
MONTANA DEPARTMENT OF TRANSPORTATION STREAM MITIGATION MONITORING REPORT

*North Fork Bear Creek
Ravalli County, Montana*

*Year Project Completed: 2011
Monitoring Report #3: Submitted December, 2015*



Prepared for:



Prepared by:



MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT #3

YEAR 2015

*North Fork Bear Creek
Ravalli County, Montana*

MDT Project Number: NH-7-1(114)56
Control Number: 2015 003

MTFWP: MDT-R2-64-2010
USACE: NWO-1997-90821-MTH

Prepared for:

MONTANA DEPARTMENT OF TRANSPORTATION
2701 Prospect Ave
Helena, MT 59620-1001

Prepared by:

Confluence Consulting, Inc.
P.O. Box 1133
Bozeman, MT 59771

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Cover: Root wads placed along North Fork Bear Creek upstream of U.S. Hwy 93.

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1.0 INTRODUCTION

The following report presents the results of the third year of post stream re-construction monitoring at the U.S. Highway 93 crossing at North Fork Bear Creek near Victor, Montana. This report includes an evaluation of monitoring results in comparison to project performance standards outlined in the post-construction monitoring plan for the site. Mitigation is to be monitored for five years to evaluate compliance toward meeting performance standards. The project was constructed in 2011; therefore, these results provide documentation of the site's condition four years following the project's completion.

As part of this project, the Montana Department of Transportation (MDT) requested authorization to replace bridges at North and South Fork Bear Creek, construct a new stream channel segment, and to place 0.07 acres of wetland fill. The North Fork Bear Creek work included removal and replacement of the existing bridge, placement of rock at bridge abutments, placement of fill within the stream channel, creation of a new stream channel, and removal of gabions downstream of the bridge. Stream mitigation was required to offset placement of riprap and other fill materials within the ordinary high watermark of the stream corridor.

Mitigation performance standards adopted for the reconstructed segment of the North Fork Bear Creek site include:

1. Riparian Vegetation Coverage

- a) Greater than 50% areal coverage of desirable perennial plants within the riparian buffer zone. Desirable plants include seeded species and those colonizing from adjacent undisturbed habitats.
- b) Greater than 25% areal coverage of woody riparian shrubs and/or trees within the riparian buffer zone.
- c) Less than 10% areal coverage of Montana State listed noxious weeds within the riparian buffer zone.

2. Stream Bank Stability

- a) Less than 25% of total bank length exhibiting signs of active erosion/cutting.

Additional reporting requirements included in the monitoring plan include:

1. **As-built** - An as-built drawing will be prepared with a list of plantings for the riparian areas within the stream channel construction zone.
2. **Weed Control** - Monitoring will include identification of state designated noxious weeds and an estimate of areal coverage of each weed species.
3. **Photo Points** - A minimum of 4 photo points will be established to document conditions along the newly constructed sections.

- a) Photo points will be established to show upstream and downstream bank conditions at bridge locations.
- b) Streambank reconstruction not associated with bridges will include photo points from upstream and downstream angles.

Results of the second year of monitoring in 2014 are presented in Section 4, and are compared to the adopted performance standards in Section 5. A site map of the project area is included in Appendix A, and photo-documentation of the site during the 2013 and 2015 monitoring events is included in Appendix B. The as-built topographic survey of the project site as surveyed in 2013 is included in Appendix C as well as the design schematics for the project area.

2.0 SITE LOCATION

The monitoring reach includes approximately 300 feet of the North Fork of Bear Creek, and extends 110 feet upstream and 100 feet downstream of the U.S. 93 Bridge (90 feet beneath the bridge). The project site is located in Section 31, Township 8 North, Range 20 West, and is approximately 1 mile south of Victor, Montana (Figure 1).

3.0 MONITORING METHODS

Monitoring field crews visited the project site on July 22, 2015. The following data were collected at the North Fork Bear Creek stream mitigation site:

3.1. Riparian Vegetation Establishment

Visual estimates of all vegetation species, woody species, and noxious weeds were performed within riparian buffer areas extending 25 feet on either side of the active stream channel. Percent cover was recorded for each vegetative category based on ocular estimates.

3.2. Stream Bank Stability

Both streambanks within the project area were visually assessed to document eroding streambanks. Eroding streambanks were labeled with a specific numeric identifier, photographed, and a GPS location was recorded.

3.3. Photo Documentation

Four photo points were selected to photo-document vegetation establishment and streambank conditions within the project site. Photo documentation included upstream and downstream bank conditions at the Highway 93 Bridge. All sites selected for photo-documentation were recorded using GPS and compass direction noted to allow for repetition during future monitoring (Appendix B).

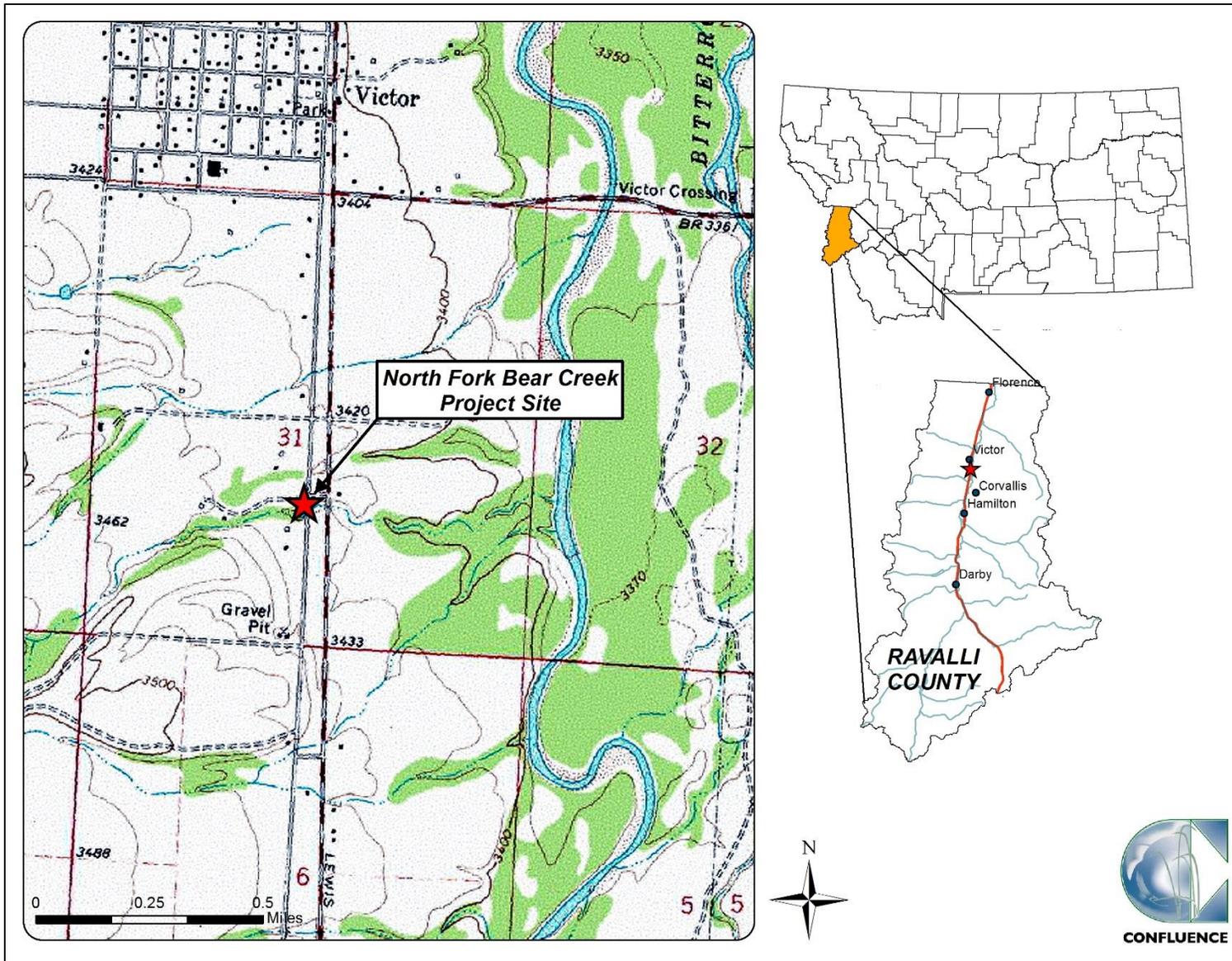


Figure 1. Project location of North Fork Bear Creek stream mitigation site.

3.4. As Built Drawings

An as-built topographic drawing of the project site was prepared as part of the 2013 (Year 1) monitoring, and included one-foot elevation contours and control points established by MDT during project construction (Appendix C).

4.0 RESULTS

4.1. Riparian Vegetation Inventory

Results of the 2013, 2014, and 2015 visual estimates of areal coverage are summarized in Table 1, and are separated into total vegetative cover, cover by woody species, cover of noxious weeds, and percent cover by perennial vegetation. In 2015, approximately 10% of the project site was bare ground, with 58% of the area vegetated with herbaceous species and 32% woody species. Overall results as compared to 2013 and 2014 were very similar, with a slight increase in percent woody cover from 27% to 32%. This result is due to continued maturation of woody species observed following two growing seasons since monitoring efforts began. The site exhibited a higher percentage of noxious weeds than in 2014, and was estimated at 40% of the total cover. Herbaceous vegetation observed at the North Fork Bear Creek site was not separated by annual, biannual, and perennial durations during the 2013 and 2014 monitoring years; therefore total percent desirable cover parameter was not calculated.

Table 1. Visual estimate of plant coverage at North Fork Bear Creek Stream Mitigation Site in 2013, 2014, and 2015.

YEAR	Total % Riparian Cover	% Bare Ground	% Woody Cover	% Noxious Weed Cover	% Perennial Cover	% Desirable Cover (Shrubs + Perennials)
2013	90	10	27	35	*	*
2014	90	10	30	35	*	*
2015	90	10	32	40	9	41

*Data not collected in 2013 or 2014

Table 2 includes a comprehensive list of plant species observed along the new channel alignment and riparian buffer areas in 2013, 2014, and 2015. The comprehensive list includes 95 species, representing an increase by 28 species from 2014 and 50 species since 2013. In 2015, 38% of species observed were hydrophytic based on the 2014 National Wetland Plant List (Lichvar et al 2014).

The relatively steep stream bank along the left (north) bank of the channel upstream of the Highway 93 Bridge may hinder the growth of riparian vegetation in this area. Downstream of the bridge, stream banks are less steep and cottonwoods (*Populus* spp.) and grasses (*Poa* spp., *Elymus* spp., *Phleum pratense*, and *Phalaris arundinacea*) are abundant.

Table 2. Comprehensive list of plant species observed at the North Fork Bear Creek Stream Mitigation Site in 2013, 2014, and 2015.

Scientific Name	Common Name	WMVC Indicator Status*	Duration	Scientific Name	Common Name	WMVC Indicator Status*	Duration
<i>Achillea millefolium</i>	Common Yarrow	FACU	P	<i>Pascopyrum smithii</i>	Western-Wheat Grass	FACU	P
<i>Agropyron cristatum</i>	Crested Wheatgrass	NL	P	Penstemon sp.	Beardtongue	NL	P
<i>Agrostis gigantea</i>	Black Bent	FAC	P	Peritoma serrulata	Rocky Mountain Beeplant	FACU	A
Agrostis scabra	Rough Bent	FAC	P	<i>Phalaris arundinacea</i>	Reed Canary Grass	FACW	P
<i>Alnus incana</i>	Speckled Alder	FACW	P	<i>Phleum pratense</i>	Common Timothy	FAC	P
<i>Alyssum alyssoides</i>	Pale Alyssum	NL	A/B	<i>Picea pungens</i>	Blue Spruce	FAC	P
Amelanchier alnifolia	Saskatoon Service-Berry	FACU	P	<i>Pinus ponderosa</i>	Ponderosa Pine	FACU	P
<i>Antennaria parvifolia</i>	Nuttall's Pussytoes	NL	P	Poa compressa	Flat-Stem Blue Grass	FACU	P
Aster sp.	Aster	NL	A/P	<i>Poa palustris</i>	Fowl Blue Grass	FAC	P
Bassia scoparia	Mexican-Fireweed	FAC	A	<i>Poa pratensis</i>	Kentucky Blue Grass	FAC	P
Berteroa incana	Hoary False-Alyssum	NL	A/B/P	<i>Polygonum sp.</i>	Knotweed Complex	NL	P
<i>Bromus inermis</i>	Smooth Brome	FAC	P	<i>Populus angustifolia</i>	Narrow-Leaf Cottonwood	FACW	P
<i>Bromus tectorum</i>	Cheatgrass	NL	A	<i>Populus balsamifera</i>	Balsam Poplar	FAC	P
Carex nebrascensis	Nebraska Sedge	OBL	P	<i>Potentilla anserina</i>	Silverweed	OBL	P
Carex sp.	Sedge	NL	P	Potentilla recta	Sulphur Cinquefoil	NL	P
<i>Centaurea stoebe</i>	Spotted Knapweed	NL	B/P	<i>Prunella vulgaris</i>	Common Selfheal	FACU	P
Chenopodium album	Lamb's-Quarters	FACU	A	<i>Prunus virginiana</i>	Choke Cherry	FACU	P
<i>Cirsium arvense</i>	Canadian Thistle	FAC	P	Pseudoroegneria spicata	Bluebunch Wheatgrass	NL	P
<i>Cornus alba</i>	Red Osier	FACW	P	<i>Pseudotsuga menziesii</i>	Douglas-Fir	FACU	P
<i>Convolvulus arvensis</i>	Field Bindweed	NL	P	<i>Ranunculus sp.</i>	Buttercup	NL	P
Coronilla varia	Common Crown-Vetch	NL	P	<i>Ribes lacustre</i>	Bristly Black Gooseberry	FAC	P
<i>Crataegus douglasii</i>	Black Hawthorn	FAC	P	<i>Rosa woodsii</i>	Woods' Rose	FACU	P
Crepis tectorum	Narrowleaf Hawksbeard	NL	A	Rubus idaeus	Common Red Raspberry	FACU	P
<i>Cynoglossum officinale</i>	Gypsy-Flower	FACU	B	<i>Rubus sp.</i>	Raspberry sp.	NL	P
<i>Dactylis glomerata</i>	Orchard Grass	FACU	P	<i>Rumex acetosa</i>	Garden Sorrel	FAC	P
<i>Dasiphora fruticosa</i>	Golden-Hardhack	FAC	P	<i>Rumex acetosella</i>	Common Sheep Sorrel	FACU	P
<i>Deschampsia cespitosa</i>	Tufted Hairgrass	FACW	P	<i>Salix amygdaloides</i>	Peach-Leaf Willow	FACW	P
Elymus glaucus	Blue Wild Rye	FACU	P	<i>Salix bebbiana</i>	Gray Willow	FACW	P
<i>Elymus repens</i>	Creeping Wild Rye	FAC	P	<i>Salix drummondiana</i>	Drummond's Willow	FACW	P
<i>Elymus trachycaulus</i>	Slender Wild Rye	FAC	P	<i>Salix lasiandra</i>	Pacific Willow	FACW	P
<i>Epilobium ciliatum</i>	Fringed Willowherb	FACW	P	<i>Salix sp.</i>	Willow	NL	P
<i>Festuca idahoensis</i>	Bluebunch Fescue	FACU	P	Salsola tragus	Prickly Russian-Thistle	FACU	A
Galium boreale	Northern Bedstraw	FACU	P	Silene noctiflora	Night-flowering Catchfly	NL	A
<i>Geranium viscosissimum</i>	Sticky Purple Crane's-Bill	FACU	P	<i>Sinapis arvensis</i>	Corn Mustard	NL	A
<i>Geum macrophyllum</i>	Large-Leaf Avens	FAC	P	Sisymbrium altissimum	Tall Hedge-Mustard	FACU	A/B
<i>Glyceria striata</i>	Fowl Manna Grass	OBL	P	<i>Solanum dulcamara</i>	Climbing Nightshade	FAC	P
<i>Hordeum jubatum</i>	Fox-Tail Barley	FAC	P	<i>Solidago canadensis</i>	Canadian Goldenrod	FACU	P
Hypericum perforatum	Common St. John's-Wort	FACU	P	<i>Sonchus arvensis</i>	Field Sow-Thistle	FACU	P
<i>Juncus sp.</i>	Rush	NL	P	<i>Symphoricarpos albus</i>	Common Snowberry	FACU	P
<i>Lactuca serriola</i>	Prickly Lettuce	FACU	A/B	Symphotrichum ascendens	Western American-Aster	FACU	P
Lepidium campestre	Field Pepper-Grass	NL	A/B	<i>Tanacetum vulgare</i>	Common Tansy	FACU	P
<i>Leucanthemum vulgare</i>	Ox-Eye Daisy	FACU	P	<i>Taraxacum officinale</i>	Common Dandelion	FACU	P
Lycopus asper	Rough Water-Horehound	OBL	P	Thlaspi arvense	Field Pennycress	UPL	A
<i>Medicago lupulina</i>	Black Medick	FACU	A/P	<i>Tragopogon dubius</i>	Meadow Goat's-beard	NL	A/B
<i>Medicago lupulina</i>	Black Medick	FACU	A/P	<i>Trifolium pratense</i>	Red Clover	FACU	B/P
<i>Medicago lupulina</i>	Black Medick	FACU	A/P	<i>Trifolium repens</i>	White Clover	FAC	P
<i>Mellilotus officinalis</i>	Yellow Sweet-Clover	FACU	A/B/P	<i>Verbascum thapsus</i>	Great Mullein	FACU	B
<i>Mentha arvensis</i>	American Wild Mint	FACW	P				
Myosotis laxa	Bay Forget-Me-Not	OBL	A/B/P				
<i>Osmorhiza occidentalis</i>	Sweet-cicely	NL	P				

*Based on Lichvar et al 2014.
Duration: A=Annual; B=Biennial; P=Perennial
New species identified in 2015 are **bolded**

Twenty-two infestations of Montana Listed Priority 2B noxious weeds and three infestations of Montana Listed Priority 1B noxious weeds were mapped within the riparian corridor at the North Fork Bear stream mitigation site (Figure 2, Appendix A). Cheatgrass (*Bromus tectorum*), a Montana Priority 3 regulated weed species (not a

Montana Listed noxious weed) was also identified across the site. Two noxious weed species observed in 2014 (*Convolvulus arvensis* and *Cynoglossum officinale*) were not observed in 2015 despite an extensive search. As a result, they have been removed from the list of noxious weeds observed on site (Table 3).

Each noxious weed infestation was identified in areas less than 0.1 acre in size with cover classes ranging from trace (less than 1 percent) to low (1 to 5 percent). Weed infestations with trace cover classes were not mapped but were included in the overall areal coverage estimate of noxious weeds observed in the project area. An estimated 40% of the project area has been colonized by noxious weed infestations. Weeds were observed on both stream banks, and were primarily concentrated upstream of the Highway 93 Bridge. It should be noted that a horse corral exists immediately adjacent to the reconstructed channel segment on the north bank upstream of the Highway 93 Bridge. This corral is entirely bare ground, and may contribute to weed propagation throughout the mitigation site.

Table 3. Weeds observed within the North Fork Bear Creek riparian zone in 2015.

Category*	Scientific Name	Common Name
Priority 1B	<i>Polygonum</i> sp.	Knotweed Complex
Priority 2B	<i>Berteroa incana</i>	Hoary False-Alyssum
	<i>Centaurea stoebe</i>	Spotted Knapweed
	<i>Cirsium arvense</i>	Canadian Thistle
	<i>Hypericum perforatum</i>	Common St. John's-Wort
	<i>Leucanthemum vulgare</i>	Ox-Eye Daisy
	<i>Potentilla recta</i>	Sulphur Cinquefoil
Priority 3 State Regulated	<i>Tanacetum vulgare</i>	Common Tansy
	<i>Bromus tectorum</i>	Cheatgrass

*Based on the Montana Dept. of Agriculture's Noxious Weed List, 2015
New species identified in 2015 are **bolded**

Attempts at establishing woody riparian vegetation within the project reach included installing cuttings along the banks upstream and downstream of the Highway 93 Bridge. Cottonwood and willow cuttings installed along the banks were unsuccessful. No cuttings were found alive during 2013, 2014, or 2015 field observations (see photo points 2.1 and 2.2, Appendix B). Upon inspection, all cuttings were installed to a depth of approximately one foot, with 4 to 5 feet of the stem extending above ground. Mortality of these cuttings can be attributed to the shallow planting depth and inability of the cuttings to extend roots to the low water table elevation.

4.2. Bank Erosion Inventory

Field examination of the North Fork Bear Creek project site documented no eroding streambanks within the project area. New banks with large woody debris installations appeared mostly stable with no undercutting or lateral channel migration evident.

During the 2014 monitoring event, the trunk of one root wad installed upstream of Highway 93 appeared more exposed than the year prior (see Photo 1 in Appendix B). The following is an excerpt from the 2013 monitoring report from this site (CCI, 2014):

The exposure of this trunk appeared as a result of the loss of cobble material placed on the upper six inches of the bank during high flows in 2014. Cobble materials placed over this root wad were covered with a layer of topsoil and coir fabric during construction; however, the fabric has peeled back from the top of the bank and is no longer providing protection of the upper bank. If additional cobbles adjacent to this root wad mobilize during subsequent high flows, the root ball may create a scouring hydraulic against the bank, reducing the ability of the root wad to provide bank protection. Although the bank is not currently considered eroding due to the lack of lateral channel movement, continued monitoring is highly recommended to determine whether this segment of the project reach becomes more susceptible to erosion.

The 2015 monitoring event did not reveal any additional loss of cobbles or other bank materials in the vicinity of this root wad and tree trunk. Furthermore, no evidence of high water debris deposits or drift lines was noted, indicating the North Fork of Bear Creek likely did not experience an out of bank flow event during spring runoff. This evidence is supported by below average snowpack documented in the Bitterroot Mountains (NRCS, 2015). The channel had no flowing water during the monitoring site visit in 2015, which occurred during mid-summer during a drought conditions. Standing water was observed in residual pools formed by scour against the rootwads installed as part of the project, but otherwise no other water was observed in the channel. No water was observed in the North Fork Bear Creek mitigation site during the 2013 monitoring event as well, indicating this segment of the channel may experience frequent dewatering.

5.0 COMPARISON OF RESULTS TO PERFORMANCE CRITERIA

Monitoring of the North Fork Bear Creek Stream Mitigation site is intended to document whether the reconstructed segment of the channel is meeting or moving toward meeting performance standards outlined in the North Fork Bear Creek Mitigation Plan. Results from the third year of monitoring indicates two of the four performance standards are being met four years post-construction, including percent woody vegetation cover and stream bank stability (Table 4). Percent cover of a) desirable perennial species and b) noxious weed species failed to meet the success criteria of >50% and <10% respectively. Photographs of photo points (Appendix B) and as-built drawings (Appendix C) have been provided as additional documentation of the site's condition in this monitoring report.

Table 4. Performance results of North Fork Bear Creek four years following project completion.

Monitoring Parameter	Performance Criteria	Status 3 Years Following Construction	Meeting Performance Criteria?
Riparian Cover	Greater than 50% aerial coverage of desirable perennial plants, including seeded species and those colonizing from adjacent undisturbed habitats.	Desirable cover estimated at 41% (90% total cover - 40% weed cover - 9% annual/biannual).	No
	Greater than 25% aerial coverage of woody riparian shrubs and/or trees.	Woody riparian species cover estimated at 32% of project area and increasing over past 3 years	Yes
	Less than 10% aerial coverage of site has Montana noxious weeds.	Noxious weed cover is estimated at 40% of the project area.	No
Streambank Stability	Less than 25% of total bank length exhibiting signs of active erosion/cutting	Erosion inventory documented 0% of project reach exhibits active erosion/cutting	Yes

5.1. Riparian Cover

Desirable perennial plants including riparian shrubs, trees, and forbs were estimated at 41% cover of the project site. This estimate was calculated by subtracting the sum of noxious weed cover (40%) bare ground (10%) and annual/biennial cover (9%) from 100. The monitoring criteria specify the site must exhibit greater than 50% cover by desirable perennial species; therefore this performance criterion is currently not being met.

Percent cover of woody vegetation has increased from 27% in 2013, to 30% in 2014, to 32% in 2015. The majority of woody plants include shrubs and trees that existed prior to relocating the channel and volunteer species that are colonizing the site. None of the woody cuttings planted along the left (north) bank survived due to inappropriate planting techniques.

Three new noxious weed species were identified during the 2015 monitoring event, including *Berteroa incana* (Hoary False-Alyssum), *Hypericum perforatum* (Common St. John's-Wort), and *Potentilla recta* (Sulphur Cinquefoil). Noxious weeds were observed along both banks of the project reach. Although each individual weed infestation is relatively small in extent, the area of all infestations combined warrants concern and must be addressed to achieve the success criterion for riparian cover.

5.2. Streambank Stability

No streambank erosion was noted along the reconstructed banks within the North Fork Bear Creek Stream Mitigation Site. Root wads placed along the north bank appear to be stable. No lateral bank retreat was observed, and as a result, no measures are currently warranted to improve bank stability within the project reach. Continued monitoring of the exposed root wad upstream of the Highway 93 Bridge is recommended to determine if that bank segment becomes unstable following future high water events.

6.0 MAINTENANCE CONCERNS

During the monitoring site visit, the remote camera stationed positioned to the west of the Highway 93 Bridge was found knocked off of its foundation and the camera removed. The monitoring crew contacted MDT and the researcher conducting wildlife use studies beneath Highway 93 Bridges to inform them of the damaged camera station.

7.0 LITERATURE CITED

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Appendix A

Project Site Map

MDT Stream Mitigation Monitoring
North Fork Bear Creek
Ravalli County, Montana



Legend

-  Photo Points
-  Berteroa incana
-  Centaurea stoebe

-  Cirsium arvense
-  Hypericum perforatum
-  Leucanthemum vulgare
-  Polygonum sp.

-  Potentilla recta
-  Tanacetum vulgare



**2015 Monitoring
NF Bear Creek**

Figure 2

Date: 09/27/2015

NFBear_features2015.mxd

Appendix B

Project Area Photos

MDT Stream Mitigation Monitoring
North Fork Bear Creek
Ravalli County, Montana

PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATES: 2013 and 2015 Monitoring Events



Photo Point 1.1—2013
Description: View of tributary/culvert entering from west. **Compass:** 270 (West)



Photo Point 1.1—2015
Description: View of tributary/culvert entering from west. **Compass:** 270 (West)



Photo Point 1.2—2013
Description: View of north streambank looking downstream. **Compass:** 45 (Northeast)



Photo Point 1.2—2015
Description: View of north streambank looking downstream. **Compass:** 45 (Northeast)



Photo Point 1.3—2013
Description: View of north streambank. **Compass:** 90 (East)



Photo Point 1.3—2015
Description: View of north streambank. **Compass:** 90 (East)

PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2015 Monitoring Events



Photo Point 1.4—2013
Description: View of dry channel looking upstream.
Compass: 230 (Southwest)



Photo Point 1.4—2015
Description: View of dry channel looking upstream.
Compass: 230 (Southwest)



Photo Point 2.1—2013
Description: View of root wads on north bank.
Compass: 225 (Southwest)



Photo Point 2.1—2015
Description: View upstream of root wads on north bank. **Compass:** 225 (Southwest)



Photo Point 2.2—2013
Description: View across channel of south stream-bank.



Photo Point 2.2—2015
Description: View across channel of south stream-bank.

PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2015 Monitoring Events



Photo Point 2.3—2013
Description: View from north bank looking across channel. **Compass:** 135 (Southeast)



Photo Point 2.3—2015
Description: View from north bank looking across channel. **Compass:** 135 (Southeast)



Photo Point 3.1—2013
Description: View downstream from north bridge abutment. **Compass:** 90 (East)



Photo Point 3.1—2015
Description: View downstream from north bridge abutment. **Compass:** 90 (East)



Photo Point 3.2—2013
Description: View of south streambank from left abutment. **Compass:** 135 (Southeast)



Photo Point 3.2—2015
Description: View of south streambank from left abutment. **Compass:** 135 (Southeast)

PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2015 Monitoring Events



Photo Point 3.3—2013
Description: View across channel of south bank from north bridge abutment. **Compass:** 180 (South)



Photo Point 3.3—2015
Description: View across channel of south bank from north bridge abutment. **Compass:** 180 (South)



Photo Point 4.1—2013
Description: View from south bank looking upstream from downstream extent. **Compass:** 270 (West)



Photo Point 4.1—2015
Description: View from south bank looking upstream from downstream extent. **Compass:** 270 (West)



Photo Point 4.2—2013
Description: View of root wads on north bank downstream of bridge. **Compass:** 0 (North)



Photo Point 4.2—2015
Description: View of root wads on north bank downstream of bridge. **Compass:** 0 (North)

PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2015 Monitoring Events



Photo Point 4.3—2013
Description: View of north bank from downstream extent of project site. **Compass:** 68 (East-Northeast)



Photo Point 4.3—2015
Description: View of north bank from downstream extent of project site. **Compass:** 68 (East-Northeast)

PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2014-2015 Monitoring Event



Loss of cobbles above root wad

Additional Photo 1—2014

Description: Root wads upstream of bridge.



No additional loss of cobbles in 2015

Additional Photo 1—2015

Description: Root wads upstream of bridge.



Additional Photo 2—2014

Description: Root wad upstream of bridge showing scour.



Additional Photo 2—2015

Description: Root wad upstream of bridge.



Additional Photo 3—2014

Description: Large hole downstream of project site.



Additional Photo 3—2015

Description: Large hole downstream of project site.

PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2015 Monitoring Event



Additional Photo 4 - 2015
Description: Downed camera station.
Taken in 2015



Additional Photo 5 - 2015
Description: Root wads upstream of 93 Bridge
Taken in 2015



Additional Photo 6 - 2015
Description: Knotweed complex
Taken in 2015



Additional Photo 7 - 2015
Description: Failed woody cuttings
Taken in 2015

Appendix C

As Built Drawings and Design Schematics

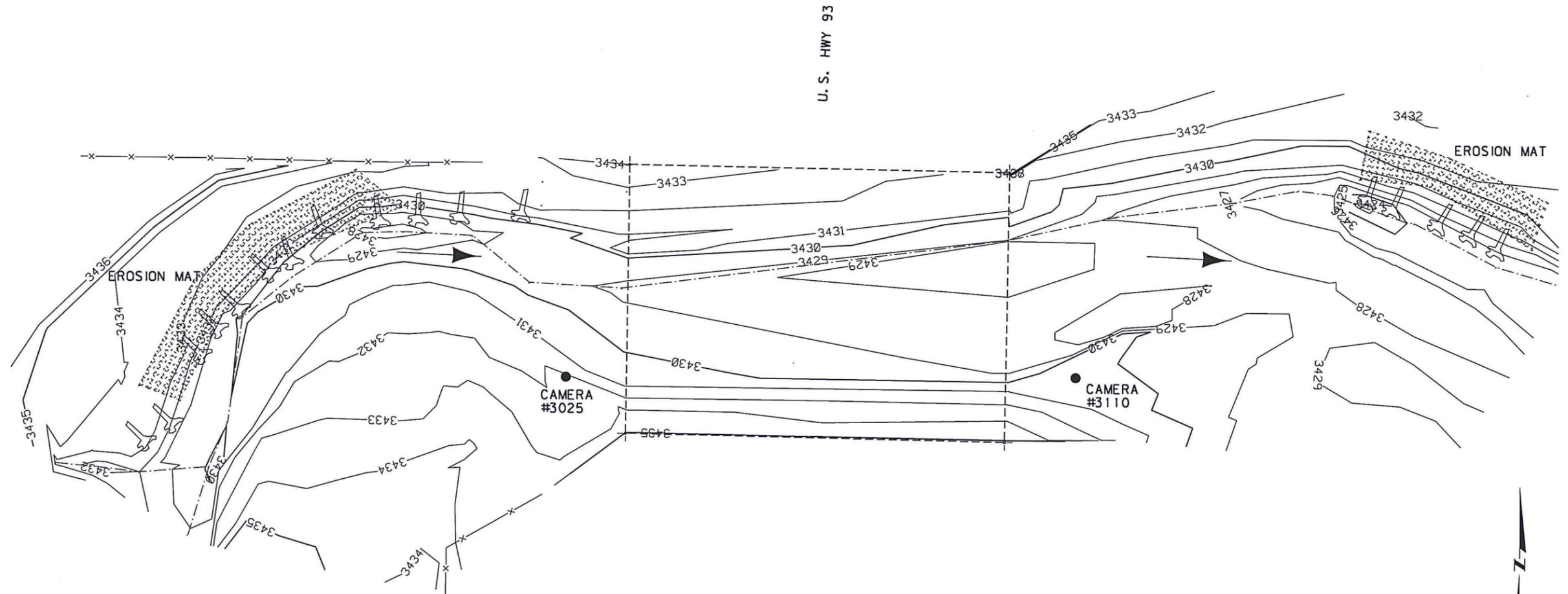
MDT Stream Mitigation Monitoring
North Fork Bear Creek
Ravalli County, Montana

CONTROL TABLE				
PNT#	NORTHING	EASTING	ELEV.	DESCRIPTION
CI2015	820308.760	797947.813	3435.224	MDT AL CAP
CG2015	819805.449	798080.492	3436.854	MDT AL CAP

CI2015

LEGEND

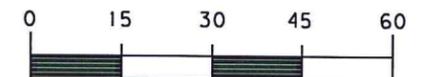
ROOT BALL



AS-BUILT TOPOGRAPHIC DRAWING OF THE NORTH FORK OF BEAR CREEK CHANNEL

SURVEYOR NOTES:

1. THIS SURVEY IS BASED ON FOUND MDT ALUMINUM CAPS STAMPED CI2015 AND CG2015 BUT THEY DO NOT HAVE ESTABLISHED MDT COORDS AND ELEVATIONS. THEREFORE LOCAL CONTROL WAS ESTABLISHED FOR THIS SITE WITH TRIMBLE GPS RTK SURVEY AND THE APPROXIMATE ASSUMED ELEVATION AT MDT ALUM CAP CI2015.
2. THE COORDINATES SHOWN HEREON ARE BASED ON MONTANA STATE PLANE GRID



3
2
1

MDT MONTANA DEPARTMENT OF TRANSPORTATION

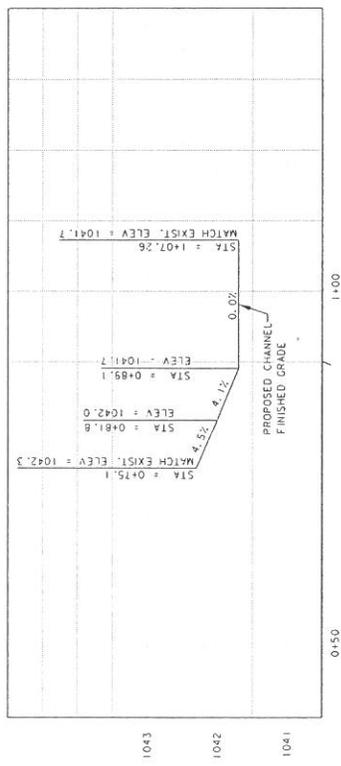
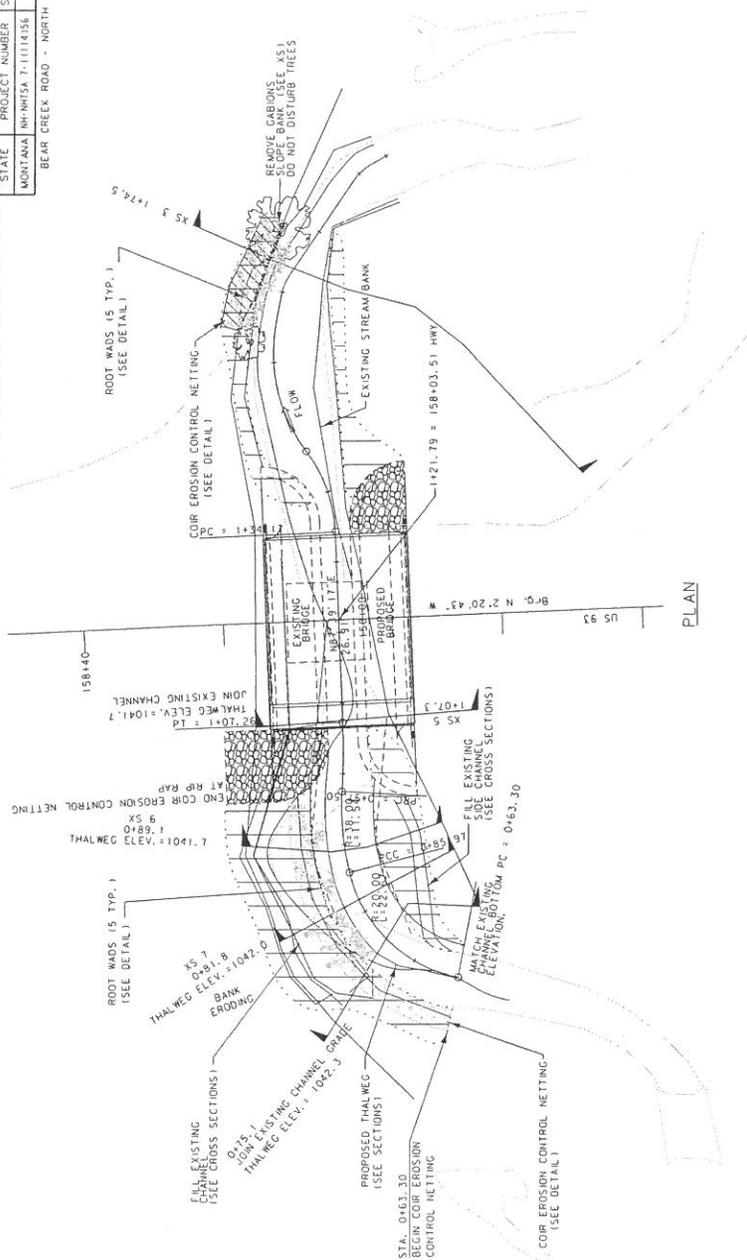
...NF BEAR CREEK PLAN.dgn
12/9/2013
11:02:51 AM awibe

DESIGNED BY ARNE W
REVIEWED BY
CHECKED BY LARRY R

N.F. BEAR CREEK

MDT STREAM MITIGATION MONITORING SURVEY

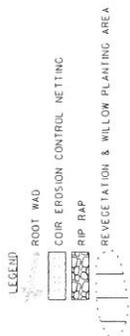


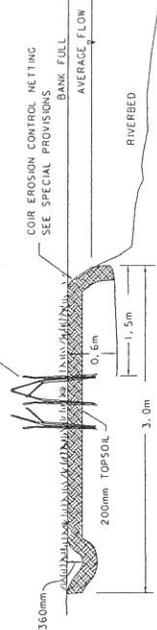


COORDINATE TABLE

STATION	NORTHING	EASTING
0+76.03	36,218.1167	56,132.1603
0+85.97	36,221.2271	56,204.3003
0+91.78	36,222.6477	56,210.5363
1+02.39	36,222.0482	56,221.2141
1+07.46	36,222.2420	56,226.0927
1+10.14	36,223.4034	56,226.3948
1+15.61	36,223.6668	56,222.3869
1+20.48	36,227.4917	56,224.3830
1+25.48	36,231.0305	56,226.2933
1+30.48	36,230.1936	56,227.8178
1+35.48	36,229.8772	56,229.1522
1+40.48	36,229.1764	56,230.3597
1+45.48	36,218.2584	56,304.6191
1+50.48	36,216.0744	56,305.8532

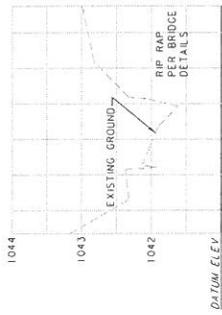
- NOTES:**
- REMOVE ALL EXISTING GABIONS, APPROXIMATE STATION 1+63 TO 1+78, AS DIRECTED BY ENGINEER.
 - INSTALL SIX (6) ROOT WAD STRUCTURES BETWEEN STATIONS 1+63 AND 1+78 AS DIRECTED BY ENGINEER.
 - INSTALL SIX (6) ROOT WAD STRUCTURES BETWEEN STATION 0+66 AND 1+10 AS DIRECTED BY ENGINEER.
 - DO NOT DISTURB EXISTING STUMPS/ROOT WADS NEAR STATION 0+90
 - DO NOT DISTURB TREES IN GABION AREA 1+78



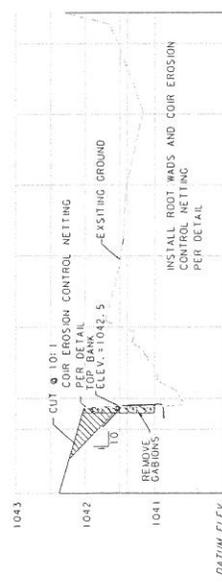


1. SUB EXCAVATE BANKS 0.6 METERS FROM EDGE OF BANK.
2. BACK FILL WITH NATIVE MATERIAL AND 0.2 METERS TOPSOIL.
3. BACK FILL WITH NATIVE MATERIAL AND 0.2 METERS TOPSOIL.
4. WRAP NETTING AND EXTEND 3.0 METERS MIN. FROM BANK EDGE.

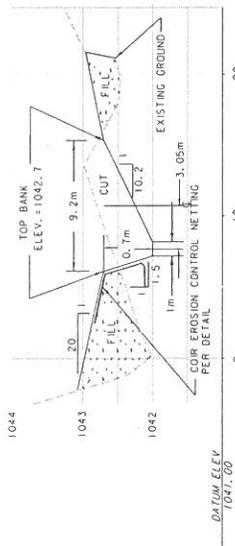
COIR EROSION CONTROL NETTING TYPICAL
N. FORK BEAR CREEK



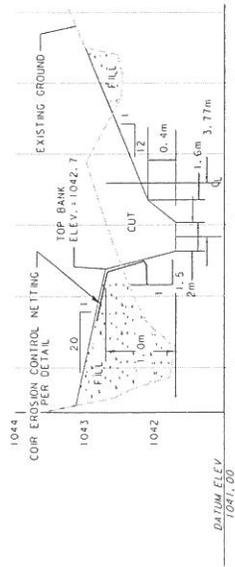
1+07.3



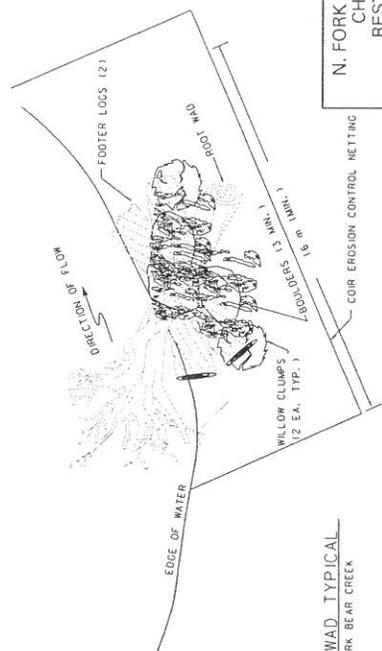
1+74.5



0+81.8



0+89.1



ROOT WAD TYPICAL
N. FORK BEAR CREEK

PLAN

0+75.1

N. FORK BEAR CREEK
CHANNEL
RESTORATION
DETAILS
STA. 158+03
SHEET 2 OF 2
NO SCALE