 on August 6. A second round of macroinvertebrate sampling was conducted on September 18 at Reach #1 and Reach #3. Photographs from the aquatic biota surveys completed in 2015 are included in Attachment A.

Table 3-1 Spider Creek 2015 Aquatic Biota Monitoring Activities

Aquatic Biota Monitoring Reach	Reach Description	June 11 Macroinvertebrate Sampling	September 18 Macroinvertebrate Sampling	August 6 Electrofishing Survey
Reach #1	Within the Spider Creek Reference Reach	X	X	X
Reach #2	Channelized Reach Downstream of Proposed Restoration Reach	X		
Reach #3	Channelized Reach Proposed for Restoration		X	X

3.1 Aquatic Biota Physical Habitat Results

Field staff completed the MPCA's quantitative habitat worksheets for Reach #1 and Reach #3 during the electrofishing surveys conducted on August 6. A quantitative habitat survey was not conducted at Reach #2, as the stretch of Spider Creek identified for restoration had been moved upstream (Reach #3) prior to conducting the electrofishing survey. The results of the quantitative habitat worksheets are summarized in Table 3-2. The quantitative habitat worksheets completed in the field are provided in Attachment B.

Reach #1 (reference reach) is 150 meters in length, and had an average wetted width of 4.7 meters at the time of the survey. There were two bends within the reach, and the entire length of the reach was identified as a run channel type. The dominant substrate in Reach #1 was composed of detritus (43 percent), while fines (silt, clay, marl) composed 26 percent of Reach #1. Gravel was present in some locations, but was heavily embedded in fines and detritus. The sediment surface was typically dark brown in appearance, but underlying fine sediment was typically a light brown or tan color, and field staff identified the underlying sediment as being marl, a sediment that contains high amounts of calcium carbonate. Aquatic vegetation was observed at 61% of the observation points within Reach #1. In-stream vegetation was primarily submerged and emergent bur-reeds (*Sparganium* spp.). Periphyton algae was recorded at 5% of observation points.

Reach #3 (within the channelized section proposed for restoration) was 180 meters in length and is within an altered section of Spider Creek that has been channelized; there were no bends present in the reach. The entire length of Reach #3 is a run channel type. The mean thalweg depth in Reach #3 was 3 cm deeper than Reach #1, while the overall mean water depth was 1 cm less. The average wetted stream width for Reach #3 at the time of the survey was 4.0 m. Sand was the dominant substrate type (66 percent) within Reach #3, followed by detritus (21 percent) and fines (10 percent). Periphyton was recorded at 4 percent of observation points within Reach #3, while macrophytes were observed at none of the observation points. Although no macrophytes were recorded at the observation points along the quantitative habitat survey transects, there was enough in-stream vegetation to sample for macroinvertebrates. The in-stream vegetation was sparse, and was limited to the edge of the stream channel when present. Overall, cover for fish was less abundant at Reach #3 than Reach #1, as Reach #3 lacked the in-stream vegetation that was present in Reach #1. One other notable feature of Reach #3 is that large trees grew in closer proximity to the stream than at the other reaches; this likely contributed to more large woody debris within the stream. By contrast, woody debris at Reach #1 was dominated by small diameter woody debris, much of which was created by beaver activity.

Table 3-2 Quantitative Physical Habitat Survey Summary

		Reach #1 (Reference Reach)	Reach #3 (Channelized Reach)
Channel Type	Riffle	0%	0%
	Run/Glide	100%	100%
	Pool	0%	0%
Stream Features	Total Length of Reach (m)	150	180
	Log Jams Within Reach	0	0
	Bends Within Reach	2	0
Physical Characteristics	Mean Thalweg Depth (cm)	42	45
	Mean Water Depth (cm)	32	31
	Mean Depth of Fines (cm)	22	12
	Mean Width (m)	4.7	4.0
	Width to Mean Depth Ratio	17	16
Substrates	Cobble Substrate	0%	2%
	Gravel Substrate	20%	1%
	Sand Substrate	11%	66%
	Fine (Silt, Clay, Marl) Substrate	26%	10%
	Detritus Substrate	43%	21%
Vegetation Abundance	Periphyton Algae Abundance	5%	4%
	Macrophyte Abundance	61%	0%
Cover for Fish	Undercut Bank	2%	3%
	Overhanging Vegetation	18%	6%
	Woody Debris	9%	10%
	Boulders	0%	0%
	Submerged Vegetation	33%	0%
	Emergent Vegetation	26%	0%

Field crews completed the MPCA Stream Habitat Assessment (MSHA) worksheets during the June macroinvertebrate surveys for Reaches #1 and #2 and during the September survey for Reach #3. The MSHA worksheet generates qualitative scores that rate aquatic biota habitat conditions on a scale of 0 to 100, with a score of 100 being most favorable for aquatic biota community. The MSHA scores are summarized in Table 3-3 and the completed MSHA worksheets are included as Attachment C. MSHA scores are somewhat subjective, and dependent on the evaluator scoring the stream. Therefore, caution should be used when comparing MSHA scores collected by different evaluators. The MSHA scores summarized in Table 3-3 were recorded by the same Barr staff, and are therefore a useful tool for comparison of the three Spider Creek aquatic biota monitoring reaches with one another.

Reach #1 (Reference Reach) rated higher than Reach #2 or Reach #3 in the channel morphology category, due to its natural sinuosity and bank stability. However, Reach #1 rated very poor in the substrate

category due to silt substrate scoring very low. The riparian zone of Reach #1 was mostly open wet meadow with some brush, which did not provide shading and lowered the riparian category score.

Although Reaches #2 and #3 are both within the altered, channelized section of the stream, they rated very different MSHA scores. Reach #2 had a MSHA score 23.5 points higher than Reach #3. In general, Reach #2 had higher quality substrate and more variety of channel type than Reach #3, as well as better riparian habitat. Reach #2 had cobble, gravel and sand substrate, which score high, while Reach #3 was primarily sand and detritus, which score lower. Reach #2 had riffles and pools in addition to run channel type, while Reach #3 only had run channel type. Reach #2 scored higher in the riparian habitat category, as Reach #2 had mature trees and shading in the riparian zone, while Reach #3 had a gravel road adjacent to the stream on one bank and mostly open wet meadow on the other, providing little to no shading.

Table 3-3 MPCA Stream Habitat Assessment Worksheet Scores

	Reach #1 (Reference Reach)	Reach #2 (Channelized Reach Downstream of Proposed Restoration)	Reach #3 (Channelized Reach)
Land Use (Max=5)	5	5	5
Riparian (Max=14)	10	12	9
Substrate (Max=28)	2	15	8
Cover (Max=18)	8	11	7
Channel Morphology (Max=35)	18	14	7
Total Score (Max=100)	**43**	**57**	**33.5**

3.2 Water Chemistry Results

Water quality field parameters were measured during each macroinvertebrate sampling visit and the electrofishing survey. Water samples were collected from Reach #1 and Reach #3 during the electrofishing survey on August 6. Flow was measured during each aquatic biota monitoring visit as well. Water chemistry, field parameter measurements, and flow measurements are summarized in Table 3-4. In general, water quality measurements were similar between sites on any particular sampling date. Field parameters varied from one sampling date to another. For example, specific conductance varied from 122 µS/cm to 370 µS/cm at Reach #1, and 143 µS/cm to 385 µS/cm at Reach #3.

Table 3-4 Spider Creek Water Chemistry

	Reach #1 (Reference Reach)			Reach #2 (Channelized Reach Downstream of Proposed Restoration)	Reach #3 (Channelized Reach)	
Date	6/11/15	8/6/15	9/18/15	6/11/15	8/6/15	9/18/15
Time	15:40	13:00	11:40	14:10	8:30	8:55
Laboratory Analytical						
Ammonia (mg/L N)	NM	0.035J	NM	NM	0.022J	NM
Nitrate + Nitrite (mg/L N)	NM	<0.0099	NM	NM	<0.0099	NM
Total Phosphorus (mg/L P)	NM	0.049	NM	NM	0.038	NM
Total Suspended Solids (mg/L)	NM	<5.0	NM	NM	<5.0	NM
Field Measurements						
Temperature (°C)	20.4	19.7	16.8	20.0	15.5	16.8
Specific Conductance (µS/cm)	217	370	122	218	385	143
DO (mg/L)	6.5	8.5	5.7	7.1	7.6	6.5
pH	7.00	7.63	7.21	7.13	7.20	7.01
Turbidity (NTU)	6.5	4.5	NM	3.1	3.3	NM
Transparency Tube (cm)	NM	NM	77	NM	NM	100
Flow (cfs)	5.3	1.13	6.8	8.4	0.95	7.1

NM - Not measured.
J - Estimated detected value. The reported value is less than the stated laboratory quantitation limit but greater than the laboratory method detection limit.

Additional water quality data were recorded at 30-minute intervals during two periods in 2015: August 6 to 10 and August 31 to September 18. Temperature, DO, and pH are plotted on Figure 3-1, and specific conductance is plotted on Figure 3-2. A strong diurnal pattern was observed in measurements of temperature and DO, with daily temperature fluctuations as much as 10° F during the first week of September, and daily dissolved oxygen fluctuations of 2-3 mg/L during the same time period. Heavy rains that occurred in the region resulted in a large increase of flow in Spider Creek on September 6, and daily fluctuations of temperature and dissolved oxygen diminished. Following the heavy rains, dissolved oxygen dropped to 3.6 mg/L, and steadily climbed back up to 7.3 mg/L by September 12. The drop in dissolved oxygen may be a result of heavy rains flushing shallow, oxygen-depleted groundwater out of wetlands in the watershed.

Figure 3-1 Temperature, Dissolved Oxygen, and pH at Reach #3

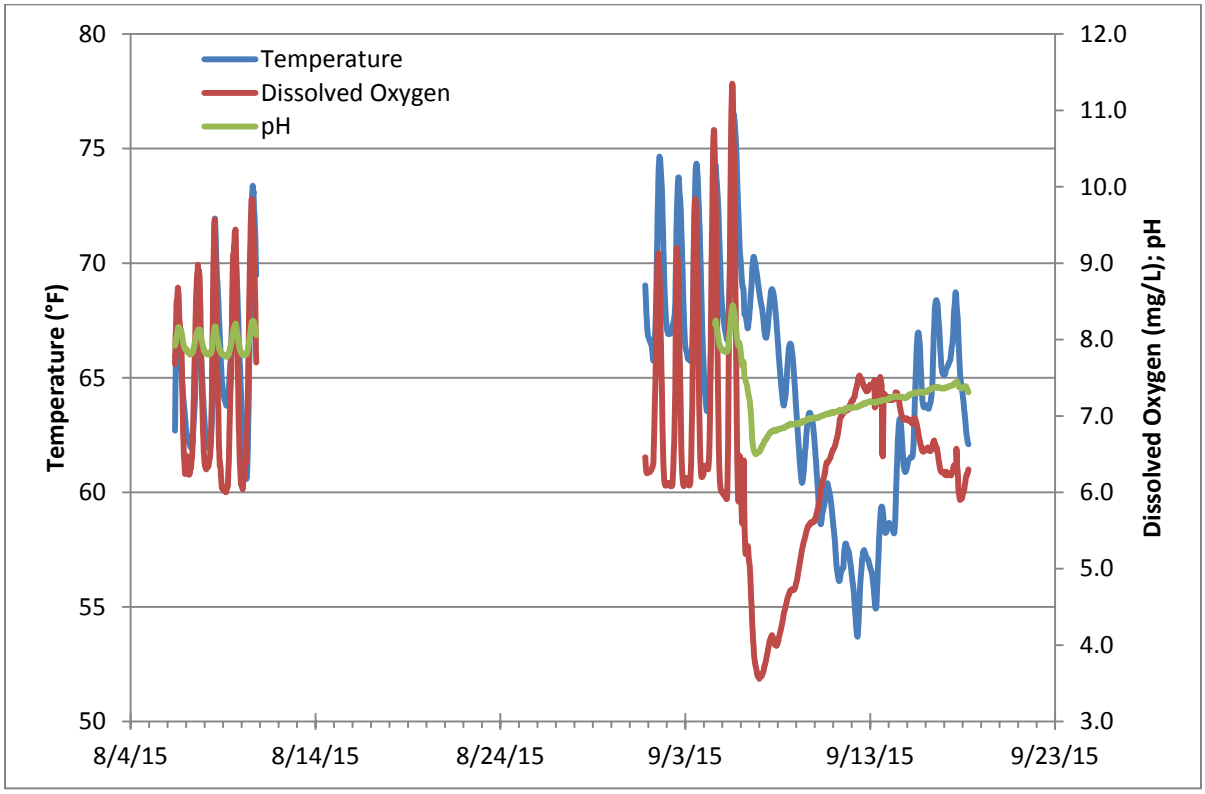
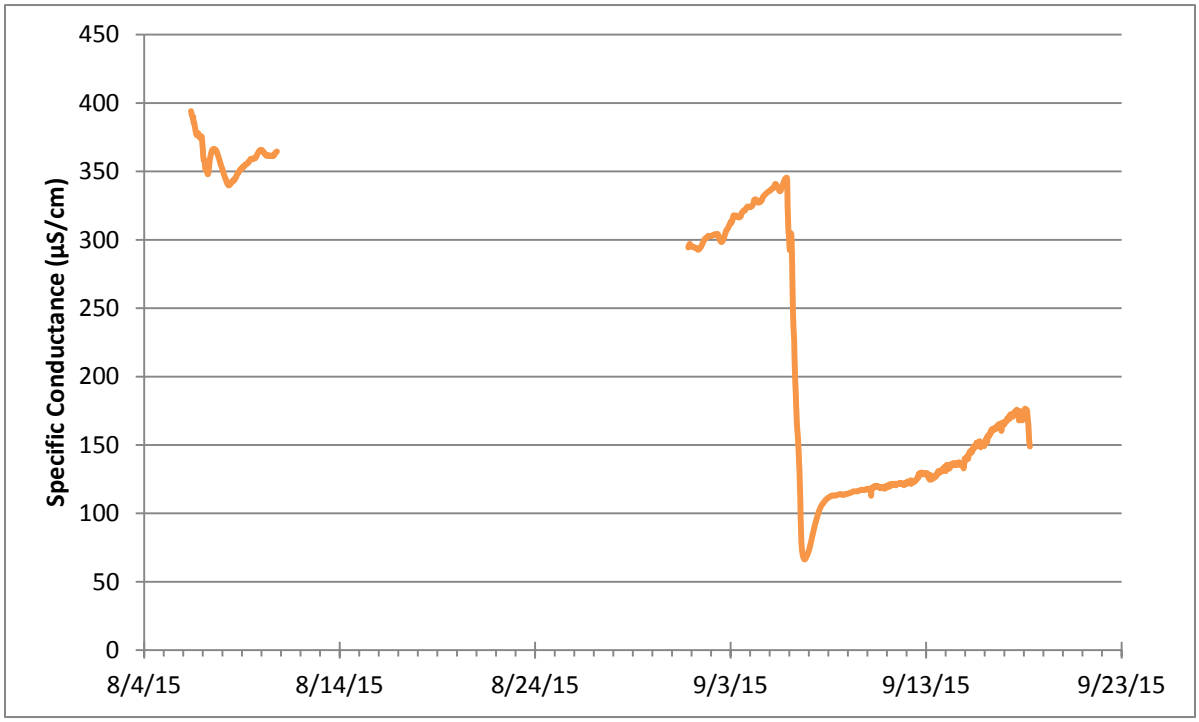


Figure 3-2 Specific Conductance at Reach #3



3.3 Electrofishing Results

Electrofishing surveys were conducted at Reach #1 and Reach #3 on August 6, 2015. The results of the electrofishing survey for Reach #1 are summarized in Table 3-5, and results of Reach #3 are summarized in Table 3-6. A total of 9 fish species were documented in Reach #1 and 11 species in Reach #3. Seven fish species were found within both reaches. Fish species captured in Reach #1 but not Reach #3 included northern pike and brook trout. Fish species captured in Reach #3 but not Reach #1 included blacknose shiner, brassy minnow, brook stickleback, and common shiner. In addition to having more species, Reach #3 had a greater number of total individuals (432 individuals) than Reach #1 (66 individuals). Of the 432 individuals captured in Reach #3, the most numerous species was pearl dace, with 181 individuals, 42% of total individuals. By contrast, only a single pearl dace was captured in Reach #1.

Any anomalies observed on captured fish were recorded. One out of the 17 white sucker individuals captured in Reach #1 was observed to have eroded fins. In Reach #3, one creek chub was observed to have eroded fins, and 30 of the creek chub were observed to have black spot, a disease caused by a parasite.

Table 3-5 Reach #1 (Reference Reach) Electrofishing Results

Common Name	MPCA Tolerance Rating	Number	Length range (mm)	Total Weight (g)	Anomalies
blacknose dace	tolerant	12	40-85	38	
brook trout	sensitive	1	220	107	
central mudminnow	very tolerant	6	55-75	21	
creek chub	tolerant	7	125-180	297	
Johnny darter	--	18	45-70	39	
mottled sculpin	sensitive	2	80-85	18	
northern pike	--	2	140-190	67	
pearl dace	sensitive	1	80	5	
white sucker	--	17	70-200	698	1 with eroded fins
Summary					
			Total Individuals	66	
			Taxa Richness	9	
			Sensitive Taxa	3	
			Sensitive Individuals (%)	6.1%	
			Tolerant Taxa	2	
			Tolerant Individuals (%)	29%	
			Very tolerant taxa	1	
			Very Tolerant Individuals (%)	9.1%	

Table 3-6 Reach #3 (Channelized Reach) Electrofishing Results

Common Name	MPCA Tolerance Rating	Number	Length range (mm)	Total Weight (g)	Anomalies
blacknose dace	tolerant	58	40-75	140	
blacknose shiner	sensitive	7	30-45	3	
brassy minnow	tolerant	5	55-65	12	
brook stickleback	tolerant	2	55-56	3	
central mudminnow	very tolerant	6	70-90	30	
common shiner	--	12	50-70	32	
creek chub	tolerant	63	30-165	489	30 with black spot; 1 with eroded fins
Johnny darter	--	69	30-65	103	
mottled sculpin	sensitive	2	70-85	13	
pearl dace	sensitive	181	60-95	940	
white sucker	--	27	30-170	244	
Summary					
			Total Individuals	432	
			Taxa Richness	11	
			Sensitive Taxa	3	
			Sensitive Individuals (%)	44%	
			Tolerant Taxa	4	
			Tolerant Individuals (%)	30%	
			Very tolerant taxa	1	
			Very Tolerant Individuals (%)	1.4%	

3.4 Macroinvertebrate Sampling Results

Macroinvertebrate taxonomy results for all aquatic biota monitoring reaches are summarized in Table 3-7 below. Complete macroinvertebrate taxonomy results are included in Attachment D. In accordance with the MPCA macroinvertebrate sampling protocol, the taxonomist subsampled approximately 300 organisms from each sample, or processed the entire sample if fewer than 300 total organisms were present. The total number of organisms in each sample were estimated by taking the total number of organisms in the subsample and dividing by the percent of the total sample that was subsampled. Reach #1, the reference reach, had fewer total organisms in samples when compared to Reach #2 and Reach #3. Despite fewer total organism, Reach #1 had greater taxa richness than Reach #2 and Reach #3. Taxa richness is the total number of individual taxa identified in the sample.

The taxonomic orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are generally considered intolerant to poor water quality and pollution, while orders such as Diptera (true flies) are generally considered more tolerant; therefore, the percentage of individuals that are within the

three orders of Ephemeroptera, Plecoptera, and Trichoptera are often reported as %EPT to help assess stream water quality. The %EPT of the June samples collected from Reach #1 and Reach #2 were comparable (47 percent and 45 percent, respectively). From the September sample, the %EPT increased to 68 percent in Reach #1 and to 79 percent in Reach #3, the highest of all samples. Reach #2 (June sampling event) had the highest number of non-insect organisms sampled, including clams, snails, and worms. Reach #2 was the only site where bottom substrate was sampled due to the presence of hard bottom riffles, which would contribute to a higher percentage of clams and worms being sampled.

The taxa identified in the samples were compared to MPCA ratings of pollution tolerance for invertebrates (MPCA 2012). The majority of the taxa sampled in Spider Creek are rated as "tolerant", "very tolerant", or unknown tolerance. Only three individuals of three separate taxa were identified that are categorized by the MPCA as "intolerant". No intolerant taxa were identified in the June samples. Intolerant taxa in the September sample collected in Reach #1 included one individual of the non-biting midge genus Nilothauma (family Chironomidae) and one individual of the caddisfly genus Oxyethira (family Hydroptilidae). Intolerant taxa in the September sample collected from Reach #3 included one individual of the mayfly genus Eurylophella (family Ephemerellidae).

Table 3-7 Macroinvertebrate Taxonomy Summary

	Reach #1 (Reference Reach)		Reach #2 (Channelized Reach Downstream of Proposed Restoration)	Reach #3 (Channelized Reach)
Sample Date	**6/11/2015**	**9/18/2015**	**6/11/2015**	**9/18/2015**
Substrates sampled	1) submerged vegetation 2) woody debris 3) undercut banks/ overhanging vegetation		1) hard bottom 2) woody debris 3) undercut banks/ overhanging vegetation	1) submerged vegetation 2) woody debris 3) undercut banks/ overhanging vegetation
Total number of organisms in subsample	247	315	322	313
Percent of total sample sorted	100%	50%	27%	17%
Estimated total number of organisms in sample*	247	630	1,206	1,874
Taxa Richness	39	37	34	30
Percent Ephemeroptera, Plecoptera, Trichoptera (%EPT)	47%	68%	45%	79%
%EPT and Odonata	50%	72%	49%	87%
% Insects	96%	89%	84%	98%

*Total number of organisms in subsample divided by percent of total sample sorted.

4.0 Conclusions

The three aquatic biota monitoring reaches included in this study are all located on Spider Creek with no significant tributaries entering the creek between monitoring reaches. The water quality is similar at all three reaches. During periods of lower flows, the creek experiences diurnal fluctuations in temperature and dissolved oxygen. DO in the creek was typically above 6 mg/L, but dropped below 4 mg/L following heavy rains in early September.

There were substantial differences in aquatic biota habitat among the three reaches. Reach #1, the reference reach, was located within a meandering, natural channel section of the stream; Reach #2 and Reach #3 were located on sections of the stream that have been channelized. Although Reach #1 had some habitat attributes that would be considered favorable, such as a natural meandering channel, the substrate in Reach #1 was mostly fine silt and detritus, which is an unfavorable substrate for many organisms. Reach #2 had the most favorable substrate overall, with gravel and cobble being present in the reach. Woody debris is also an important substrate for macroinvertebrates in streams as many insect larvae such as caddisflies and mayflies cling to the woody debris. Reach #2 had a high frequency of large diameter woody debris with rough surfaces that were relatively free of silt, which is favorable habitat for many aquatic insects. A large number of caddisflies and other insects were visible on many pieces of woody debris found in Reach #2. By contrast, woody debris found in Reach #1 consisted of small diameter, smooth woody debris pieces (including alder and other brush cut by beaver), which are less favorable habitat than large, rough woody debris. Woody debris within Reach #1 was also more likely to be coated in a layer of silt or detritus, diminishing its value as a suitable substrate for aquatic insects. Fewer organisms were observed on woody debris in Reach #1, compared to Reach #2 and Reach #3. Reach #3 had greater overall abundance of fish and macroinvertebrates compared to Reach #1. Fish taxa richness was slightly less in Reach #1 compared to Reach #3, but macroinvertebrate taxa richness was higher in Reach #1 when compared to both Reach #2 and Reach #3.

5.0 References

MPCA, 2004. Laboratory Analysis – Invertebrate Sample Processing and Identification.

MPCA 2012. "MPCA tolerance categories". Email correspondence from Will Bouchard (MPCA) to Kevin Menken. 12/17/2012.

MPCA 2014a. Fish Community Sampling Protocol for Stream Monitoring Sites.

MPCA 2014b. Invertebrate Community Sampling Protocol for Stream Monitoring Sites.

MPCA 2014c. MPCA Stream Habitat Assessment (MSHA) Protocol for Stream Monitoring Sites.

MPCA 2014d. Quantitative Physical Habitat Assessment Protocol for Wadeable Stream Monitoring Sites.

MPCA 2014e. Reconnaissance Procedures for Initial Visit to Stream Monitoring Sites.

Attachments

Attachment A

Photographs

Attachment A. Photographs
Spider Creek 2015 Aquatic Biota Assessment

Photograph 1. Spider Creek Aquatic Biota Reach #1, August 6, 2015.

Photograph 2. Spider Creek Aquatic Biota Reach #1, August 6, 2015.

Attachment A. Photographs
Spider Creek 2015 Aquatic Biota Assessment

Photograph 3. Spider Creek Reach #2, June 11, 2015.

Photograph 4. Spider Creek Reach #2, June 11, 2015.

Attachment A. Photographs
Spider Creek 2015 Aquatic Biota Assessment

Photograph 5. Spider Creek Aquatic Biota Reach #3, August 6, 2015.

Photograph 6. Spider Creek Aquatic Biota Reach #3, August 6, 2015.

Attachment A. Photographs
Spider Creek 2015 Aquatic Biota Assessment

Photograph 7. Brook Trout, Spider Creek Aquatic Biota Reach #1, August 6, 2015.

Attachment B

MPCA Quantitative Physical Habitat Assessment Worksheets

Reach 1

9/6/15

Meadow ID on transect sheet

could also be

meadow / wet meadow / wetland

Canopy / shading

almost if not all densiometer readings @ end of Bank were overhanging grasses

TRANSECT

MPCA

Field Number: Reach 1 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 1

Crew: DSM, CSB, KDM, RMM Distance from Start (m): 6 11.5

Stream Width (m): 4.2 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	0	1.6	2.4	3.2	
Depth of Fines and Water (cm)	28	38	39	36	
Embeddedness of Coarse Substrates (nearest 25%)	35	53	72	95	0
	—	75	—	—	3/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)		X			
Silt					
Clay					
Detritus	X		X	X	
Other (specify) marl		X	X		

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	10	10	10	
Macrophytes (nearest 5%)	5	100	75	100	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

3 Undercut Banks 12 Overhanging Vegetation 3 Woody Debris 0 Boulders

80 Submergent Macrophytes 20 Emergent Macrophytes 0 Other (specify): —

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock

X/X Meadow ___/___Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock

X/___Meadow ___/___Shrubs ___/X Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: >10 (m) RIGHT BANK *: >10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 1 Center Right 14 Left Bank * 13 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 1 Date (mm/dd/yy): 8-6-15 Transect Number (1-13): 2

Crew: DJM, CJB, LCDM, RRM Distance from Start (m): 17.5

Stream Width (m): 4.0 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	.8	1.6	2.4	3.2	
Depth of Fines and Water (cm)	13	36	33	51	0
Embeddedness of Coarse Substrates (nearest 25%)	27	72	72	75	
	—	—	—	—	4/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)					
Silt	X				
Clay					
Detritus	X	X	X		X
Other (specify) MARL				X	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	5	5	5		
Macrophytes (nearest 5%)	75	75	75		

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

0 Undercut Banks 30 Overhanging Vegetation 0 Woody Debris 0 Boulders

75 Submergent Macrophytes 50 Emergent Macrophytes — Other (specify): —

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock

X/X Meadow ___/___Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify): _____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock

X/X Meadow ___/___Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify): _____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 10 (m) RIGHT BANK *: 10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 15 Center Left 0 Center Downstream 0 Center Right 17 Left Bank * 14 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT MPCA

Field Number: Reach 1 Date (mm/dd/yy): 8-6-15 Transect Number (1-13): 3

Crew: DJN, KDR, CJB, RRH Distance from Start (m): 29.0

Stream Width (m): 3.6 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	.7	1.4	2.1	2.8	
Depth of Fines and Water (cm)	11	16	24	32	D
Embeddedness of Coarse Substrates (nearest 25%)	17	22	35	41	
	100	—	—	—	4/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)	X		X	X	
Sand (gritty, visible, < BB)					
Silt	X				
Clay					
Detritus		X	X	X	
Other (specify)					D

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	5	5	5	5	
Macrophytes (nearest 5%)	20	70	70	100	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

11 Undercut Banks 39 Overhanging Vegetation 0 Woody Debris 0 Boulders
90 Submergent Macrophytes 10 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
X/X Meadow ___/___Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/___Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: >10 (m) RIGHT BANK *: >10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 2 Center Left 0 Center Downstream 0 Center Right 13 Left Bank * 12 Right Bank *

* Right Bank and Left Bank identified while facing downstream. (Revised Dec 2002)

TRANSECT — MPCA

Field Number: Red 1 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 4

Crew: DJM, CSB, RRM, KDM Distance from Start (m): 40.5

Stream Width (m): 3.4 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
	.7	1.4	2.1	2.8	
Water Depth (cm)	20	27	37	45	
Depth of Fines and Water (cm)	37	49	57	63	2
Embeddedness of Coarse Substrates (nearest 25%)	—	50	50	75	4/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)		X	X	X	
Sand (gritty, visible, < BB)					
Silt	X				
Clay					
Detritus	X		X		
Other (specify)					

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	5	5	5	0	
Macrophytes (nearest 5%)	50	100	50	0	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*
3 Undercut Banks 32 Overhanging Vegetation 5 Woody Debris 0 Boulders
90 Submergent Macrophytes 0 Emergent Macrophytes — Other (specify): —

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*
LEFT BANK *: 0 (m) RIGHT BANK *: 0.2 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/___Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***
LEFT BANK *: 10 (m) RIGHT BANK *: 10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):
0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 14 Left Bank * 4 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 1 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 5

Crew: DJM, KDM, CSB, RAM Distance from Start (m): 52.0

Stream Width (m): 5.0 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	18	20	23	24	
Depth of Fines and Water (cm)	27	29	41	41	
Embeddedness of Coarse Substrates (nearest 25%)	75	75	75	75	0

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)	X	X	X	X	
Sand (gritty, visible, < BB)					
Silt					
Clay					
Detritus	X		X	X	
Other (specify)					

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	5	5			
Macrophytes (nearest 5%)	50	100	100		

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

9 Undercut Banks 10 Overhanging Vegetation 0 Woody Debris 0 Boulders

90 Submergent Macrophytes 10 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: .2 (m) RIGHT BANK *: 0 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock

___/X Meadow ___/___Shrubs X/___Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock

___/___Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: >10 (m) RIGHT BANK *: >10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

5 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 13 Left Bank * 1 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Read 1 Date (mm/dd/yy): 9/6/15 Transect Number (1-13): 6

Crew: DJM, KDM, RDM, CJB Distance from Start (m): 63.5

Stream Width (m): 4.2 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	13	16	2.4	3.2	
Depth of Fines and Water (cm)	18	22	19	17	
Embeddedness of Coarse Substrates (nearest 25%)	24	27	23	20	
	75	75	75	75	

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X	X	X	X	
Silt					
Clay					
Detritus					
Other (specify)	X				

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	20	20	20	20	
Macrophytes (nearest 5%)	75	100	100	25	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

0 Undercut Banks 8 Overhanging Vegetation 5 Woody Debris 0 Boulders

Submergent Macrophytes 75 Emergent Macrophytes 6 Other (specify): -

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: .2 (m) RIGHT BANK *: .3 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

/ Cropland / Pasture / Barnyard / Developed / Exposed Rock

X / Meadow / Shrubs X / Woodland / Wetland / Other (specify):

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

/ Cropland / Pasture / Barnyard / Developed / Exposed Rock

/ Meadow / Shrubs X / X Woodland / Wetland / Other (specify):

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: >10 (m) RIGHT BANK *: >10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 0 Left Bank * 14 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 1 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 7

Crew: DJM, KDM, CJB, RAM Distance from Start (m): 75

Stream Width (m): 5.6 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	1.1	2.2	3.3	4.4	
Depth of Fines and Water (cm)	44	66	63	43	
Embeddedness of Coarse Substrates (nearest 25%)	71	108	87	73	N
	—	—	—	—	

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)					
Silt					
Clay					
Detritus					
Other (specify) marl	X	X	X	X	
		X	X	X	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	
Macrophytes (nearest 5%)	0	0	0	10	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*
___Undercut Banks ___Overhanging Vegetation 0 Woody Debris ___Boulders
___Submergent Macrophytes 0 Emergent Macrophytes ___Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*
LEFT BANK *: .5 (m) RIGHT BANK *: 011 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
X/X Meadow X/___Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):___

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify):___

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***
LEFT BANK *: 7.2 (m) RIGHT BANK *: 7.2 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):
0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 17 Left Bank * 0 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Read 1 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 8

Crew: DJM, KDM, CJB, RAM Distance from Start (m): 86.5

Stream Width (m): 4.3 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	.8	1.6	2.4	3.2	
Depth of Fines and Water (cm)	28	49	69	60	
Embeddedness of Coarse Substrates (nearest 25%)	68	86	110	95	W
	-	-	-	-	

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)					
Silt					
Clay					
Detritus					
Other (specify)	X				
Woody debris mat	X	X	X	X	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)					
Macrophytes (nearest 5%)	0	0	0	0	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*
___Undercut Banks 16 Overhanging Vegetation 5 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): —

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*
LEFT BANK *: 0.1 (m) RIGHT BANK *: 0 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
X/___Meadow ___/X Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):___

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow X/___Shrubs ___/X Woodland ___/___Wetland ___/___Other (specify):___

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***
LEFT BANK *: 7/2 (m) RIGHT BANK *: 7/2 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):
0 Center Upstream 0 Center Left 0 Center Downstream 1 Center Right 8 Left Bank * 10 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT MPCA

Field Number: Read 1 Date (mm/dd/yy): _____ Transect Number (1-13): 9

Crew: DJM, KDM, CJB, RRM Distance from Start (m): 98

Stream Width (m): 4.9 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	37	35	38	28	
Depth of Fines and Water (cm)	45	50	100	39	
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—	—	3/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)				X	
Silt				X	
Clay					
Detritus		X			✓
Other (specify) mvl	X	X	X		

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	
Macrophytes (nearest 5%)	5	10	0	0	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*
4 Undercut Banks 16 Overhanging Vegetation ___ Woody Debris 0 Boulders
10 Submergent Macrophytes 10 Emergent Macrophytes ___ Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*
LEFT BANK *: .5 (m) RIGHT BANK *: .2 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock .05
X/___Meadow ___/X Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify): .2 ML

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify): _____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***
LEFT BANK *: 10 (m) RIGHT BANK *: 10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):
0 Center Upstream 0 Center Left 3 Center Downstream 0 Center Right 11 Left Bank * 1 Right Bank *

* Right Bank and Left Bank identified while facing downstream. (Revised Dec 2002)

TRANSECT MPCA

Field Number: Reach 1 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 10

Crew: DJM, KDM, CJB, RRM Distance from Start (m): 109.5

Stream Width (m): 5.1 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
	1	2	3	4	
Water Depth (cm)	40	50	56	48	
Depth of Fines and Water (cm)	81	96	120	105	
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—	—	

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)					
Silt	x				
Clay					
Detritus					
Other (specify) marl	x	x	x	x	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	
Macrophytes (nearest 5%)	0	0	0	0	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*
0 Undercut Banks 6 Overhanging Vegetation 0 Woody Debris 0 Boulders
0 Submergent Macrophytes 10 Emergent Macrophytes — Other (specify):

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*
LEFT BANK *: 0 (m) RIGHT BANK *: 0.4 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
x/___Meadow ___/✓Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs ✓/x Woodland ___/___Wetland ___/___Other (specify):

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***
LEFT BANK *: >10 (m) RIGHT BANK *: >10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):
0 Center Upstream 0 Center Left 0 Center Downstream 2 Center Right 1 Left Bank * 16 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Read 1 Date (mm/dd/yy): 9/6/15 Transect Number (1-13): 11

Crew: DJM, CJB, RRM, ICDM Distance from Start (m): 621

Stream Width (m): 5.5 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
	1.1	2.2	2.2	2.2	
Water Depth (cm)	38	33	20	22	
Depth of Fines and Water (cm)	66	34	40	27	
Embeddedness of Coarse Substrates (nearest 25%)	–	75	–		

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)		–			
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)		X			
Sand (gritty, visible, < BB)			X	X	
Silt	X				
Clay					
Detritus	X	X	X		
Other (specify) Wood Debris				X	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)					
Macrophytes (nearest 5%) burr-reed Emy.	100	100	100	100	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

0 Undercut Banks 0 Overhanging Vegetation 100 Woody Debris 0 Boulders
0 Submergent Macrophytes 100 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0 (m) RIGHT BANK *: 0.1 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
X/___Meadow ___/X Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
X/___Meadow ___/___Shrubs ___/X Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: >10 (m) RIGHT BANK *: >10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 1 Center Right 0 Left Bank * 17 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT — MPCA

Field Number: Read 1 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 12

Crew: DJM, CJB, RRM, KDM Distance from Start (m): 632.5

Stream Width (m): 5.2 Channel Type (circle one): Riffle Pool Run

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	30	37	26	22	
Depth of Fines and Water (cm)	56	68	34	53	
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—	—	

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)		X	X		
Silt					
Clay					
Detritus	X			X	
Other (specify) Woody debris	X	X			X

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	20	
Macrophytes (nearest 5%) Emergent	0	0	0	100	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*
0 Undercut Banks 10 Overhanging Vegetation 5 Woody Debris 1 Boulders
0 Submergent Macrophytes 50 Emergent Macrophytes ____ Other (specify): ____

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*
LEFT BANK *: .4 (m) RIGHT BANK *: 0.1 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
X/___Meadow ___/X Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify): ____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
X/___Meadow ___/___Shrubs ___/X Woodland ___/___Wetland ___/___Other (specify): ____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***
LEFT BANK *: 10 (m) RIGHT BANK *: 10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):
0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 2 Left Bank * 17 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Read 1 Date (mm/dd/yy): 9/6/15 Transect Number (1-13): 13

Crew: DJM, KDM, CJB, ARM Distance from Start (m): 144

Stream Width (m): 5.7 Channel Type (circle one): Riffle Pool (Run)

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	0	0	17	33	
Depth of Fines and Water (cm)	0	0	24	57	
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—		

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X		X	X	
Silt	X				
Clay					
Detritus			X	X	
Other (specify)		X			

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	
Macrophytes (nearest 5%)	0	0	0	0	

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

5 Undercut Banks 30 Overhanging Vegetation 20 Woody Debris 0 Boulders
0 Submergent Macrophytes 5 Emergent Macrophytes ___ Other (specify): —

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge,*** *along transect:*

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow X/___Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
X/___Meadow ___/X Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 10 (m) RIGHT BANK *: 10 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 10 Left Bank * 0 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

STATION FEATURES

MPCA

Field Number: Spike Creek Reach 1 Date(mm/dd/yy): 9/1/15 Crew: DJH, KAM, CJB, RAN

DISTANCE FROM START (m)	STREAM FEATURE (Riffle, Pool, Run, Bend Log Jam, etc.) *	LENGTH (m)
0	RUN	
46.0	BEND	
109.5	BEND (LF)	
150	RUN	
	0 - 150 ⇒ RUN	

DISTANCE SUMMARY

Distance Between Bends(m):

1st - 2nd:	63.5
2nd - 3rd:	
3rd - 4th:	
4th - 5th:	
5th - 6th:	
6th - 7th:	
7th - 8th:	
8th - 9th:	
9th - 10th:	
10th - 11th:	
11th - 12th:	
12th - 13th:	
13th - 14th:	
14th - 15th:	
Sum:	63.5
Mean:	63.5

Distance Between Riffles(m):

1st - 2nd:	
2nd - 3rd:	
3rd - 4th:	
4th - 5th:	
5th - 6th:	
6th - 7th:	
7th - 8th:	
8th - 9th:	
9th - 10th:	
10th - 11th:	
11th - 12th:	
12th - 13th:	
13th - 14th:	
14th - 15th:	
Sum:	
Mean:	

Length (m) Of Individual Riffles, Pools, And Runs:

1st Riffle:	1st Pool:	1st Run: 150
2nd Riffle:	2nd Pool:	2nd Run:
3rd Riffle:	3rd Pool:	3rd Run:
4th Riffle:	4th Pool:	4th Run:
5th Riffle:	5th Pool:	5th Run:
6th Riffle:	6th Pool:	6th Run:
7th Riffle:	7th Pool:	7th Run:
8th Riffle:	8th Pool:	8th Run:
9th Riffle:	9th Pool:	9th Run:
10th Riffle:	10th Pool:	10th Run:
11th Riffle:	11th Pool:	11th Run:
12th Riffle:	12th Pool:	12th Run:
13th Riffle:	13th Pool:	13th Run:
14th Riffle:	14th Pool:	14th Run:
15th Riffle:	15th Pool:	15th Run:
Sum:	Sum:	Sum:

* For riffles, runs, and pools note distance from start at beginning of feature. For bends, log jams, etc., note center-point.

(Revised Dec. 2002)

Reach 3

8/6/15

meadow I.D. on Transect sheet
could be also
* meadow / wet meadow / wetland

* most canopy / densiometer readings
@ end of banks (rt/lf) were
overhanging grasses

110.

TRANSECT

MPCA

Field Number: Read 3 Date (mm/dd/yy): 8-6-15 Transect Number (1-13): 6

Crew: DJM, CJB, ICOM, RAM Distance from Start (m): ~~12.9~~ 13.0 (12.9)

Stream Width (m): 3.8 Channel Type (circle one): Riffle .8 Pool 1.6 Run 2.4 Glide 3.2

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	13	26	35	41	
Depth of Fines and Water (cm)	35	63	54	50	
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—		4/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X	X	X	X	X
Silt	X			X	
Clay					
Detritus					
Other (specify) woody debris			X		

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	0	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

0 Undercut Banks 10 Overhanging Vegetation 10 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0.4 (m) RIGHT BANK *: 1.0 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
X/X Meadow ___/___Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):___

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** * ROAD

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify):___ Along Left Bank 1-13

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 10 Left Bank * 3 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 3 Date (mm/dd/yy): 8-6-15 Transect Number (1-13): 2

Crew: DJm, CJB, KDm, RAn Distance from Start (m): ~~19.4~~ 20.8

Stream Width (m): 4.1 Channel Type (circle one): Riffle Pool Run/slide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	.3	1.6	2.4	2.2	
Depth of Fines and Water (cm)	34	40	50	50	
Embeddedness of Coarse Substrates (nearest 25%)	50	54	60	55	a)
	—	—	—	50	3/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)				X	
Silt		X	X	X	
Clay	X				
Detritus					
Other (specify)					

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	0	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

5 Undercut Banks 21 Overhanging Vegetation 0 Woody Debris 0 Boulders

___ Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0 (grass)

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0.3 (m) RIGHT BANK *: 0.5 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock

X/X Meadow ___/___ Shrubs ___/___ Woodland ___/___ Wetland ___/___ Other (specify): ___

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock

___/___ Meadow ___/___ Shrubs X/X Woodland ___/___ Wetland ___/___ Other (specify): ___

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 8 Left Bank * 10 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reed 2 Date (mm/dd/yy): 9/6/15 Transect Number (1-13): 3

Crew: DJR, CJB, KDM, RAM Distance from Start (m): ~~32.3~~ 34.6

Stream Width (m): 3.7 Channel Type (circle one): Riffle Pool Run/Slide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	.7	1.4	2.1	2.8	
Depth of Fines and Water (cm)	72	50	40	30	
Embeddedness of Coarse Substrates (nearest 25%)	82	65	55	40	
	—	—	—	—	2

1/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X	X	X		
Silt				X	
Clay					
Detritus					
Other (specify) woody debris	X				

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	—
Macrophytes (nearest 5%)	0	0	0	0	—

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

0 Undercut Banks 0 Overhanging Vegetation 0 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: .4 (m) RIGHT BANK *: .1 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock
X/X Meadow ___/___ Shrubs ___/___ Woodland ___/___ Wetland ___/___ Other (specify):

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock
X/X Meadow ___/___ Shrubs X/X Woodland ___/___ Wetland ___/___ Other (specify):

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 3 Left Bank * 17 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Read 3 Date (mm/dd/yy): 8-6-15 Transect Number (1-13): 4

Crew: DJM, CJB, KDM, RRM Distance from Start (m): ~~45.2~~ 48.4

Stream Width (m): 4.5 Channel Type (circle one): Riffle Pool Run/slide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	.9	1.8	2.7	3.6	
Depth of Fines and Water (cm)	29	67	69	29	
Embeddedness of Coarse Substrates (nearest 25%)	41	97	87	33	0
	—	—	—	—	3/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	x	x			
Silt	x				
Clay					
Detritus		x	x	x	
Other (specify) woody debris			x	x	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	0	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

0 Undercut Banks 13 Overhanging Vegetation 5 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: .2 (m) RIGHT BANK *: .7 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
x/x Meadow ___/___Shrubs ___/___Woodland ___/___Wetland ___/___Other (specify):

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs x/x Woodland ___/___Wetland ___/___Other (specify):

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 16 Left Bank * 7 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 2 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 5

Crew: DJM, CJB, KDM, RRM Distance from Start (m): ~~58.1~~ 62.2

Stream Width (m): 5.0 Channel Type (circle one): Riffle Pool Run/slide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
	1	2	3	4	
Water Depth (cm)	44	19	20	11	
Depth of Fines and Water (cm)	48	33	29	20	
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—	—	2

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X	X	X	X	
Silt					
Clay					
Detritus		X			
Other (specify)					

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	0	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

6 Undercut Banks 0 Overhanging Vegetation 0 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: .5 (m) RIGHT BANK *: 0.2 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/___Woodland ___/___Wetland ___/___Other (specify):

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify):

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 2 Left Bank * 17 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 3 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 6

Crew: DJm, CJB, KDM, RRM Distance from Start (m): 11 76

Stream Width (m): 4.3 Channel Type (circle one): Riffle Pool Run/slik

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
	.9	1.3	2.7	3.4	
Water Depth (cm)	17	13	47	46	
Depth of Fines and Water (cm)	40	46	57	54	
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—	—	2/3/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)		X	X		
Silt				X	
Clay				X	
Detritus	X		X		
Other (specify)					

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	0	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

7 Undercut Banks 11 Overhanging Vegetation 2 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0.4 (m) RIGHT BANK *: 0.5 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/___Woodland ___/___Wetland ___/___Other (specify):___

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs X/1 Woodland ___/___Wetland ___/___Other (specify):___

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 1 Left Bank * 17 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 2 Date (mm/dd/yy): 9-6-15 Transect Number (1-13): 7

Crew: DJM, CJB, KDM, RAM Distance from Start (m): ~~83.9~~ 89.8

Stream Width (m): 5.1 Channel Type (circle one): Riffle Pool Run/Slide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
	1	2	3	4	
Water Depth (cm)	40	28	13	13	
Depth of Fines and Water (cm)	56	49	20	13	
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—		

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X	X	X	X	
Silt					
Clay					
Detritus					
Other (specify) woody debris				X	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	—
Macrophytes (nearest 5%)	0	0	0	0	—

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*
9 Undercut Banks 0 Overhanging Vegetation 20 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*
LEFT BANK *: 0 (m) RIGHT BANK *: 0.3 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/___Woodland ___/___Wetland ___/___Other (specify):

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify):

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***
LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):
0 Center Upstream 1 Center Left 0 Center Downstream 0 Center Right 7 Left Bank * 17 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Read 3 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 8

Crew: DJM, CSB, KDM, RPM Distance from Start (m): ~~96.8~~ 103.6

Stream Width (m): 4.5 Channel Type (circle one): Riffle Pool Run/Slide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	6	16	24	23	
Depth of Fines and Water (cm)	18	27	31	29	
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—	—	

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X	X	X	X	
Silt					
Clay					
Detritus					
Other (specify)					

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	—
Macrophytes (nearest 5%)	0	0	0	0	—

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

3 Undercut Banks ___ Overhanging Vegetation 0 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: .4 (m) RIGHT BANK *: .8 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock
___/X Meadow ___/___ Shrubs X/___ Woodland ___/___ Wetland ___/___ Other (specify):___

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock
___/___ Meadow ___/___ Shrubs X/X Woodland ___/___ Wetland ___/___ Other (specify):___

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 1 Center Left 0 Center Downstream 0 Center Right 16 Left Bank * 3 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 3 Date (mm/dd/yy): 8/6/15 Transect Number (1-13): 9

Crew: DJM, KLM, CJB, RBM Distance from Start (m): ~~109.7~~ 117.4

Stream Width (m): 3.6 Channel Type (circle one): Riffle Pool Run/slide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	17	14	21	21.8	
Depth of Fines and Water (cm)	14	17	14	36	
Embeddedness of Coarse Substrates (nearest 25%)	26	27	24	45	
	—	—	—	—	2, 4, 5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X	X	X	X	
Silt	X				
Clay					
Detritus					
Other (specify) woody debris		X			

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	0	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

0 Undercut Banks ___ Overhanging Vegetation ___ Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0.2 (m) RIGHT BANK *: 1.0 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock
___/X Meadow ___/___ Shrubs X/___ Woodland ___/___ Wetland ___/___ Other (specify): ___

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock
___/___ Meadow ___/___ Shrubs X/X Woodland ___/___ Wetland ___/___ Other (specify): ___

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 0 Center Left 0 Center Downstream 0 Center Right 16 Left Bank * 17 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Read 2 Date (mm/dd/yy): 9-6-15 Transect Number (1-13): 10

Crew: DJM, CJB, KDM, RRM Distance from Start (m): ~~122.6~~ 131.2

Stream Width (m): 3.1 Channel Type (circle one): Riffle Pool Run/Glide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	.6	1.2	1.8	2.4	
Depth of Fines and Water (cm)	19	14	15	8	
Embeddedness of Coarse Substrates (nearest 25%)	19	23	30	19	W
	50	—	—	—	1/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)	X				
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)		X	X	X	
Silt					
Clay					
Detritus					
Other (specify) woody debris		X		X	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	50	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	5	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

0 Undercut Banks ___ Overhanging Vegetation 4 Woody Debris 0 Boulders

___ Submergent Macrophytes ___ Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 1.0 (m) RIGHT BANK *: 0 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock

___/X Meadow ___/___ Shrubs X/___ Woodland ___/___ Wetland ___/___ Other (specify): ___

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___ Cropland ___/___ Pasture ___/___ Barnyard ___/___ Developed ___/___ Exposed Rock

___/___ Meadow ___/___ Shrubs X/X Woodland ___/___ Wetland ___/___ Other (specify): ___

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 1 Center Left 0 Center Downstream 0 Center Right 0 Left Bank * 2 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 3 Date (mm/dd/yy): 9-6-15 Transect Number (1-13): 4

Crew: BJM, KOM, CSB, RRm Distance from Start (m): 1355.5 1455.0

Stream Width (m): 3.1 Channel Type (circle one): Riffle Pool Run /slide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
	.6	1.2	1.4	2.4	
Water Depth (cm)	33	29	19	10	
Depth of Fines and Water (cm)	47	34	36	15	W
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—	—	1/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X	X	X	X	
Silt					
Clay					
Detritus					
Other (specify) woody debris		X	X	X	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	0	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

6 Undercut Banks 26 Overhanging Vegetation 50 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): _____

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0 (m) RIGHT BANK *: 0.3 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/___Woodland ___/___Wetland ___/___Other (specify): _____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify): _____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

0 Center Upstream 3 Center Left 0 Center Downstream 0 Center Right 17 Left Bank * 14 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Reach 2 Date (mm/dd/yy): 8/1/15 Transect Number (1-13): 12

Crew: DJM, KDM, CJB, ARM Distance from Start (m): ~~148.9~~ 158.8

Stream Width (m): 4.0 Channel Type (circle one): Riffle Pool Run/Slide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
	.8	1.6	2.4	3.2	
Water Depth (cm)	43	75	87	63	
Depth of Fines and Water (cm)	56	85	99	64	D
Embeddedness of Coarse Substrates (nearest 25%)	—	—	—	—	/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)		X	X		
Silt					
Clay					
Detritus	X				
Other (specify) Woody debris	X			X	

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	0	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*

0 Undercut Banks 0 Overhanging Vegetation 20 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes — Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*

LEFT BANK *: 0.5 (m) RIGHT BANK *: 0.2 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/___Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *

___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***

LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):

6 Center Upstream 0 Center Left 0 Center Downstream 1 Center Right 17 Left Bank * 17 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

TRANSECT

MPCA

Field Number: Read 2 Date (mm/dd/yy): 9-6-15 Transect Number (1-13): 13

Crew: DJM, KDM, CJB, RRM Distance from Start (m): ~~161~~ 172.6

Stream Width (m): 3.0 Channel Type (circle one): Riffle Pool Run/glide

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Water Depth (cm)	.6	1.2	1.4	2.4	
Depth of Fines and Water (cm)	20	19	11	5	
Embeddedness of Coarse Substrates (nearest 25%)	20	34	24	10	D
	—	—	—	—	1/5

Check Dominant Substrate Type in Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Bedrock (solid slab)					
Boulder (basketball or bigger)					
Rubble/Cobble (tennis ball to basketball)					
Gravel (BB to tennis ball)					
Sand (gritty, visible, < BB)	X	X	X	X	
Silt					
Clay					
Detritus					
Other (specify) woody debris	*				

Note Amount Observed on Quadrate:

Channel Position (fifths of wetted stream width and deepest point, 0 = rightbank *)	1/5	2/5	3/5	4/5	Deep
Algae (attached & filamentous., nearest 5%)	0	0	0	0	0
Macrophytes (nearest 5%)	0	0	0	0	0

Cover for Fish: *Percent length of transect* ***(over at least 10 cm water depth)*** *with:*
0 Undercut Banks 0 Overhanging Vegetation 20 Woody Debris 0 Boulders
0 Submergent Macrophytes 0 Emergent Macrophytes 0 Other (specify): 0

Bank Erosion: *Length (nearest 0.1 m) of bare soil,* ***within 5 m of waters edge****, along transect:*
LEFT BANK *: 1.7 (m) RIGHT BANK *: 0.4 (m)

Riparian Land Use: *Dominant land use* ***within 30 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/X Meadow ___/___Shrubs X/___Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Land Use: *Dominant land use* ***from 30 to 100 m of stream edge*** *(along transect):* ***(L / R)*** *
___/___Cropland ___/___Pasture ___/___Barnyard ___/___Developed ___/___Exposed Rock
___/___Meadow ___/___Shrubs X/X Woodland ___/___Wetland ___/___Other (specify):_____

Riparian Buffer Width: *Length (nearest meter) of undisturbed land use along transect,* ***within 10 m of stream:***
LEFT BANK *: 0 (m) RIGHT BANK *: 0 (m)

Canopy/Shading (Densiometer reading, note #/17 that are shaded):
0 Center Upstream 2 Center Left 0 Center Downstream 0 Center Right 4 Left Bank * 8 Right Bank *

* Right Bank and Left Bank identified while facing downstream.

(Revised Dec 2002)

STATION FEATURES

MPCA

Field Number: Reach 3 Date(mm/dd/yy): 8/6/15 Crew: DJM, CJB, KDM, RM

DISTANCE FROM START (m)	STREAM FEATURE (Riffle, Pool, Run, Bend Log Jam, etc.) *	LENGTH (m)
0	—	Run/glide
180	—	↓

DISTANCE SUMMARY

Distance Between Bends(m):

1st - 2nd:
2nd - 3rd:
3rd - 4th:
4th - 5th:
5th - 6th:
6th - 7th:
7th - 8th:
8th - 9th:
9th - 10th:
10th - 11th:
11th - 12th:
12th - 13th:
13th - 14th:
14th - 15th:

Sum:

Mean:

Distance Between Riffles(m):

1st - 2nd:
2nd - 3rd:
3rd - 4th:
4th - 5th:
5th - 6th:
6th - 7th:
7th - 8th:
8th - 9th:
9th - 10th:
10th - 11th:
11th - 12th:
12th - 13th:
13th - 14th:
14th - 15th:

Sum:

Mean:

13,8

Length (m) Of Individual Riffles, Pools, And Runs:

Riffle	Pool	Run
1st Riffle:	1st Pool:	1st Run: 180
2nd Riffle:	2nd Pool:	2nd Run:
3rd Riffle:	3rd Pool:	3rd Run:
4th Riffle:	4th Pool:	4th Run:
5th Riffle:	5th Pool:	5th Run:
6th Riffle:	6th Pool:	6th Run:
7th Riffle:	7th Pool:	7th Run:
8th Riffle:	8th Pool:	8th Run:
9th Riffle:	9th Pool:	9th Run:
10th Riffle:	10th Pool:	10th Run:
11th Riffle:	11th Pool:	11th Run:
12th Riffle:	12th Pool:	12th Run:
13th Riffle:	13th Pool:	13th Run:
14th Riffle:	14th Pool:	14th Run:
15th Riffle:	15th Pool:	15th Run:
Sum:	Sum:	Sum: 180

* For riffles, runs, and pools note distance from start at beginning of feature. For bends, log jams, etc., note center-point.

(Revised Dec. 2002)

Attachment C

MPCA Stream Habitat Assessment (MSHA) Worksheets

MPCA STREAM HABITAT ASSESSMENT (MSHA)

(revised April 2014)

1. Stream Documentation

Field Number: Reach 1 Stream Name: Spider Date: 6/11/15

Person Scoring: K. Monkem Water Level (circle one): Flood / High / Normal / Low / Interstitial

MSHA SCORE 43 Max=100

2. Surrounding Land Use (Streams) or Floodplain Quality (Rivers)

(check the most predominant or check two and average scores)

L	R		
☒	☒	Forest, Wetland, Prairie, Shrub	[5]
☐	☐	Old Field/Hay Field	[3]
☐	☐	Fenced Pasture	[2]
☐	☐	Residential/Park	[2]
☐	☐	Conservation Tillage, No Till	[2]

[L=left bank/R =right bank, facing downstream]

L	R		
☐	☐	Diked Wetland	[2]
☐	☐	Urban/Industrial	[0]
☐	☐	Open Pasture	[0]
☐	☐	Mining/Construction	[0]
☐	☐	Row Crop	[0]

Land Use 5 Max=5

3. Riparian Zone (check the most predominant)

A. Riparian Width

L	R			
☒	☒	Extensive	> 100 m	[5]
☐	☐	Wide	50-100 m	[4]
☐	☐	Moderate	10-50 m	[3]
☐	☐	Narrow	5-10 m	[2]
☐	☐	Very Narrow	1-5 m	[1]
☐	☐	None		[0]

B. Bank Erosion

L	R			
☐	☐	None		[5]
☒	☒	Little	5-25%	[4]
☐	☐	Moderate	25-50%	[3]
☐	☐	Heavy	50-75%	[1]
☐	☐	Severe	75-100%	[0]

C. Shade

L	R			
☐	☐	Heavy	>75%	[4]
☐	☐	Substantial	50-75%	[3]
☐	☐	Moderate	25-50%	[2]
☒	☒	Light	5-25%	[1]
☐	☐	None		[0]

Riparian 10 Max=14

4. Instream Zone

A. Substrate (check two for each channel type)

	[10] Boulder	[9] Cobble	[8] Gravel	[6] Sand	[5] Clay	[5] Bedrock	[2] Silt	[1] Muck	[1] Detritus	[0] Sludge	Channel Type %
Pool	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Riffle	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Run	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	100
Glide	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Note	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Presence

B. Embeddedness

☐	None	[5]
☐	Light 25-50%	[3]
☐	Moderate 50-75%	[1]
☐	Severe 75-100%	[-1]
☒	No coarse substrate	[0]

C. Siltation

☐	Silt Free	[1]
☒	Silt Normal	[0]
☐	Silt Moderate	[-1]
☐	Silt Heavy	[-2]

D. Substrate Types

☐	≥4	[2]
☒	<4	[0]

Substrate 3 Max=28

E. Cover Type (check all that apply)

☒	Undercut Banks	[1]	☐ Oxbows, Backwaters [1]
☒	Overhanging Vegetation	[1]	☐ Shallows (in slow water) [1]
☐	Deep Pools	[1]	☒ Macrophytes [1]
☒	Logs or Woody Debris	[1]	☒ Submergent
☐	Boulders	[1]	☐ Emergent
☒	Rootwads	[1]	☐ Floating Leaf

F. Cover Amount (check one)

☐	Extensive	>50%	[9]
☐	Moderate	25-50%	[7]
☒	Sparse	5-25%	[3]
☐	Nearly Absent		[0]
☐	Choking Vegetation only		[-1]

Cover 8 Max=18

5. Channel Morphology

A. Depth Variability

☐	Greatest Depth >4X Shallow Depth	[4]
☒	Greatest Depth 2-4X Shallow Depth	[2]
☐	Greatest Depth <2X Shallow Depth	[0]

B. Channel Stability

☐	High	[9]
☒	Moderate/High	[6]
☐	Moderate	[3]
☐	Low	[0]

C. Velocity Types (check all that apply)

☐	Fast	[1]
☒	Moderate	[1]
☒	Slow	[1]
☐	Eddies	[1]
☐	Torrential	[-1]
☐	None	[-1]
☐	Interstitial	[-1]
☐	Intermittent	[-2]

D. Sinuosity

☒	Excellent	[4]
☐	Good	[3]
☐	Fair	[2]
☐	Poor	[0]

E. Pool Width/Riffle Width

☐	Pool Width > Riffle Width	[2]
☐	Pool Width = Riffle Width	[1]
☐	Pool Width < Riffle Width	[0]
☒	No Riffle	[0]
☐	No Pool	[0]
☐	Impounded	[-2]

F. Channel Development

☐	Excellent	[9]
☐	Good	[6]
☒	Fair	[3]
☐	Poor	[0]

G. Modifications (check all that apply)

☐	Leveed	[-1]	☐ Rip Rap [1]
☐	Dredged	[-1]	☐ Const. Island [1]
☐	Bank Shaping	[-1]	☐ Wood Pilings [1]
☐	Railroad Ties	[-1]	
☐	Cemented	[-2]	
☐	Bulkheads	[-2]	

Channel 17 Max=35

Aquatic Vegetation (indicate as follows for observed abundance: Abundant=[3]; Moderate=[2]; Sparse=[1])

A. Beneficial Aquatic Vegetation

____ Pond Lilies (*Nymphaea/Nuphar*)	____ Sedge (*Cyperaceae*)	____ Wild Celery (*Vallisneria*)
____ Wild Rice (*Zizania*)	____ Pond Weed (*Potamogeton*)	____ Bulrush (*Scirpus*)
____ Waterweed (*Elodea*)	____ Coontail (*Ceratophyllum*)	____ Water Cress (*Nasturtium*)

B. Invasive and Negative Aquatic Vegetation

____ Eurasian Milfoil (*Myriophyllum*)	____ Purple Loosestrife (*Lythrum*)	3 Reed Canary Grass (*Phalaris*)
____ Cattails (*Typha*)	____ Duckweed (*Lemna*)	____ Algae (Floating Mats)
____ Algae (Planktonic)	____ Algae (Benthic)	

No Vegetation Noted ☐

Comments: Some areas of sparse to moderate floating leaf bur-reed.

MPCA STREAM HABITAT ASSESSMENT (MSHA)

(revised April 2014)

1. Stream Documentation

Field Number: Reach #2 Stream Name: Spider Creek Date: 6/11/15

Person Scoring: K. Menken Water Level (circle one): Flood / High / (Normal) / Low / Interstitial

MSHA SCORE 57 Max=100

2. Surrounding Land Use (Streams) or Floodplain Quality (Rivers)

(check the most predominant or check two and average scores)

L	R		
☒	☒	Forest, Wetland, Prairie, Shrub	[5]
☐	☐	Old Field/Hay Field	[3]
☐	☐	Fenced Pasture	[2]
☐	☐	Residential/Park	[2]
☐	☐	Conservation Tillage, No Till	[2]

[L=left bank/R =right bank, facing downstream]

L	R		
☐	☐	Diked Wetland	[2]
☐	☐	Urban/Industrial	[0]
☐	☐	Open Pasture	[0]
☐	☐	Mining/Construction	[0]
☐	☐	Row Crop	[0]

Land Use 5 Max=5

3. Riparian Zone (check the most predominant)

A. Riparian Width

L	R			
☒	☒	Extensive	> 100 m	[5]
☐	☐	Wide	50-100 m	[4]
☐	☐	Moderate	10-50 m	[3]
☐	☐	Narrow	5-10 m	[2]
☐	☐	Very Narrow	1-5 m	[1]
☐	☐	None		[0]

B. Bank Erosion

L	R			
☐	☐	None		[5]
☒	☒	Little	5-25%	[4]
☐	☐	Moderate	25-50%	[3]
☐	☐	Heavy	50-75%	[1]
☐	☐	Severe	75-100%	[0]

C. Shade

L	R			
☐	☐	Heavy	>75%	[4]
☒	☒	Substantial	50-75%	[3]
☐	☐	Moderate	25-50%	[2]
☐	☐	Light	5-25%	[1]
☐	☐	None		[0]

Riparian 12 Max=14

4. Instream Zone

A. Substrate (check two for each channel type)

	[10] Boulder	[9] Cobble	[8] Gravel	[6] Sand	[5] Clay	[5] Bedrock	[2] Silt	[1] Muck	[1] Detritus	[0] Sludge	Channel Type %
Pool	☐	☐	☒	☒	☐	☐	☐	☐	☐	☐	10
Riffle	☐	☒	☒	☐	☐	☐	☐	☐	☐	☐	5
Run	☐	☐	☒	☒	☐	☐	☐	☐	☐	☐	85
Glide	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Note	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Presence

B. Embeddedness

☐	None	[5]
☐	Light 25-50%	[3]
☒	Moderate 50-75%	[1]
☐	Severe 75-100%	[-1]
☐	No coarse substrate	[0]

C. Siltation

☐	Silt Free	[1]
☒	Silt Normal	[0]
☐	Silt Moderate	[-1]
☐	Silt Heavy	[-2]

D. Substrate Types

☐	≥4	[2]
☒	<4	[0]

Substrate 15 Max=28

E. Cover Type (check all that apply)

☒	Undercut Banks	[1]
☒	Overhanging Vegetation	[1]
☐	Deep Pools	[1]
☒	Logs or Woody Debris	[1]
☐	Boulders	[1]
☒	Rootwads	[1]
☐	Oxbows, Backwaters	[1]
☐	Shallows (in slow water)	[1]
☐	Macrophytes	[1]
☐	Submergent	
☐	Emergent	
☐	Floating Leaf	

F. Cover Amount (check one)

☐	Extensive >50%	[9]
☒	Moderate 25-50%	[7]
☐	Sparse 5-25%	[3]
☐	Nearly Absent	[0]
☐	Choking Vegetation only	[-1]

Cover 11 Max=18

5. Channel Morphology

A. Depth Variability

☐	Greatest Depth >4X Shallow Depth	[4]
☒	Greatest Depth 2-4X Shallow Depth	[2]
☐	Greatest Depth <2X Shallow Depth	[0]

B. Channel Stability

☐	High	[9]
☒	Moderate/High	[6]
☐	Moderate	[3]
☐	Low	[0]

C. Velocity Types (check all that apply)

☒	Fast	[1]
☒	Moderate	[1]
☒	Slow	[1]
☐	Eddies	[1]
☐	Torrential	[-1]
☐	None	[-1]
☐	Interstitial	[-1]
☐	Intermittent	[-2]

D. Sinuosity

☐	Excellent	[4]
☐	Good	[3]
☐	Fair	[2]
☒	Poor	[0]

E. Pool Width/Riffle Width

☐	Pool Width > Riffle Width	[2]
☒	Pool Width = Riffle Width	[1]
☐	Pool Width < Riffle Width	[0]
☐	No Riffle	[0]
☐	No Pool	[0]
☐	Impounded	[-2]

F. Channel Development

☐	Excellent	[9]
☐	Good	[6]
☒	Fair	[3]
☐	Poor	[0]

G. Modifications (check all that apply)

☐	Leveed	[-1]	☐	Rip Rap [1]
☐	Dredged	[-1]	☐	Const. Island [1]
☐	Bank Shaping	[-1]	☐	Wood Pilings [1]
☐	Railroad Ties	[-1]		
☐	Cemented	[-2]		
☐	Bulkheads	[-2]		

Channel 14 Max=35

Aquatic Vegetation (indicate as follows for observed abundance: Abundant=[3]; Moderate=[2]; Sparse=[1])

A. Beneficial Aquatic Vegetation

____ Pond Lilies (*Nymphaea/Nuphar*)	____ Sedge (*Cyperaceae*)	____ Wild Celery (*Vallisneria*)
____ Wild Rice (*Zizania*)	____ Pond Weed (*Potamogeton*)	____ Bulrush (*Scirpus*)
____ Waterweed (*Elodea*)	____ Coontail (*Ceratophyllum*)	____ Water Cress (*Nasturtium*)

B. Invasive and Negative Aquatic Vegetation

____ Eurasian Milfoil (*Myriophyllum*)	____ Purple Loosestrife (*Lythrum*)	3 Reed Canary Grass (*Phalaris*)
____ Cattails (*Typha*)	____ Duckweed (*Lemna*)	____ Algae (Floating Mats)
____ Algae (Planktonic)	____ Algae (Benthic)	

No Vegetation Noted ☐

Comments: a few sparse occurances of floating bur-reed in creek.

MPCA STREAM HABITAT ASSESSMENT (MSHA)

(revised April 2014)

1. Stream Documentation

Field Number: Reach #3 Stream Name: Spider Creek Date: 9/16/14

Person Scoring: Kevin Menken Water Level (circle one): Flood / High / Normal / Low / Interstitial

MSHA SCORE 38.5 Max=100

2. Surrounding Land Use (Streams) or Floodplain Quality (Rivers)

(check the most predominant or check two and average scores)

[L=left bank/R =right bank, facing downstream]

L	R			L	R		
☒	☒	Forest, Wetland, Prairie, Shrub	[5]	☐	☐	Diked Wetland	[2]
☐	☐	Old Field/Hay Field	[3]	☐	☐	Urban/Industrial	[0]
☐	☐	Fenced Pasture	[2]	☐	☐	Open Pasture	[0]
☐	☐	Residential/Park	[2]	☐	☐	Mining/Construction	[0]
☐	☐	Conservation Tillage, No Till	[2]	☐	☐	Row Crop	[0]

Land Use 5 Max=5

3. Riparian Zone (check the most predominant)

A. Riparian Width

L	R			
☒	☐	Extensive	> 100 m	[5]
☐	☐	Wide	50-100 m	[4]
☐	☐	Moderate	10-50 m	[3]
☐	☒	Narrow	5-10 m	[2]
☐	☐	Very Narrow	1-5 m	[1]
☐	☐	None		[0]

B. Bank Erosion

L	R			
☐	☐	None		[5]
☐	☐	Little	5-25%	[4]
☒	☒	Moderate	25-50%	[3]
☐	☐	Heavy	50-75%	[1]
☐	☐	Severe	75-100%	[0]

C. Shade

L	R			
☐	☐	Heavy	>75%	[4]
☐	☐	Substantial	50-75%	[3]
☐	☐	Moderate	25-50%	[2]
☒	☒	Light	5-25%	[1]
☐	☐	None		[0]

Riparian 7.5 Max=14

4. Instream Zone

A. Substrate (check two for each channel type)

	[10] Boulder	[9] Cobble	[8] Gravel	[6] Sand	[5] Clay	[5] Bedrock	[2] Silt	[1] Muck	[1] Detritus	[0] Sludge	Channel Type %
Pool	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Riffle	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Run	☐	☐	☐	☒	☐	☐	☐	☐	☒	☐	100
Glide	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Note	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Presence

B. Embeddedness

☐	None	[5]
☐	Light 25-50%	[3]
☐	Moderate 50-75%	[1]
☐	Severe 75-100%	[-1]
☒	No coarse substrate	[0]

C. Siltation

☐	Silt Free	[1]
☒	Silt Normal	[0]
☐	Silt Moderate	[-1]
☐	Silt Heavy	[-2]

D. Substrate Types

☐	≥4	[2]
☒	<4	[0]

Substrate 7 Max=28

E. Cover Type (check all that apply)

☒	Undercut Banks	[1]	☐	Oxbows, Backwaters	[1]
☒	Overhanging Vegetation	[1]	☐	Shallows (in slow water)	[1]
☐	Deep Pools	[1]	☒	Macrophytes	[1]
☒	Logs or Woody Debris	[1]	☒	Submergent	
☐	Boulders	[1]	☐	Emergent	
☐	Rootwads	[1]	☐	Floating Leaf	

F. Cover Amount (check one)

☐	Extensive	>50%	[9]
☐	Moderate	25-50%	[7]
☒	Sparse	5-25%	[3]
☐	Nearly Absent		[0]
☐	Choking Vegetation only		[-1]

Cover 7 Max=18

5. Channel Morphology

A. Depth Variability

☐	Greatest Depth >4X Shallow Depth	[4]
☒	Greatest Depth 2-4X Shallow Depth	[2]
☐	Greatest Depth <2X Shallow Depth	[0]

B. Channel Stability

☐	High	[9]
☐	Moderate/High	[6]
☒	Moderate	[3]
☐	Low	[0]

C. Velocity Types (check all that apply)

☐	Fast	[1]
☒	Moderate	[1]
☒	Slow	[1]
☐	Eddies	[1]
☐	Torrential	[-1]
☐	None	[-1]
☐	Interstitial	[-1]
☐	Intermittent	[-2]

D. Sinuosity

☐	Excellent	[4]
☐	Good	[3]
☐	Fair	[2]
☒	Poor	[0]

E. Pool Width/Riffle Width

☐	Pool Width > Riffle Width	[2]
☐	Pool Width = Riffle Width	[1]
☐	Pool Width < Riffle Width	[0]
☒	No Riffle	[0]
☐	No Pool	[0]
☐	Impounded	[-2]

F. Channel Development

☐	Excellent	[9]
☐	Good	[6]
☐	Fair	[3]
☒	Poor	[0]

G. Modifications (check all that apply)

☐	Leveed	[-1]	☐	Rip Rap	[1]
☐	Dredged	[-1]	☐	Const. Island	[1]
☐	Bank Shaping	[-1]	☐	Wood Pilings	[1]
☐	Railroad Ties	[-1]			
☐	Cemented	[-2]			
☐	Bulkheads	[-2]			

Channel 7 Max=35

Aquatic Vegetation (indicate as follows for observed abundance: Abundant=[3]; Moderate=[2]; Sparse=[1])

A. Beneficial Aquatic Vegetation

____ Pond Lilies (*Nymphaea/Nuphar*)	____ Sedge (*Cyperaceae*)	____ Wild Celery (*Vallisneria*)
____ Wild Rice (*Zizania*)	____ Pond Weed (*Potamogeton*)	____ Bulrush (*Scirpus*)
____ Waterweed (*Elodea*)	____ Coontail (*Ceratophyllum*)	____ Water Cress (*Nasturtium*)

B. Invasive and Negative Aquatic Vegetation

____ Eurasian Milfoil (*Myriophyllum*)	____ Purple Loosestrife (*Lythrum*)	3 Reed Canary Grass (*Phalaris*)
____ Cattails (*Typha*)	____ Duckweed (*Lemna*)	____ Algae (Floating Mats)
____ Algae (Planktonic)	____ Algae (Benthic)	

No Vegetation Noted ☐

Comments: Overhanging reed canary grass, and small amounts of submerged and emergent bur-reed.

Attachment D

Macroinvertebrate Taxonomic Results

Attachment D. Macroinvertebrate Taxonomic Results
Spider Creek 2015 Aquatic Biota Assessment

Table D-1. Spider Creek Reach #1 June 11, 2015 Macroinvertebrate Taxonomy.

Class	Order	Family	Genus	MPCA Tolerance Rating	# of Organisms
Arachnida				T	2
Insecta	Coleoptera	Dytiscidae	Neoporus	VT	1
		Elmidae	Dubiraphia	VT	3
		Gyrinidae		U	1
		Hydrochidae	Hydrochus	VT	1
		Hydrophilidae		VT	1
	Diptera	Ceratopogonidae		T	1
		Chironomidae	Phaenopsectra	T	2
			Polypedilum	VT	6
			Stenochironomus	T	3
			Tribelos	T	1
			Ablabesmyia	T	5
			Thienemannimyia	T	32
			Conchapelopia	VT	1
			Procladius	T	4
			Paratanytarsus	VT	1
			Tanytarsus	T	1
			Brillia	VT	2
			Cricotopus	VT	2
			Diplocladius	VT	1
			Limnophyes	VT	1
			Parakiefferiella	VT	1
			Tvetenia	T	4
			(unidentified)	T	1
		Empididae	Hemerodromia	T	1
			(unidentified)	T	1
		Simuliidae	Simulium	T	28
		Tabanidae		T	3
	Ephemeroptera	Baetidae	Baetis	T	35
		Caenidae	Caenis	VT	44
	Hemiptera	Corixidae	Hesperocorixa	VT	1
	Megaloptera	Sialidae	Sialis	U	3
	Odonata	Aeshnidae		T	3
		Calopterygidae	Calopteryx	U	2
		Corduliidae		U	2
	Plecoptera	Perlidae		VT	1
	Trichoptera	Leptoceridae	Triaenodes	T	2
		Limnephilidae	Anabolia	U	28
			Pycnopsyche	U	1
			(unidentified)	U	3
		Polycentropodidae		U	1
		(unidentified)		U	2
Bivalvia	Veneroida	Pisidiidae		VT	8
Summary					
				Total # of organisms in subsample	247
				Percent of total sample sorted	100%
				Estimated total # of organisms in sample	247
				Taxa Richness	39
				% EPT	47%
				%EPT and Odonata	50%
				% Insects	96%

%EPT – Percent Ephemeroptera, Plecoptera, and Trichoptera
I – Intolerant
T – Tolerant
VT – Very Tolerant
U – Unknown Tolerance

Attachment D. Macroinvertebrate Taxonomic Results
Spider Creek 2015 Aquatic Biota Assessment

Table D-2. Spider Creek Reach #2 June 11, 2015 Macroinvertebrate Taxonomy.

Class	Order	Family	Genus	MPCA Tolerance Rating	# of Organisms
Insecta	Coleoptera	Dytiscidae	Hygrotus	VT	1
		Elmidae	Dubiraphia	VT	13
			Optioservus	VT	1
		Haliplidae	Haliplus	VT	1
	Diptera	Athericidae	Atherix	T	1
		Ceratopogonidae		T	1
		Chironomidae	Stenochironomus	T	2
			Thienemannimyia	T	14
			Rheotanytarsus	T	1
			Tanytarsus	T	5
			Brillia	VT	1
			Limnophyes	VT	1
			Parakiefferiella	VT	1
			Parametriocnemus	T	1
			Tvetenia	T	7
			Xylotopus	T	1
		Empididae	Hemerodromia	T	4
			Neoplasta	T	2
			(unidentified)	T	4
		Simuliidae	Simulium	T	50
	Ephemeroptera	Baetidae	Baetis	T	66
		Caenidae	Caenis	VT	14
		Heptageniidae	Maccaffertium	T	7
			Stenacron	T	2
			(unidentified)	T	1
	Odonata	Aeshnidae	Boyeria	T	2
			(unidentified)	T	1
		Calopterygidae	Calopteryx	U	8
		Gomphidae		U	1
		(unidentified)		U	1
	Trichoptera	Hydropsychidae	Ceratopsyche	T	11
			Hydropsyche	T	12
			(unidentified)	T	2
		Limnephilidae	Anabolia	U	19
			Pycnopsyche	U	9
		Psychomyiidae	Lype	U	2
Bivalvia	Veneroida	Pisidiidae		VT	21
Gastropoda	Basommatophora	Physidae	Physella	VT	11
Oligochaeta				T	20
Summary					
				Total # of organisms in subsample	322
				Percent of total sample sorted	27%
				Estimated total # of organisms in sample	1206
				Taxa Richness	34
				% EPT	45%
				%EPT and Odonata	49%
				% Insects	84%

%EPT – Percent Ephemeroptera, Plecoptera, and Trichoptera
I – Intolerant
T – Tolerant
VT – Very Tolerant
U – Unknown Tolerance

Attachment D. Macroinvertebrate Taxonomic Results
Spider Creek 2015 Aquatic Biota Assessment

Table D-3. Spider Creek Reach #1 September 18, 2015 Macroinvertebrate Taxonomy.

Class	Order	Family	Genus	MPCA Tolerance Rating	# of Organisms
Arachnida				T	1
Insecta	Coleoptera	Dytiscidae	Liodessus	T	6
		Elmidae	Dubiraphia	VT	8
		Gyrinidae	Gyrinus	U	2
		Helophoridae	Helophorus	VT	1
		Hydrophilidae	Tropisternus	VT	1
	Diptera	Chironomidae	Dicrotendipes	VT	6
			Microtendipes	T	10
			Nilothauma	I	1
			Procladius	T	1
			Stenochironomus	T	2
			Thienemannimyia	T	1
		Empididae	Hemerodromia	T	3
		Simuliidae	Simulium	T	7
	Ephemeroptera	Baetidae	Baetis	T	58
		Caenidae	Caenis	VT	31
		Leptophlebiidae	Paraleptophlebia	U	66
	Hemiptera	Belostomatidae	Belostoma	VT	3
		Nepidae	Ranatra	VT	1
		Pleidae	Neoplea	VT	1
	Odonata	Aeshnidae	Aeshna	T	6
		Calopterygidae	Calopteryx	U	6
	Trichoptera	Hydropsychidae	Ceratopsyche	T	1
			Cheumatopsyche	VT	25
			Hydropsyche	T	14
		Hydroptilidae	Oxyethira	I	1
		Leptoceridae	Ceraclea	T	1
			Oecetis	T	3
		Limnephilidae		U	9
		Phryganeidae	Ptilostomis	U	5
		Polycentropodidae		U	1
Malacostraca	Amphipoda	Hyalellidae	Hyalella	T	1
Bivalvia	Veneroida	Pisidiidae		U	14
Gastropoda	Basommatophora	Ancylidae	Ferrissia	T	14
		Physidae	Physella	VT	2
		Planorbidae	Planorbella	VT	1
	Hygrophila	Lymnaeidae	Galba	VT	1

Summary	
Total # of organisms in subsample	315
Percent of total sample sorted	50.0%
Estimated total # of organisms in sample	630
Taxa Richness	37
% EPT	68%
%EPT and Odonata	72%
% Insects	89%

%EPT – Percent Ephemeroptera, Plecoptera, and Trichoptera
I – Intolerant
T – Tolerant
VT – Very Tolerant
U – Unknown Tolerance

Attachment D. Macroinvertebrate Taxonomic Results
Spider Creek 2015 Aquatic Biota Assessment

Table D-4. Spider Creek Reach #3 September 18, 2015 Macroinvertebrate Taxonomy.

Class	Order	Family	Genus	MPCA Tolerance Rating	# of Organisms
Insecta	Coleoptera	Dytiscidae	Liodessus	T	5
		Elmidae	Dubiraphia	VT	16
		Hydrophilidae	Enochrus	VT	1
		Hydrophilidae	Tropisternus	VT	2
	Diptera	Chironomidae	Orthocladius	T	1
			Parametriocnemus	T	1
			Procladius	T	2
			Rheotanytarsus	T	3
			Thienemannimyia	T	2
		Simuliidae	Simulium	T	3
	Ephemeroptera	Caenidae	Caenis	VT	9
		Ephemerellidae	Eurylophella	I	1
		Heptageniidae	Maccaffertium	T	20
			Stenacron	T	4
		Leptophlebiidae	Paraleptophlebia	U	147
	Odonata	Aeshnidae		T	1
		Calopterygidae	Calopteryx	U	22
		Corduliidae	Epitheca	U	1
	Plecoptera	Perlidae	Isoperla	VT	1
	Trichoptera	Hydropsychidae	Cheumatopsyche	VT	14
			Hydropsyche	T	29
		Leptoceridae	Oecetis	T	3
		Limnephilidae		U	4
		Phryganeidae	Ptilostomis	U	6
		Polycentropodidae	Nyctiophylax	U	6
		Psychomyiidae	Lype	U	3
Hirudinea				VT	2
Oligochaeta				T	1
Bivalvia	Veneroida	Pisidiidae		U	1
Gastropoda	Basommatophora	Ancylidae	Ferrissia	T	2
Summary					
Total # of organisms in subsample					313
Percent of total sample sorted					16.7%
Estimated total # of organisms in sample					1874
Taxa Richness					30
% EPT					79%
%EPT and Odonata					87%
% Insects					98%

%EPT – Percent Ephemeroptera, Plecoptera, and Trichoptera
I – Intolerant
T – Tolerant
VT – Very Tolerant
U – Unknown Tolerance

Attachment D: Phase I Archaeological Survey Report

PHASE I ARCHAEOLOGICAL SURVEY

FOR PROPOSED STREAM RESTORATION

ON A PORTION OF SPIDER CREEK,

ST. LOUIS COUNTY,

MINNESOTA

Susan C. Mulholland

and

Stephen L. Mulholland

Duluth Archaeology Center

5910 Fremont Street Suite 1

Duluth, Minnesota

For

Barr Engineering Company

on behalf of U.S. Steel Minntac

January 2017

Duluth Archaeology Center Report Number 17–02

ABSTRACT

A Phase I reconnaissance survey was requested by Barr Engineering Company on behalf of U.S. Steel Minntac for a proposed restoration of a portion of Spider Creek on Richardson Road in Trail in Ness Township near Floodwood, St. Louis County, Minnesota. The project area is located south and north of Richardson Road and will restore this portion of Spider Creek to a more natural channel. The existing channel was straightened prior to 1940 with the removed sediment used to construct Richardson Road. The land ownership is State tax-forfeit land (administered by St. Louis County Lands Department) and private ownership including the Spider Creek Hunting Association. Pedestrian walkover survey was conducted over the entire project area. Shovel testing was not conducted since the project area includes previously disturbed or water-saturated terrain. The only current water feature in the corridor is Spider Creek.

One post-Contact site was documented, the Spider Creek Farmstead (21SL1244) north of Richardson Road/Spider Creek on the north edge of the project. The historic site consists of three surface features, two log construction buildings (mostly collapsed) and a bermed root cellar. Additional subsurface deposits may be present. The farmstead is shown on the 1940 aerial photograph (CIR-12-018). The area around the surface features and the access road to the site from Richardson Road are recommended for avoidance during the stream restoration project. If avoidance of the site is possible, then no additional archaeological work is recommended for this project and a determination of No Historic Properties Affected is recommended. If the site cannot be avoided, then a Phase II evaluation is recommended to determine eligibility to the National Register of Historic Places.

Copies sent to:

Julie Kloss Molina, Barr Engineering, 325 South Lake Avenue, Duluth MN 55802.

Sarah Beimers, Compliance Officer, State Historic Preservation Office, History Building, 345 Kellogg Boulevard West, St. Paul, MN 55102.

Amanda Gronhovd, State Archaeologist, Ft. Snelling History Center, St. Paul, MN 55111.

Acknowledgments:

Daniel Tix and Julie Kloss Molina, Barr Engineering, provided information and maps of the project area. Thomas Cinadr of the State Historic Preservation Office provided a background search of State records and an inventory number for the bridge. Amanda Gronhovd, State Archaeologist, issued the State Archaeology License; Bruce Koenen provided the state site number.

Personnel:

Susan C. Mulholland	Principal Investigator
Stephen L. Mulholland	co-Principal Investigator
Hollie Lincoln	survey technician
Katherine Hagsten	graphics technician

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BACKGROUND INFORMATION

INTRODUCTION

A Phase I archaeological reconnaissance survey was conducted by the Duluth Archaeology Center (DAC) for the proposed restoration of a portion of Spider Creek in Ness Township near Floodwood, St. Louis County, Minnesota (Figure 1). The general project area is located on Richardson Road/County Road 167 from the junction with County Road 166 to the end of Richardson Road (Figure 2). The Area of Potential Effects (APE) is approximately 200 feet north and south of Richardson Road for the length of the road, although slightly larger on the northwest end. Terrain is mostly the water-saturated immediate floodplain of Spider Creek with small portions of slightly higher terrain on the north and south edges of the APE. The only water feature within the APE is Spider Creek, which joins the Whiteface River to the west.

DAC was contracted by Barr Engineering Company on behalf of U.S. Steel Minntac to provide a standard Phase I archaeological survey of the project APE. Areas along rivers and other water features are generally considered to have a high potential for unrecorded archaeological sites (Hudak et al. 2002). The Phase I survey of the Spider Creek Stream Restoration Project was conducted to State Historic Preservation Office (SHPO) and Office of the State Archaeologist (OSA) standards (Anfinson 2011). Survey of the project area was conducted on December 3 and 5, 2016, under OSA annual archaeology license 16-022 (Appendix I).

PROJECT LOCATION AND SETTING

The Spider Creek stream restoration project is located between Alborn and Floodwod within Ness Township in St. Louis County, Minnesota (Figure 2). The legal description of the APE is T52N, R19W, Section 24, SE/SW of NE and NE of NW. Universal Transverse Mercator (UTM) coordinates for Richardson Road within the APE are listed (Table 1).

Table 1. UTM coordinates of the project APE*

Northwest End	523552E	5203202N
Southeast End	524310E	5202763N

*All coordinates are in zone 15 and are based on the 1983 North American Datum (NAD)

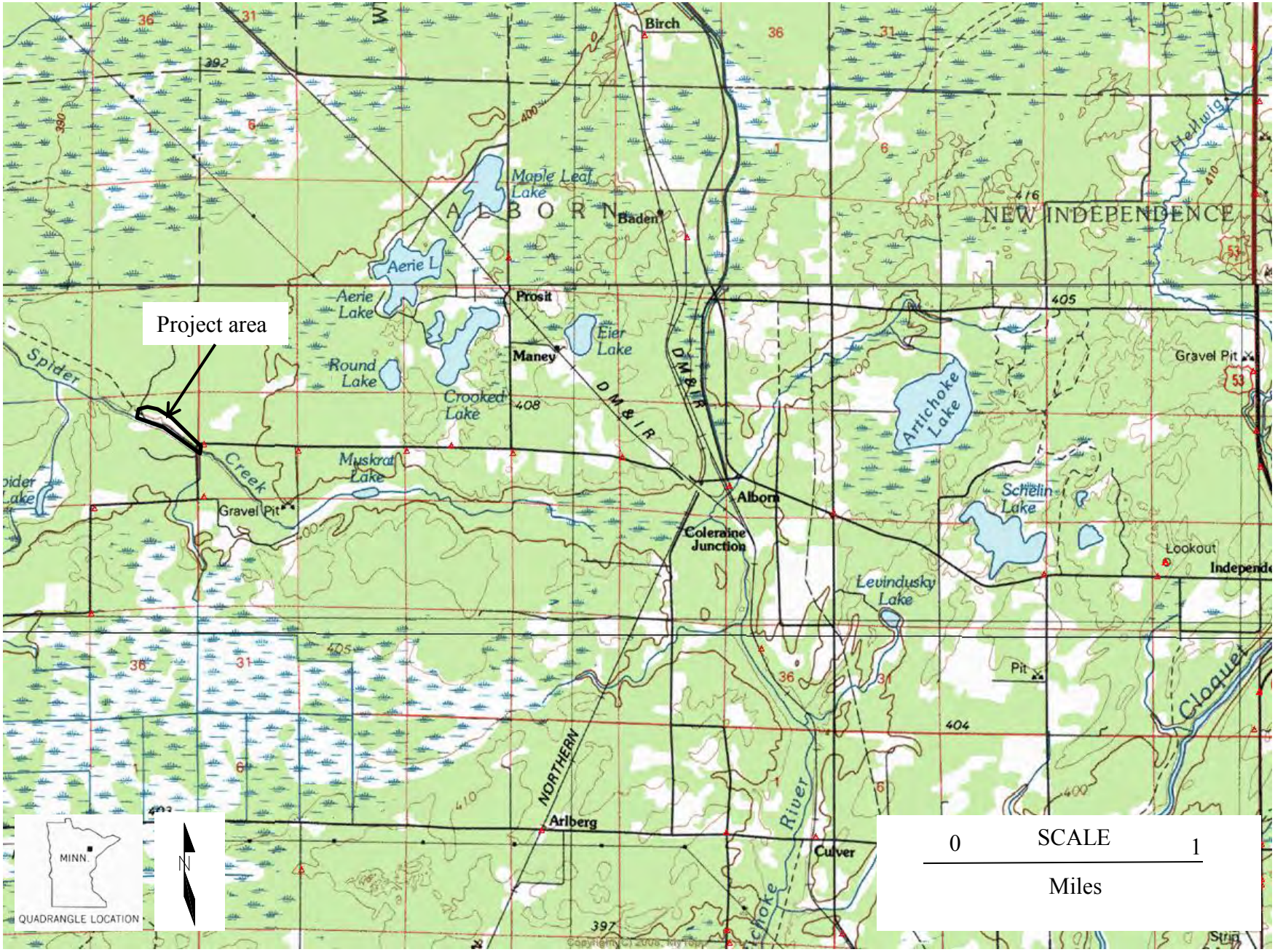

Figure 1. Location of the project area, Duluth (1980) quadrangle (1:100,000) USGS topographic map.

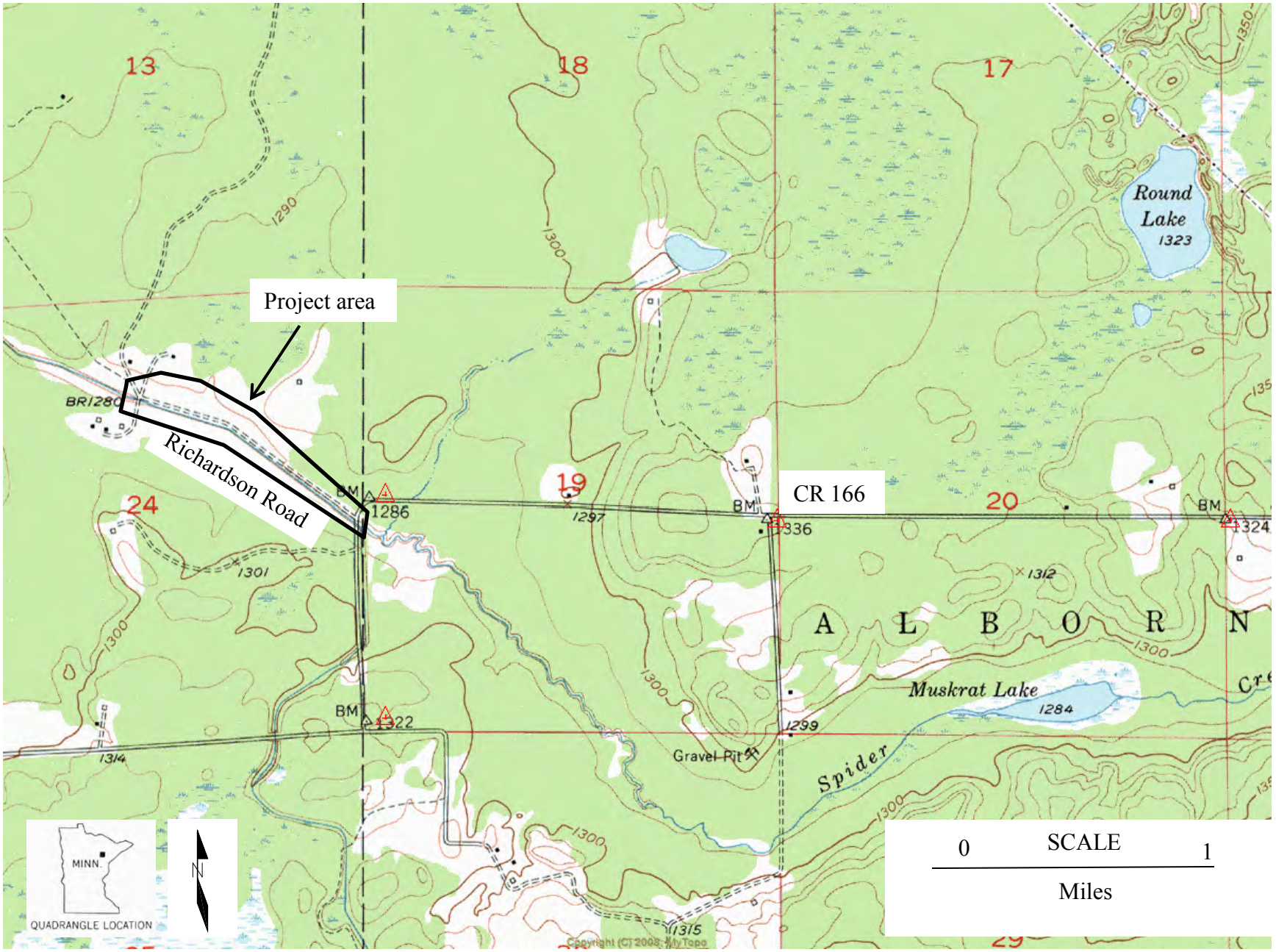

Figure 2. Location of the project area, Brookston NW (1953/1975) quadrangle (1:24,000) USGS topographic map.

The APE is approximately 200 feet north and south of Richardson Road. The proposed stream restoration will be on both sides of Richardson Road/County Road 167 from the junction with County Road 166 northwest to the end, at which several driveways to individual properties are located (Figure 3). Land ownership within the APE is largely State tax-forfeit land administered by the St. Louis County Lands Department as well as private landowners, including the Spider Creek Hunting Association and Mitchell Melindam (Figure 3). Permissions for the survey were obtained by Barr Engineering personnel (Daniel Tix, personal communication, November 2016).

The lakes and rivers throughout Minnesota watersheds possess a higher potential for prehistoric activity (Hudak et al. 2002). Spider Creek is a tributary to the Whiteface River, a major tributary to the St. Louis River which is the largest drainage in Northeastern Minnesota (Waters 1977). Archaeological sites from the appropriate pre-Contact historic contexts are to be expected on higher ground adjacent to waterways. Sites from post-Contact historic contexts may be expected throughout the project.

The geomorphic history of this area is a complex of glacial and post-glacial activity. The parcel is located in the Upham Lacustrine Plain geomorphic area, a level to gently undulating area that was formed as the basin of a glacial lake (University of Minnesota 1977). Glacial Lake Upham formed from melting of the Rainy Lobe of glacial ice; it was confluent with Glacial Lake Aitkin to the west and south at various times. Both lakes were large and received discharge from Glacial Lake Koochiching, a portion of Glacial Lake Agassiz; drainage was to Lake Superior by the St. Louis River in early times and by the Mississippi River in later times (Hobbs 1983). This area is also designated the Glacial Lakes Upham and Aitkin physiographic area, characterized by a lake bottom plain of silt and sand covered by swampy terrain (Wright 1972:567).

The APE is located within the Whiteface River watershed, above the junction with the St. Louis River. The St. Louis River watershed is one of the largest in the state as well as northeastern Minnesota (Waters 1977:27). The Whiteface is in the center of the drainage, joining the St. Louis upstream from the sharp southeast bend at Floodwood. The direction of the Whiteface and the portion of the St. Louis north of this bend is toward the Mississippi River; at Floodwood, the East Savannah River joins from the southwest and the Savannah Portage along this tributary connected the St. Louis drainage to the Mississippi (Luukkonen 2007). Spider Creek is a small tributary in this large and important watershed. Prehistoric sites are expected on high ground near these waterways.

The vegetation at the mid-1800s as based on the General Land Office survey records is a patchwork of several types (Marschner 1974). An aspen-birch complex covers most of the area, containing white and Norway pines, balsam fir, and spruce. Conifer bogs and swamps occurred

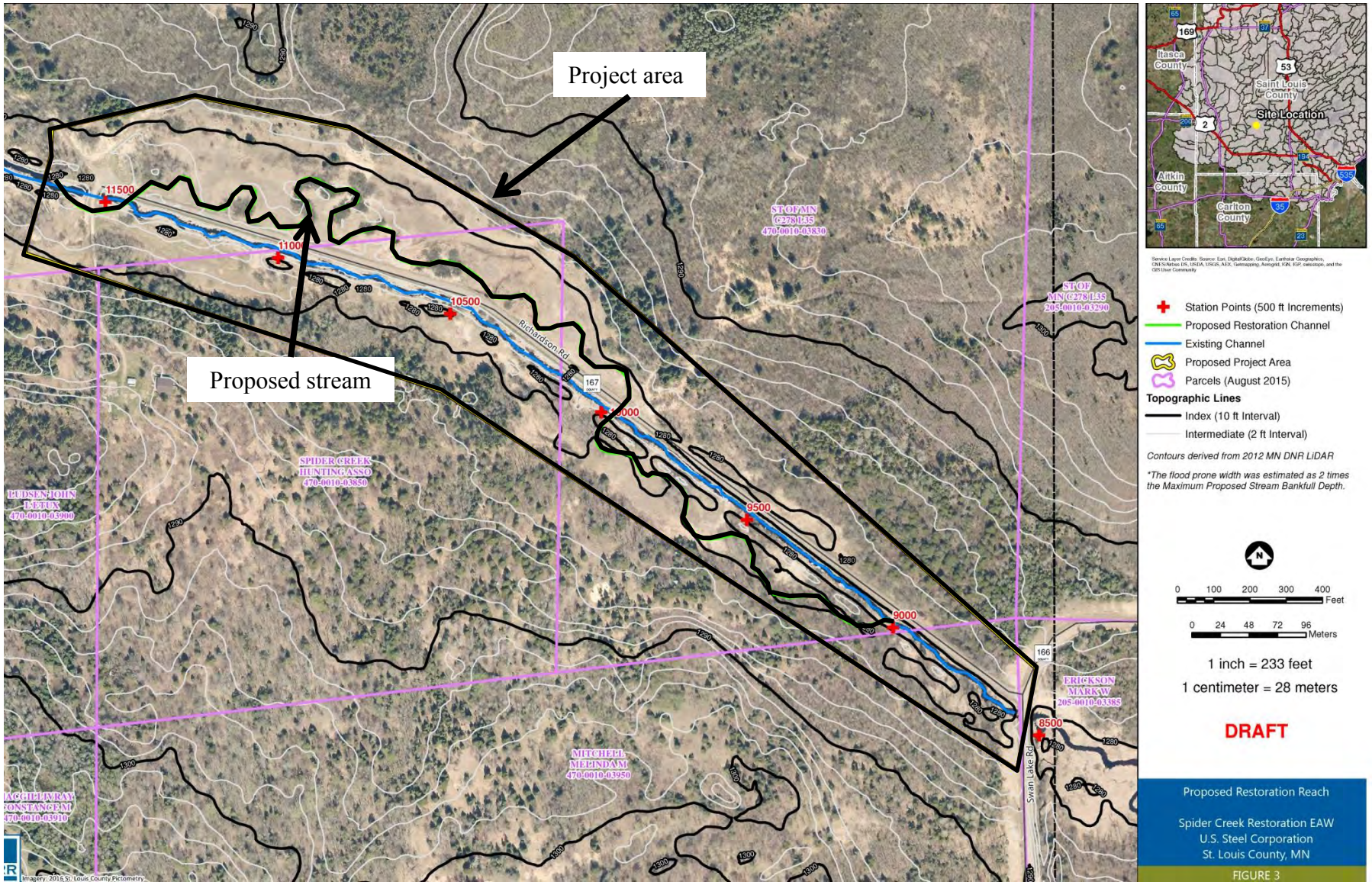

Figure 3. Stream restoration and landownership map. Provided by BARR Engineering.

extensively in the township as well; spruce, tamarack, cedar, and balsam are the primary components. A patch of conifer bogs and swamps within the aspen-birch complex may correlate to the APE and upstream on Spider Creek.

ARCHAEOLOGICAL BACKGROUND

The survey APE is in the Central Coniferous Lakes archaeological region (5) of Minnesota (Anfinson 1990) in the southern part of the eastern portion of the region (5e). The project area is also located within the western part of the Northeastern Minnesota District (4) on which the state historic contexts are based (Dobbs 1988a:19). Although specific boundaries generally follow county lines, the areas incorporate roughly similar geographic landscapes that reflect various episodes of glacial activity.

The two slightly different versions of archaeological regions or districts in Minnesota reflect different emphasis on physical landscape characteristics. Anfinson (1990) bases regions on patterns of lakes with some vegetational input. Dobbs (1988a: 19-24) focuses on glacial history and therefore surface geomorphology, as well as using county boundaries where feasible. In general, the two classifications fit reasonably well in terms of the archaeological districts.

The major stages in which pre-Contact historic contexts are grouped are most commonly considered to be Paleoindian, Archaic, and Woodland although later, more complex contexts are recognized as well (Minnesota Historical Society 1999:24). Dobbs (1988a) splits the Paleoindian into Fluted (Early) and Lanceolate (Late) segments, as well as dividing the Woodland into Ceramic/Mound and Late Prehistoric. Individual historic contexts are considered in relation to the regional differences in the archaeological record. District 4 contains evidence of the three major stages but not all historic contexts within those stages. However, no sites are listed for any pre-Contact historic context within the project area.

Only scattered projectile points indicative of Early Paleoindian (Fluted) occupation have been reported in Minnesota (Higgenbottom 1996; Buhta et al. 2011); Late Paleoindian (or Lanceolate) is better documented (Florin 1996), particularly at the Reservoir Lakes to the south (Harrison et al. 1995) and in the Superior National Forest to the north. The Archaic Tradition is represented by Lake-Forest Archaic to the south, Prairie Archaic to the west and Shield Archaic to the north. The Woodland Tradition (Ceramic/Mound) is well-represented in the general area: Laurel is well-known with Brainerd to the west (Anfinson 1979). The Late Prehistoric includes Blackduck as well as Selkirk to the north. The Sandy Lake historic context occurs in northeastern Minnesota as well.

Most or all of the Contact period contexts are likely represented in the project area (Dobbs 1988b). Both Dakota and Ojibwe were in northern Minnesota during Contact times. Euro-American contexts could include French, British, and Initial United States as the Northwest Trail on the St. Louis River to Big Sandy Lake connects Lake Superior to the Mississippi River (Luukkonen 2007).

Post-Contact contexts include both period and thematic contexts (Minnesota Historical Society 1999). Northern Minnesota Logging (1870-1930s) is directly applicable to all of Northeastern Minnesota. The Mining context is applicable to the Iron Ranges in general. Other potential historic contexts include the Civilian Conservation Corps, Recreation Tourism in the Lakes Region, and Homesteads.

Spider Creek Project

The immediate project APE has not been previously surveyed and no archaeological sites are recorded in the township, although four buildings and a bridge have been documented in the adjoining Alborn Township to the east (Cinadr, personal communication, 2016). No trails are recorded in T52N R18W and T52N R19W to the east APE (Trygg 1966)

Aerial photographs (1940-2005) of the project APE were reviewed to check for potential sites on the Minnesota DNR Landview webpage (www.DNR.state.mn.us/maps/landview.html). A complex of buildings was noted on the north boundary of the APE (Figure 4) and other building complexes are present to the west around the western terminus of the APE. The clearings around these buildings suggest a series of farmsteads. Most are outside the APE but the one on the north boundary appears to correlate to structures found during the surveys.

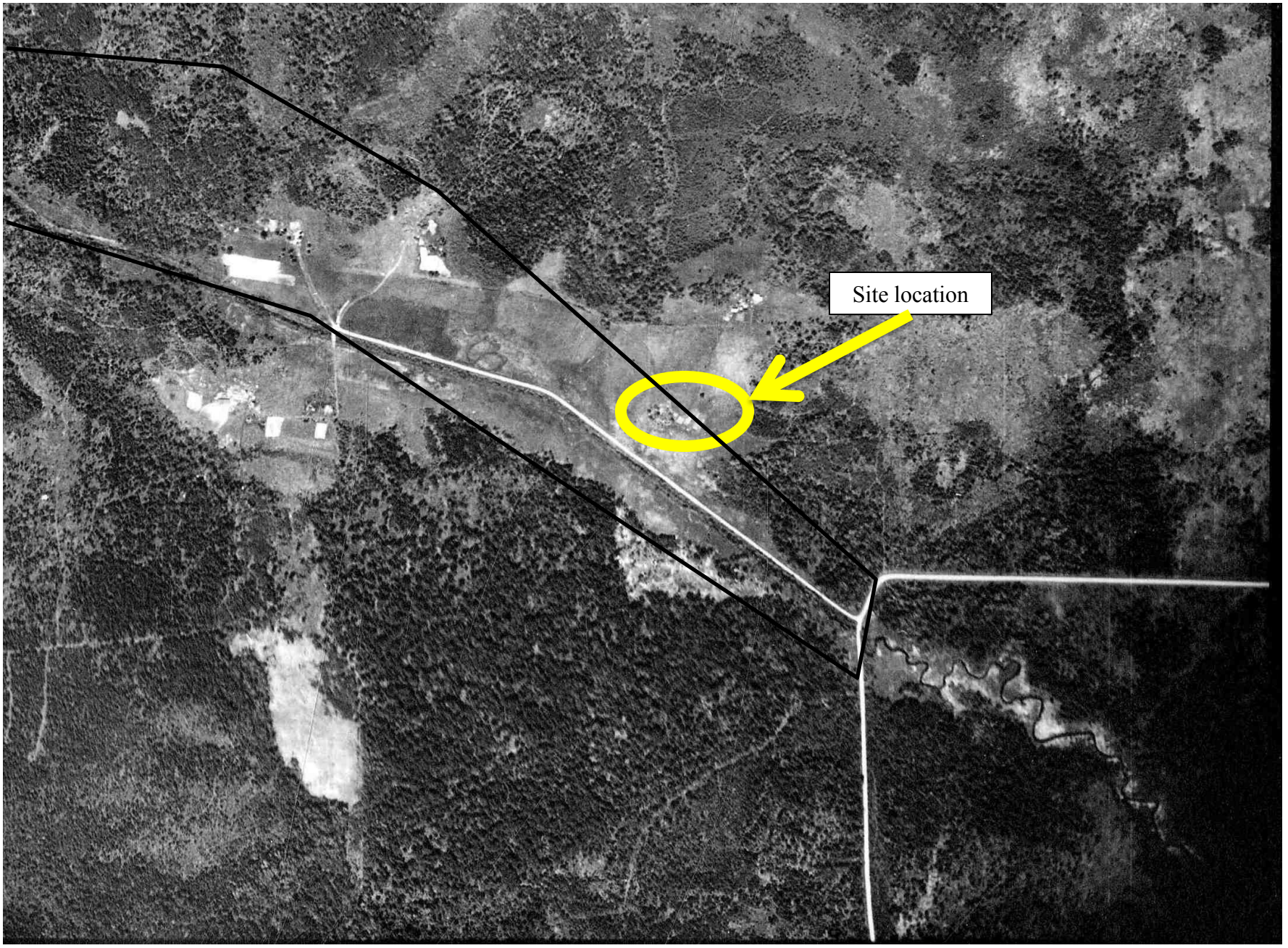

Figure 4. Aerial photograph of site location (06-18-40, picture #CIR-12-018).

ARCHAEOLOGICAL PHASE I SURVEY

FIELD METHODOLOGY

The archaeological survey of the Spider Creek stream restoration APE was conducted using standard Phase I survey methodology. Permission to conduct the survey on all parcels was obtained by Barr Engineering. The APE is located within the Whiteface River drainage with most of the APE in the floodplain of Spider Creek; a small portion is on slightly higher terrain. The survey methodology involved primarily walkover examination of the entire APE, with shovel testing considered in areas determined to have a high potential for archaeological sites. Areas of high potential for pre-Contact archaeological sites include undisturbed areas of higher ground located near existing potable water resources or where these resources existed earlier.

A standard Phase I methodology examines the entire area of the APE with either shovel testing or walk-over survey depending on surface visibility and the degree of surficial disturbance, at a maximum of a 15 meter (50 foot) interval between transects and test holes. If cultural materials are identified, a shorter interval spacing of 5 to 7.5 meters (16 to 24 feet) is most commonly used to better define the site dimensions and intra-site artifact densities. Where the ground is suitable, walkover survey is conducted in lieu of shovel testing using an approximate 5 to 10 meter (15 to 30 foot) spacing between transect intervals. Modifications are based on field conditions and include avoidance of visible cultural features. During the Phase I testing, areas exhibiting extensive surface disturbance are not shovel tested but do receive walk-over survey if feasible.

Where shovel testing is conducted, the test hole size is approximately 40 cm (16 inches) in diameter. The diameter of the hole is also contingent on the depth that the testing is expected to reach; the greater the depth, the wider the hole. Test hole depths vary widely and are dependent on the depositional environment and region in which the investigation is taking place. In environments where the possibility of deeply buried cultural deposits might be expected, such as large river valleys, test hole depths can exceed 100 cm (39 inches). Where feasible, shovel probes are extended at least 20 cm into the usually lighter colored lower sediments or tills. Test holes are back-filled when the above depth conditions are reached. Prior to back-filling observations are made about sediment stratigraphy from all test holes, both positive and negative. All sediments removed from the shovel test holes are dry screened through quarter-inch hardware mesh.

While the methodologies outlined above work well to locate archaeological cultural

materials, the determination that the items observed represent a distinct cultural entity or site is also vital. Localities with pre-Contact materials are for the most part assigned site status. However, post-Contact materials in some cases may represent isolated random pieces of roadside or other scattered trash, traditionally not assigned site status, and need to be separated from those deposited from an occupation or special activity use area. Though this may appear on the surface a simple task, in reality it may be more difficult than it first appears. In some instances in Minnesota the field survey is examining areas occupied or used historically for well over 150 years, including old farmsteads and roads that have had little alteration in their route or location over that time span. A broken glass fragment from a bottle thrown away l00 years ago looks the same whether it is directly associated with a farmstead or is roadside trash or some other types of random garbage scatter. Therefore, the context and association in which the artifact(s) are recovered becomes vital.

The identification of whether or not post-Contact artifacts are part of a site or represent trash disposal or dispersal is based on the presence of definable site boundaries, or by the association with either physical structural remains or an activity use area. Site identifications based on surface or shovel test recovered artifacts require that an association be made either with a visible surficial structural remnant or with a definable artifact concentration. The logic to these stringent site identification criteria is based on the known fact that many areas have had extensive and continuous occupation during the recent post-Contact period and that culturally derived materials from that general temporal framework litter the area. These limitations were established to eliminate site designations that are based on post-Contact trash dispersal patterns, especially those of the more recent periods.

After the identification that the post-Contact cultural materials represent a definable entity with its boundaries defined, a plan map of all pertinent features associated with the site is made. Items mapped include any structural remnants, physical features, debris determined to be associated with the function of the site (excluding recent roadside trash), and natural features, all plotted by compass readings with either paced or taped measurements. The mapping of pre-Contact sites is similar but concentrates on site boundaries, artifact concentrations and associated shovel test holes (both positive and negative), and their relationship with the existing terrain. Sites located in agricultural fields with no discernable landmarks are tied to datum points via compass and paced measurements. Pre-Contact site boundaries are recorded using a global positioning unit (GPS) for later placement on plan maps.

LABORATORY ANALYSIS

No artifacts were collected during work on this project, therefore, no analysis was conducted.

SPECIFIC PROJECT DATA

The field examination for the Phase I survey occurred on December 3 and 5, 2016. The focus of this survey was an archaeological examination of the APE for the proposed stream restoration of a portion of Spider Creek in Ness Township in St. Louis County, Minnesota (Figure 2). Much of the project APE was water-saturated ground in the floodplain of Spider Creek; only small portions on the northern and southern edges were slightly higher in elevation with drier sediments. The channelization of this portion of Spider Creek caused disturbance in the current channel, with the sediment used to construct Richardson Road. Areas immediately adjacent to the current creek were untestable as a result of this disturbance and the water-saturated nature of the floodplain. The slightly higher terrain on the northern and southern edges of the APE were generally untestable as well since the terrain was only slightly higher than the floodplain. The entire project area was surveyed by pedestrian walkover.

RESULTS

The focus of the Phase I survey was the examination of the APE for the proposed stream reconstruction of a portion of Spider Creek in Ness Township in St. Louis County, Minnesota (Figure 1). The APE for the project area is a block approximately 200 feet north and south of Richardson Road, between the junction with County Road 166 and the dead end to the west. The majority of the APE is water-saturated ground in the Spider Creek floodplain; small areas on the northern and southern sides of the block have slightly higher terrain. This portion of Spider Creek was channelized, possibly for the farmsteads shown on the 1940 aerial photograph; the area immediately adjacent to the creek is highly disturbed, including Richardson Road.

The entire APE received walkover coverage; however, no suitable areas for shovel testing could be located. The floodplain was water-saturated, some areas with standing water. The area south of Richardson Road was disturbed as well, with ATV tracks and a field road ending in an old farm clearing. The area north of Richardson Road contained more standing water and wetland vegetation. The east end was a wetland with cedar trees and other lowland species. The west and central areas were an open wetland with a drainage flowing from the north into the area. One area

of slightly higher terrain was accessed by a field road that was built up above the surrounding wetland areas. This road accessed a farmstead with three structures (Figure 5). The site corresponds to the farmstead on the 1940 aerial photograph (Figure 4).

Spider Creek Farmstead (21SL1244)

Three surface structures were recorded in the approximate location of the farmstead noted on the 1940 aerial photograph (Figures 4, 5). The Spider Creek Farmstead (21SL1244) consists of two log construction buildings and an earthen bermed root cellar (Figure 6). These features are located in an approximate northwest/southeast line from the access road extending northwest. This site is on slightly higher terrain above the water-saturated floodplain north of Richardson Road and does not have standing water. However, a ditch was present extending from the front of the root cellar to the southwest toward the floodplain. The access road is on the south and east side of the site; farther to the south, it is built up by addition of sediment fill above the surrounding floodplain.

Structure 1 (Figure 7) is a collapsed log construction building about 8 feet square. The north, west, and south walls have 3-4 courses of logs. The east wall is open to the adjacent access road with short segments of walls on the north and south sides. The west wall has broken logs where trees have fallen on them. Deciduous trees, perhaps aspen, of 8-10 inches diameter at breast height are growing inside this structure.

Structure 2 (Figure 8) is a collapsing log construction building about 10 feet square. The south wall is the most intact structure, with nine courses of logs. A 3 foot tall doorway is present in the southeast of this wall. Wire nails occur in the outside wall. The east and west walls are collapsing with the south ends interlocked into the south wall but the north ends on the ground. A window is present in the west wall on the south end. The north wall has collapsed to the ground; it was not determined whether any log courses were present. In addition to the east and west wall logs, the roof timbers also slant down to the north wall across the interior of the structure.

Structure 3 (Figure 9) is an earthen bermed root cellar. The berm is horseshoe shaped with the opening to the south; the walls are very thick, about 5-6 feet while the open area between is relatively narrow at 4-5 feet. The structure is about 15 feet north to south and slightly larger east to west. The berm is quite distinct, 4-5 feet high with a rounded top. No indications of a roof were observed but a ditch is present extending from the front of the east berm to the southwest.

The site area is on the north edge of the project APE, although the access road extends south to Richardson Road and is within the APE. The access road is built up by addition of sediment fill. The site is located on the slightly higher terrain above the water-saturated floodplain meadow to the

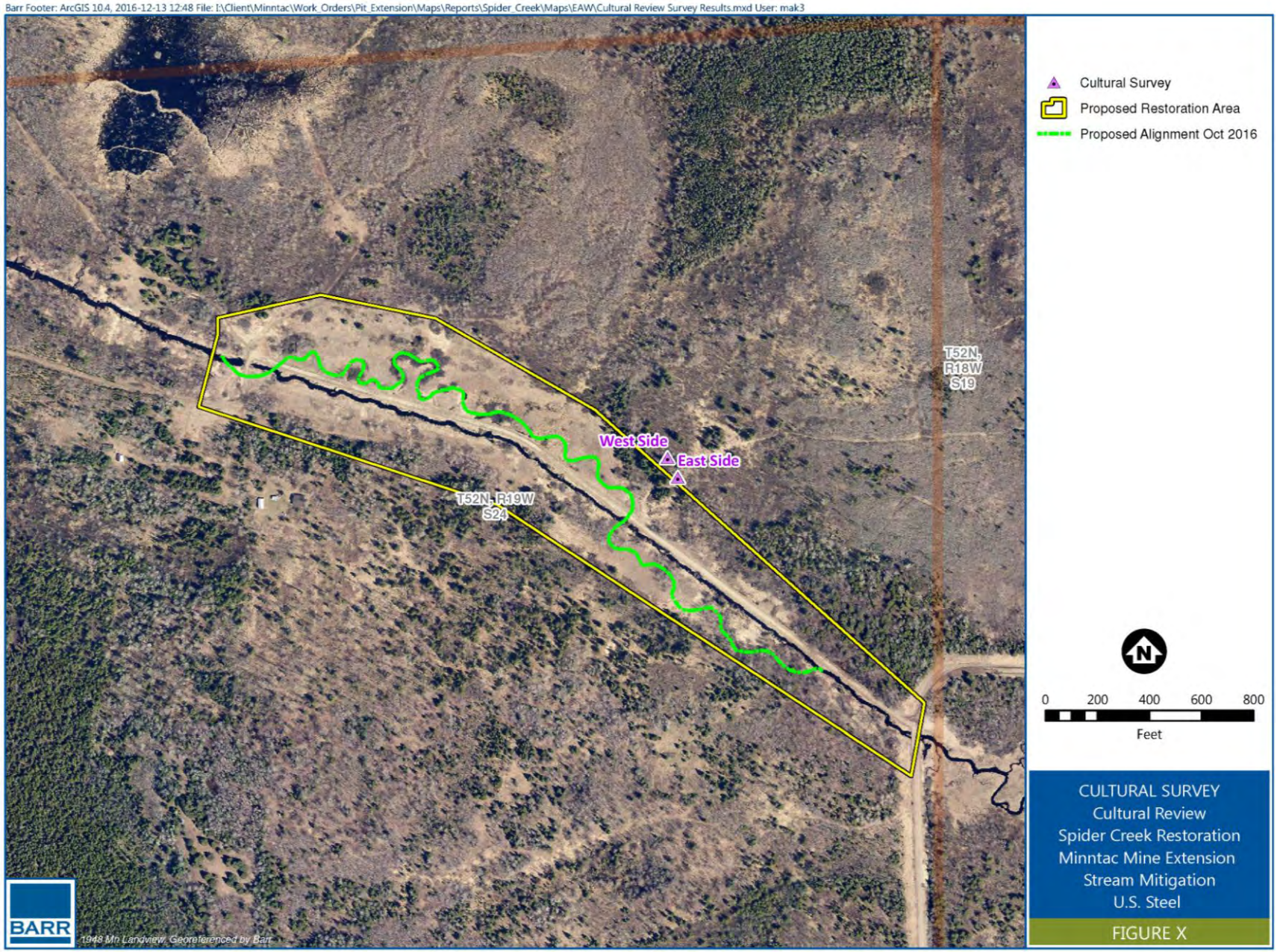

Figure 5. Location of Spider Creek Farmstead site. Map provided by BARR Engineering.

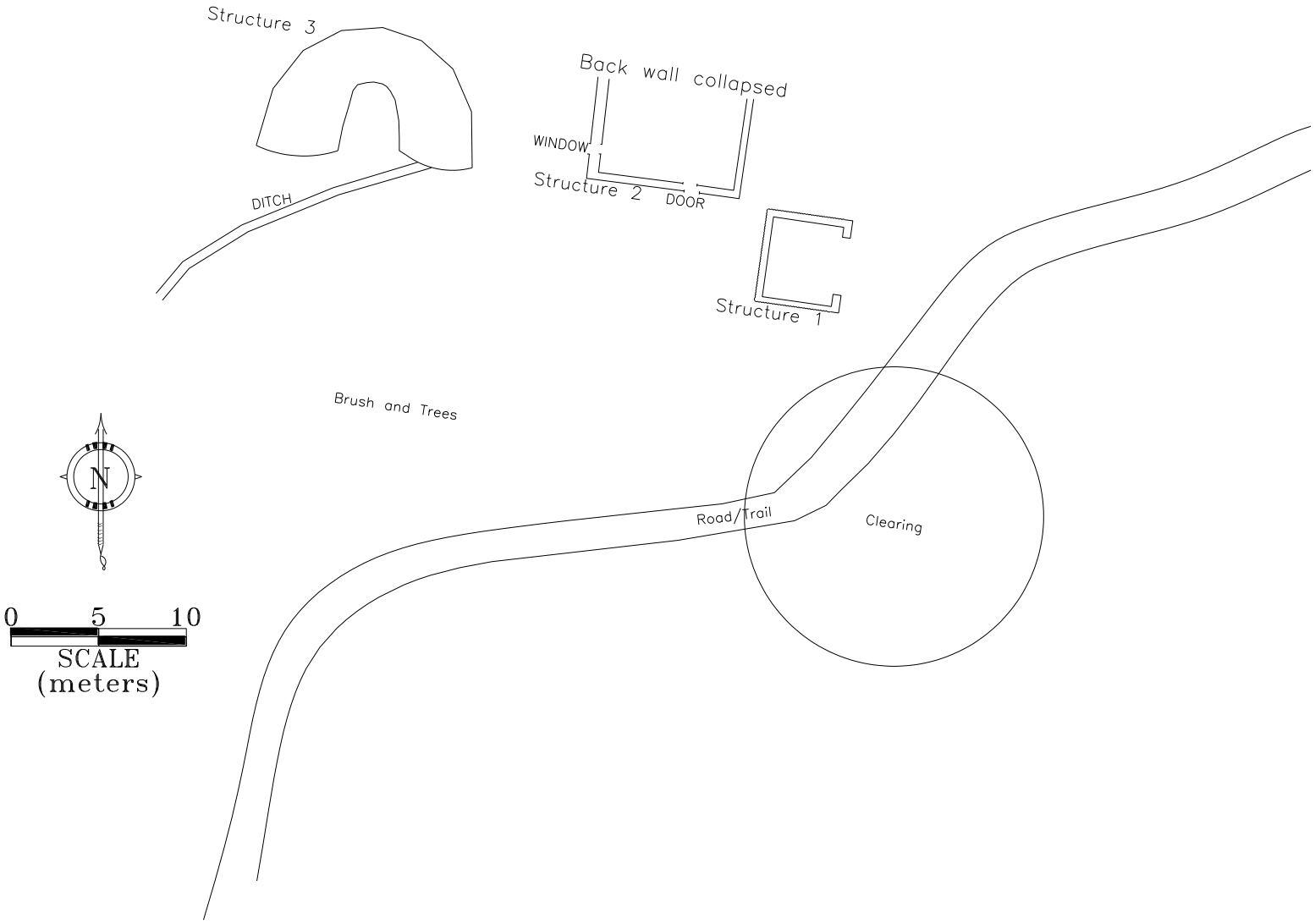

Figure 6. Sketch map of site features.

Figure 7. Photograph of first structure at site location.

Figure 8. Photograph of second structure at site location.

Figure 9. Photograph of berm/third structure at site location. (Dashed line on top of berm)

west. No subsurface testing was conducted; snow on the ground made identification of artifact concentrations not feasible.

The Spider Creek Farmstead is interpreted as farm structures associated with the farm on the 1940 aerial photograph (Figure 10). Structure 1 is interpreted as a garage based on the large opening in the eastern wall and the location immediately west/adjacent to the access road. Structure 2 is interpreted as a habitation based on the larger size and the door/window openings. Structure 3 is interpreted as a root cellar based on the thick earthen berm walls. All three are shown on the 1940 aerial photograph, although the bermed root cellar (the farthest west structure) appears to have a square roof or structure on the top.

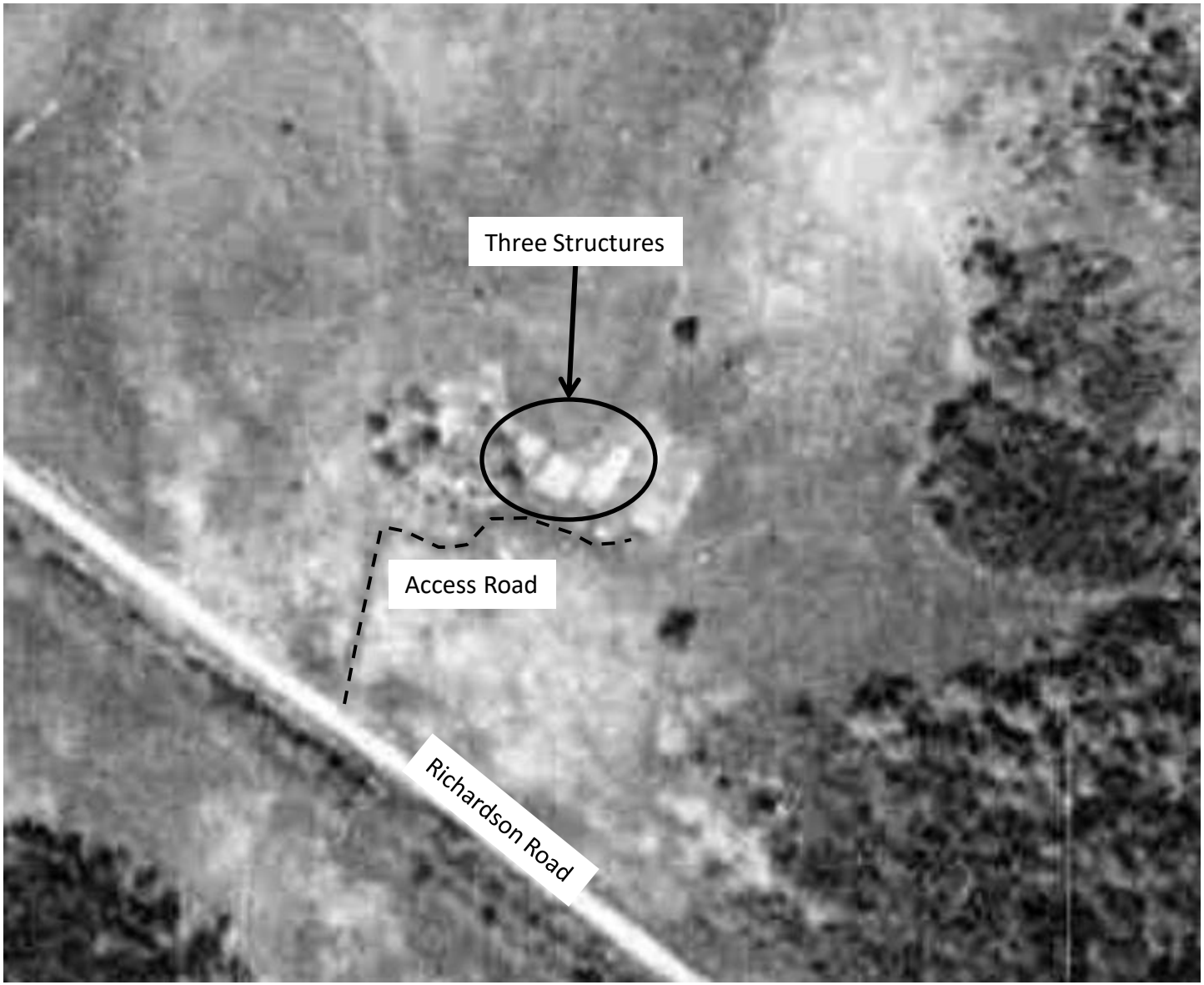

Figure 10. Spider Creek Farmstead on enlarged 1940 aerial photograph.

CONCLUSIONS AND RECOMMENDATIONS

A standard Phase I archaeological survey was conducted throughout the APE for a portion of Spider Creek along Richardson Road. Survey was conducted by pedestrian walkover; no shovel testing was conducted as a result of abundant water-saturated ground in the floodplain of the APE. The walkover examination of the APE identified one post-Contact historic site, the Spider Creek Farmstead which was recorded as state site number 21SL1244 (Appendix II). The site was not evaluated for the NRHP; the proposed stream restoration will be in the lower floodplain area of the APE and will avoid the site area as well as the access road (Julie Kloss Molina, personal communication, December 2016).

Based on the results of the Phase I survey, it is recommended that a determination of No Historic Properties Affected is made for this project if the Spider Creek Farmstead (21SL1244) is avoided by construction activities. In that case, no further archaeological investigations are recommended. If the site cannot be avoided, then a Phase II evaluation is recommended to determine if it is eligible for the National Register of Historic Places.

If any evidence of human remains are uncovered during construction or any other disturbance activities, the provisions of the Minnesota Private Cemeteries Act (MnST 308.07) must be followed. All project work in the area of the possible burial (at least 50 feet) must cease and the proper authorities notified, including local law enforcement and the Office of the State Archaeologist (OSA).

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APPENDIX I: MN State Archaeology License 16-022

APPLICATION FOR MINNESOTA
ANNUAL ARCHAEOLOGICAL RECONNAISSANCE SURVEY LICENSE

This license only applies to reconnaissance (Phase I) surveys conducted under Minnesota Statutes 138.31-.42 during calendar year __2016___. Separate licenses must be obtained for site evaluation (Phase II) surveys, for major site investigations (Phase III), for burial site authentications under Minnesota statutes 307.08, and for survey work that will continue into another calendar year. Only the below listed individual is licensed as a Principal Investigator, not the institution/agency/company or others who work for that entity. The licensed individual is required to comply with all the conditions attached to this license form. Permission to enter land for the purposes of archaeological investigation must be obtained from the landowner or land manager.

Name: ___Susan Mulholland _____

Institution/Agency/Company Affiliation: __Duluth Archaeology Center _____

Title/Position: __President/Principal Investigator _____

Address: __5910 Fremont St., Suite 1, Duluth MN 55807 _____

Work Phone: _218-624-5489 _____ E-Mail:__archcenter@aol.com _____

Name of Advanced Degree Institution:__University of Minnesota _____ Year:_1987 __

Name of Department: _Interdisciplinary Archaeology ___ Degree: __MA __MS __PhD X

Purpose: (check all that may apply)
CRM _X_ Academic Research _X_ Institutional Field School _X_

Type of Land: (check all that may apply)
State Owned _X_ County Owned _X_ Township/City Owned _X_
Other non-federal public _X__ List: __School District _____

MHS Repository Agreement # _718 _____ Other Approved Curation Facility:_____

Previous License: Year _2015 Type _annual _____ Number _2015-029 _____

Signed (applicant): __ Susan Mulholland _____ Date: _3-2-2016 ____

Required Attachments: *Curriculum Vita* ___ and Documentation of Appropriate Experience ___
for previously unlicensed individuals.

Submit one copy of this form and attachments to:
Office of the State Archaeologist, Ft. Snelling History Center, St. Paul, MN 55111
612-725-2411 612-725-2729 FAX 612-725-2427 email: mnosa@state.mn.us

Minnesota Historical Society Approval: _____ Date: 3-14-16
State Archaeologist Approval: _____ Date: 3/14/16
License Number: 16-022

Form Date: 2/15/11

APPENDIX II: MN State Site Form, Spider Creek Farmstead (21SL1244)

Rev.: 7/1/09

MINNESOTA ARCHAEOLOGICAL SITE FORM

OFFICE OF THE STATE ARCHAEOLOGIST
Fort Snelling History Center, St. Paul, MN 55111 (612) 725-2729

SITE #: 21- SL-1244 Site Name: Spider Creek Farmstead Agency/Field #: NA
(OSA assigns if New Site)

_x_ New Site __ Site Update OSA License #: 16-022 SHPO RC #:

Type of Fieldwork: __x_ Reconnaissance/Phase I Date(s) of This Fieldwork: 12/5/2016
___ Evaluation/Phase II
___ Excavation/Phase III

NRHP Status: __ Listed __ Determined Eligible __ CEF(106) __ CNEF(106) _x_ Undetermined

LOCATIONAL INFORMATION

County: St. Louis Country City/Twp. Name: Ness SHPO Sub-Region:5e
(see map in instructions)

USGS 7.5' Quadrangle Map *(name and year):* Brookston NW (1953) 1975

Township: 52N	Range: 19W	Section: 24	¼ Sections (at least 2): NW1/4 of SE1/4 of NE1/4
Township:	Range:	Section:	¼ Sections (at least 2):
Township:	Range:	Section:	¼ Sections (at least 2):

UTM Coordinates: (*less than 10 acres use center; over 10 acres define polygon around site; draw points on USGS*)
Zone: 15 __ Datum: ___ 1927 _X__ 1983 Method: ___ USGS Map __X_ GPS ___ Other

Point 1: Easting 524037E	Northing 5203063N
Point 2: Easting	Northing
Point 3: Easting	Northing
Point 4: Easting	Northing
Point 5: Easting	Northing

SITE CHARACTERISTICS

Acreage: <0.1 Site Dimensions: N-S __70ft____ E-W ___35ft Maximum Cultural Depth (if known) _____

Site Description *(√all that apply, but only one check per line):*
__ single artifact __ lithic scatter __ artifact scatter
__ burial mound (number of mounds _____) __ non-mound lone grave __ non-mound cemetery
__ petroglyph __ pictograph __ petroform
x__ surface features (list below)
__ other: _____
2 collapsing log structures and an earthen bermed root cellar

Surface Features (*√all that apply*): x__ earthwork __ pit/depression _x_ foundation/ruin __ other: _____

Inferred Site Function (*√all that apply*): __ habitation __ mortuary _x_ farm __ industrial __ transportation
__ Other (*list*): _____ __ unknown

Current Land Use (*list approximate % for all that apply):*
____ cultivated ____ fallow ____ commercial ____ recreational ____ industrial ____ residential
_100__ woodland ____ grassland ____ water-covered ____ other: _____

Surface Visibility (*list approximate % for all that apply):*
____ excellent ____ good __50__ fair 50___ poor/none

Degree of Disturbance (*list approximate % for all that apply or √ unassessed):*
_100___ minimal ___ moderate ___ heavy ___ completely destroyed ___ unassessed

Current Threats to Site: (*√all that apply or √ none known)*
__ erosion __ development __ agricultural x__ other: _stream restoration project_____ __ none known

SITE #: 21- SL-1244 Site Name: Spider Creek Farmstead Agency/Field #:NA

CULTURAL/TEMPORAL AFFILIATION
(list all that apply by level of certainty: 1 = confirmed; 2 = probable or √"not determined"):

Period:
__ not determined
__ Precontact (9500 BC - 1650 AD)
__ Contact (1650-1837)
_1_ Post-Contact (1837-1945)

Precontact Context: *(list all that apply by level of certainty; if unable to discern specific context, √here __)*

Paleoindian Tradition __ not determined __ Folsom __ Lanceolate Point/Plano __ Clovis __ Eastern Fluted __ other: _____

Archaic Tradition __ not determined __ Prairie __ Riverine __ Shield __ Lake-Forest __ other: _____

Woodland Tradition __ not determined __ Fox Lake __ Laurel __ SE Mn Early __ C Mn Transitional __ Lake Benton __ Brainerd __ Blackduck-Kathio __ Psinomani/Sandy Lake __ Havana-Related __ SE Mn Late __ Rainy River Late __ other: _____

Plains Village Tradition __ not determined __ Cambria __ Great Oasis __ Big Stone __ other: _____

Mississippian Tradition __ not determined __ Silvernale __ other: _____

Oneota Tradition __ not determined __ Blue Earth __ Orr __ other: _____

Contact Context: *(list all that apply by level of certainty; if unable to discern specific context, √here __)*

American Indian __ not determined __ Dakota __ Ojibwe __ other: _____

Euro-American __ not determined __ British __ other: _____ __ French __ Initial US

Post-Contact Context: *(list all that apply by level of certainty; if unable to discern specific context, √here __)*

__ Indian Communities & Reservations (1837-1934)
_2_ Early Agriculture & River Settlement (1840-1870)
__ Northern MN Lumbering (1870-1930s)
__ Tourism & Recreation (1870-1945)
__ St. Croix Triangle Lumbering (1830s-1900s)
__ Railroads & Agricultural Development (1870-1940)
__ Iron Ore Industry (1880s-1945)
__ Urban Centers (1870-1940)

Approximate Post-Contact Occupation/Site Formation Date(s): pre 1940

Context Assignment/Dating Methods *(√all that apply):*

__ artifact type/style __ feature type __ radiometric __ relative stratigraphy __ geomorphology
__ historic accounts (list) _____
__ historic maps (list) _____
_x_ other(s) (*specify*): aerial photograph (06-18-40, photo #CIR-12-018)

(For radiometric dates, attach photocopies of laboratory sheets if available.)

MATERIALS PRESENT *(√all that apply):*

Basic Artifact Categories

Ceramics	*Lithics*	*Biological Remains*	*Historic Materials*
__ Aboriginal	__ projectile points	__ animal	__ glass
__ Euro-American	__ other chipped stone tools	__ human	_x_ metal
	__ debitage	__ unidentified bone	__ brick
	__ ground/pecked stone	__ seeds/nuts	__ other:
	__ FCR	__ charcoal	
	__ aboriginal copper	__ wood	

SITE #: 21- SL-1244 Site Name: Spider Creek Farmstead Agency/Field #:NA

Major Exotic Materials *(√all that apply):*

__ catlinite __ native copper __ Hixton orthoquartzite
__ Knife River Flint __ obsidian __ other: _____

Diagnostic Artifacts:

Ceramics: Prehistoric Types/Wares/Temper _____
Historic _____
Prehistoric Lithics: _____
Glass: _____
Metal: wire nails
Other: _____

ENVIRONMENTAL DATA **Current Topographic Setting** *(√all that apply):*

Away from Water	*Riverine*	*Lacustrine*
__ general upland	__ fan	__ inlet/outlet
__ terrace edge	__ terrace/bluff top	__ peninsula
__ hilltop	__ stream-stream junction	__ island
__ glacial beach ridge	__ bluff-base	__ isthmus
__ rock outcrop	__ cave/rockshelter	__ general shoreline
__ other: _____	x floodplain	__ bog/slough/lake bottom
	__ other: _____	__ other: _____

Topographic Feature Name from USGS Map: _Spider Creek_____

OWNERSHIP INFORMATION

Source and Date of Ownership Information *(e.g., plat map, county recorder's office, personal communication, etc.):*
Barr Engineering supplied ownership information

Ownership Type (*list approximate % for all that apply; if unknown √here __):*
___ Federal 100 State ___ Local (public) ___ Tribal ___ Private

Land Owner *(name and address if known):* State of Minnesota tax-forfeit land administered by St. Louis County Lands Dept.

CURRENT INVESTIGATION INFORMATION

Methods/Techniques Employed *(√all that apply):*

__ informant report __ small diameter soil coring (≈ 1" diameter) x surface survey
__ shovel testing __ formal test units __ mechanical testing max. test depth _____
__ geomorphological survey *(specify)*: _____
__ geophysical survey *(specify)*: _____
__ other: _____

Informant Name and Address (if known): NA

Known Collectors/Collections: NA

Artifact Repository *(name and accession numbers or repository agreement number):* NA

Most Recent Survey Report – Title, Author, Date: *Phase I Archaeological Survey for Proposed Stream Restoration on a Portion of Spider Creek, St. Louis County, Minnesota*, Duluth Archaeology Center Report No. 17-02. Susan C. Mulholland
Major Previous Bibliographic Reference(s) to Site: NA

Principal Investigator *(name and affiliation):* Susan C. Mulholland, Duluth Archaeology Center

Form Completed By *(name and date):* Katherine Hagsten 01/13/17 Susan Mulholland 1/19/17

MAPS: *Attach/include original scale copy of 7.5' USGS map with site location clearly outlined or designated.*
Attach a sketch map if surface features present, if sub-surface testing done, or if complicated boundaries/setting.
Sketch map must have re-locatable datum, scale, north arrow, and legend if symbols are used.

SITE #: 21- SL-1244 Site Name: Spider Creek Farmstead Agency/Field #:NA

ADDITIONAL INFORMATION *(Reason for Update or Survey, Location, Site Characteristics, Materials Present, Setting, Archaeological Methods, etc.; attach extra sheets as needed.)*

US Steel proposes to restore a portion of Spider Creek to a more natural channel (the current stream was channelized prior to 1940). Barr Engineering contracted with the Duluth Archaeology Center to conduct a Phase I archaeological survey of the project APE on both sides of Richardson Road (County Road 167) from the junction with County Road 166 west to the end of Richardson Road. Most of this APE is within the floodplain of Spider Creek with only small areas on the north and south sides of the APE having slightly higher terrain. Historic aerial photographs (1940) show several concentrations of buildings in the general vicinity with one concentration within or immediately adjacent to the north edge of the APE. Pedestrian walkover was conducted over the entire APE, which mostly consisted of low and water saturated terrain. No areas suitable for shovel testing were observed.

Several trails/roads were walked on the west end of the APE from the end of Richardson Road. The north road led to a clearing but no structural remnants were observed. The west road led to a standing structure that is still in use. The southwest road led to a locked gate, as did the south road (gate to the Spider Creek Hunting Association). The clearing, the standing structure, and the two locked gates were outside the APE so further survey was not conducted. Buildings on the west and south roads are visible on the 1940 aerial photographs.

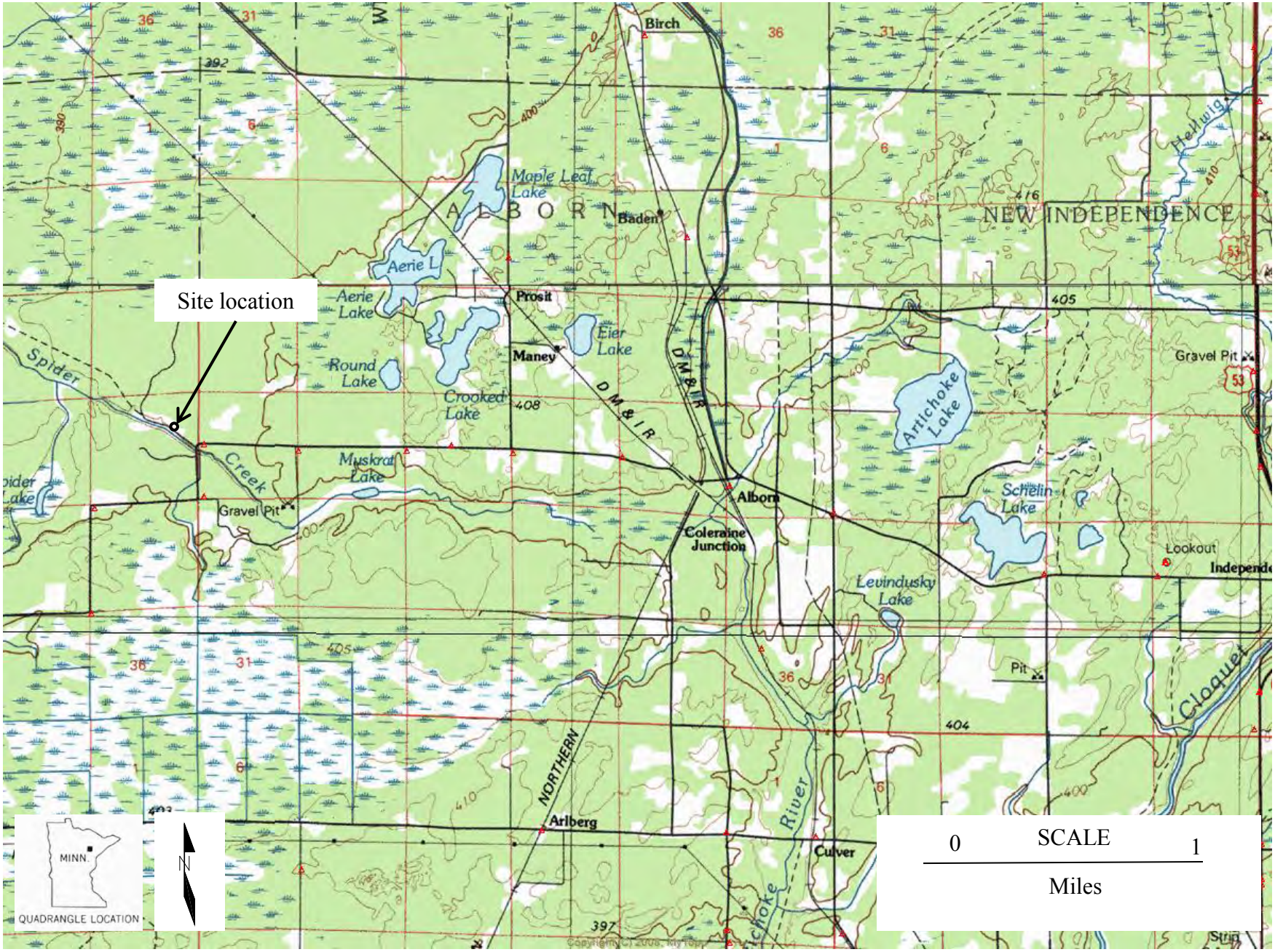
One additional road was located at 524002E / 5203000N on the north side of Richardson Road east of the bend. This road was build up above the surrounding floodplain by the addition of sediment fill; it extends roughly north and then east around the south side of a slightly elevated hill before turning north/northeast again. The Spider Creek Farmstead is located on the elevated area north and west of this curve. The site consists of three surface structures in a line: two partially collapsed log construction buildings and a bermed root cellar. The buildings are on the east with one adjacent to the road and the second structure immediately to the west. The root cellar is located farthest west with the opening to the south; a ditch extends from the front of the structure to the southwest.

Structure 1 (524039E / 5203056N) is a partially collapsed square building approximately 8 feet on each side. The north, west, and south sides retain 3-4 courses of logs while the east side is mostly open with short log wall segments extending south and north. This structure appears to be a shed or garage; trees have fallen in on top of the structure obscuring the walls and interior. This structure is visible on the 1940 aerial photograph (CIR-12-018).

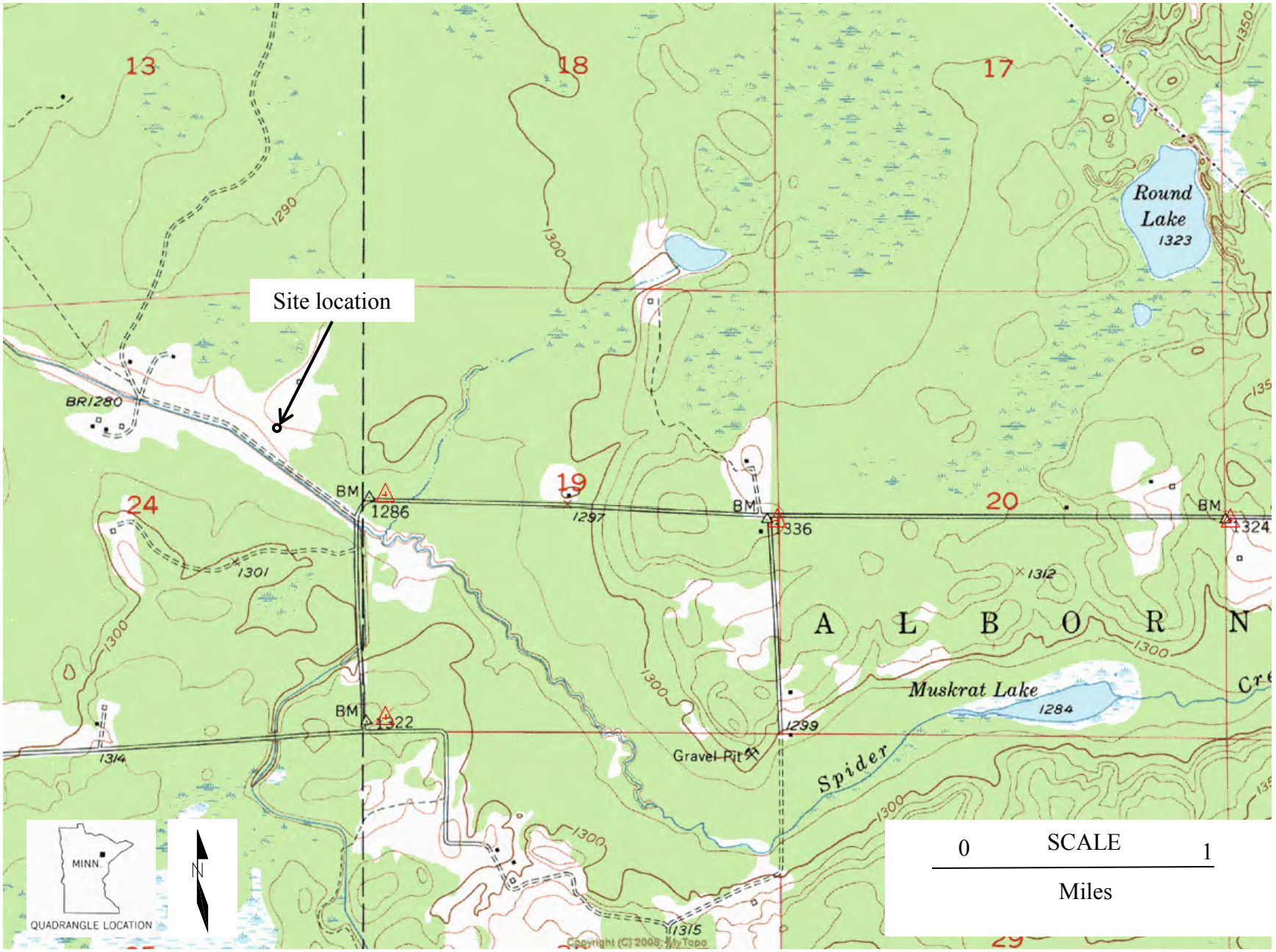
Structure 2 (524037E / 5203063N) is a partially collapsed square building approximately 10 feet on each side. The south wall has a 3 foot high door in the southeast portion. The west wall has a window in the southwest portion; the east wall appears to lack any openings. The south wall has 9 courses of logs that may represent the entire wall. The east and west walls slant down to the north; the north wall appears to have collapsed. The roof timbers slant down from the south wall to the north across the interior. Wire nails were observed in the outside of the south wall. This structure appears to be a habitation and is visible on the 1940 aerial photograph (CIR-12-018).

Structure 3 (524035E / 5203073N) is a U-shaped massive berm with the opening to the south. The berm measures about 15 feet north/south; the walls are 5-6 feet thick with the opening about 4 feet wide so the structure is slightly wider east/west than north/south. No artifacts were observed. This structure appears to be a root cellar. A ditch extends from the opening to the southwest. This structure is visible on the 1940 aerial photograph (CIR-12-018) with a roof or other structure on the top.

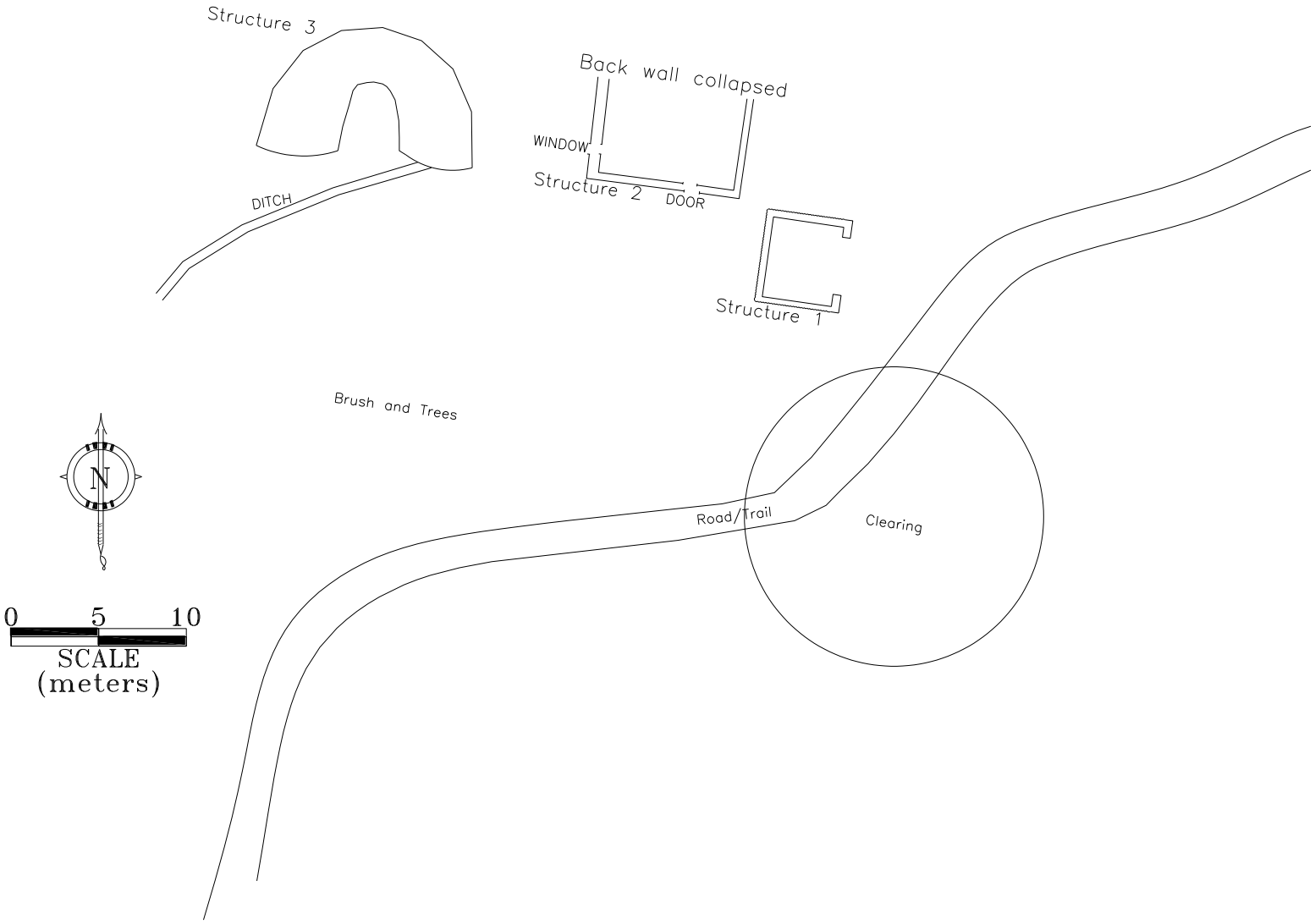
No additional surface structures were noted during the survey, although the area to the north was not surveyed in detail. No shovel tests were placed around the structures. Additional materials may be present around the structures. The entire elevated area is considered within the site boundary. Avoidance of the site area, including the access road from Richardson Road, is recommended. The site area around the structures is just on the boundary of the APE but the access road extends south through the APE to Richardson Road.



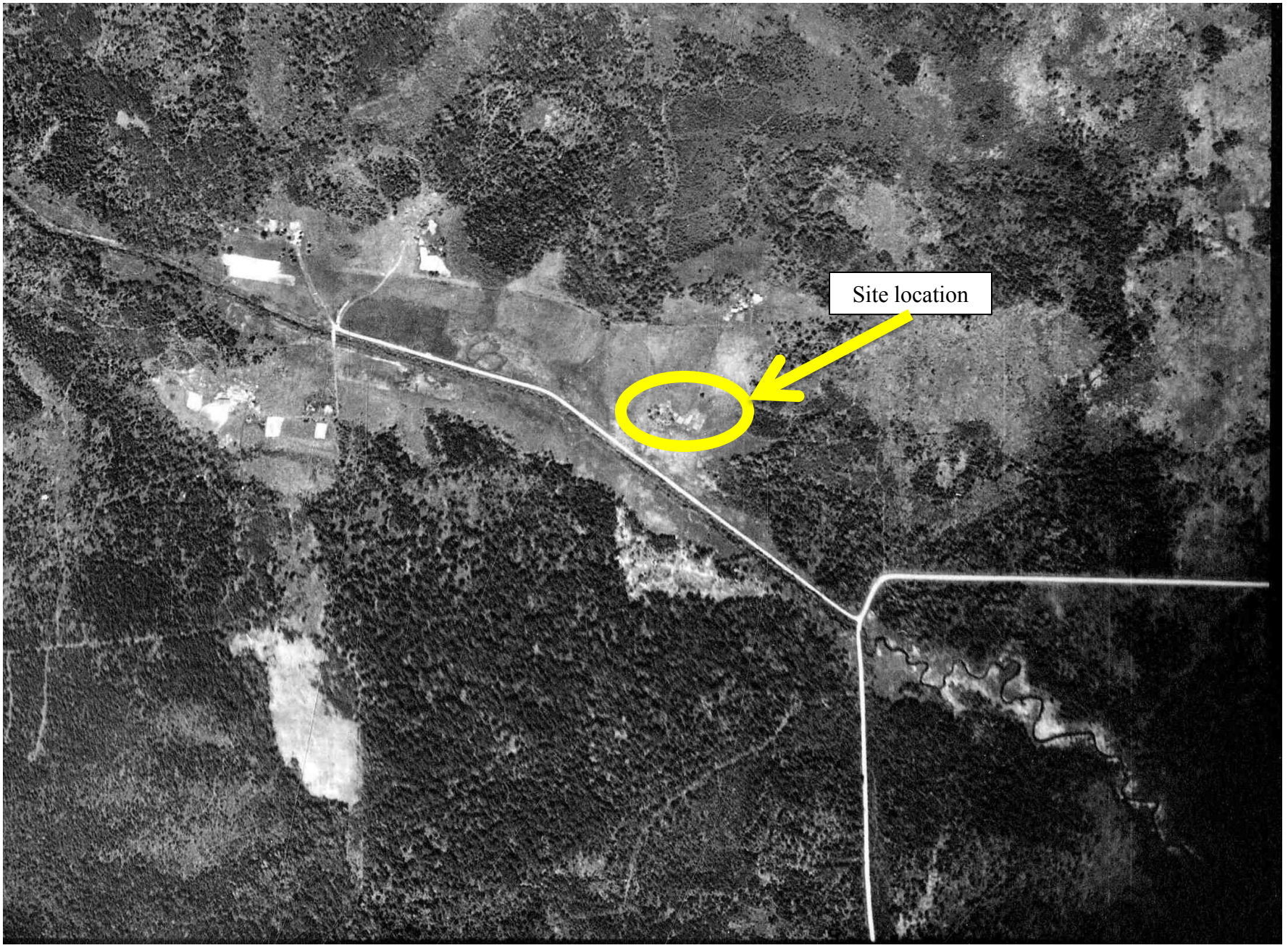
Site location, Duluth (1980) quadrangle (1:100,000) USGS topographic map.



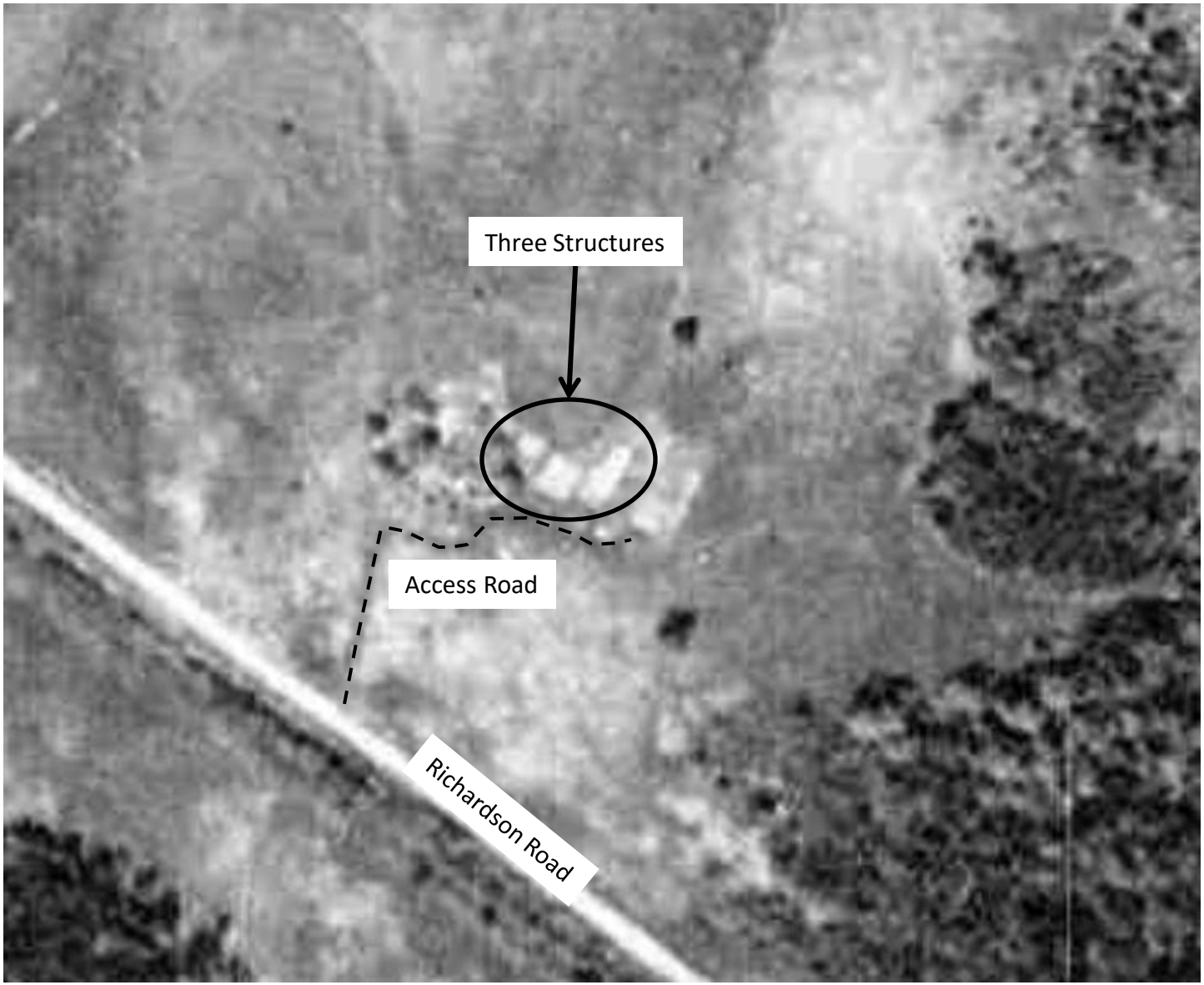
Site location, Brookston NW (1953/1975) quadrangle (1:24,000) USGS topographic map.



Sketch map of Spider Creek Farmstead features.



Aerial photograph showing Spider Creek Farmstead location (06-18-40, CIR-12-018).



Spider Creek Farmstead on enlarged 1940 aerial photograph.