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# MONTANA DEPARTMENT OF TRANSPORTATION STREAM MITIGATION MONITORING REPORT

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*North Fork Bear Creek  
Ravalli County, Montana*

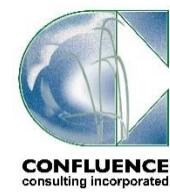
*Year Project Completed: 2011  
Monitoring Report #5: Submitted December, 2017*



Prepared for:



Prepared by:



# **MONTANA DEPARTMENT OF TRANSPORTATION**

## **STREAM MITIGATION MONITORING REPORT #5**

**YEAR 2017**

*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

December 2017

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

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- Appendix B: Project Area Photos
- Appendix C: As Built Drawings and Design Schematics

## 1.0 INTRODUCTION

The following report presents the results of the fifth 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 a minimum of 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 six 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 fill within jurisdictional wetlands. The North Fork Bear Creek work included removal and replacement of the U.S Highway 93 bridge, placement of rock around the new bridge abutments, creation of a new stream channel alignment, filling the deactivated stream segment, 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.

Performance standards outlined in the mitigation plan for the reconstructed segment of the North Fork Bear Creek 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 outlined 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 fifth year of monitoring in 2017 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 2017 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, extending 110 feet upstream and 100 feet downstream of the U.S. 93 Bridge (plus 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 12, 2017 and again on August 16th. The following data were collected at the North Fork Bear Creek stream mitigation site during these monitoring events:

### **3.1. Riparian Vegetation Establishment**

Visual estimates of total vegetation, woody species, noxious weeds, and annual/biennial species were recorded within riparian buffer areas extending 25 feet on either side of the active stream channel. Areal percent cover was recorded for each vegetation category based on ocular estimate methodologies outlined in Elzinga et al. (1998). Annual, biennial, and/or perennial species durations were based on those provided in the USDA PLANTS Database (2017). Areal percent cover was visually estimated for species with annual and/or biennial durations only. If a species had a variable duration and included perennial classification, its percent cover was not visually estimated or included in the estimate of annual/biennial species cover within the riparian buffer areas. Percent cover of desirable species was then calculated by subtracting noxious weed and annual/biennial cover from total vegetation cover.

Noxious weed infestations, with cover classes ranging from low to high, were identified and mapped on aerial photographs, with species noted. Observations of isolated noxious weed occurrences and those with a trace cover class were included in the species lists and total areal percent cover estimate of noxious weeds within the project area, but were not mapped. Percent cover of noxious weed species observed along the riparian belt transects were visually estimated and recorded using the classification values listed in Table 1.

**Table 1. Classification values and associated percent cover classes used for noxious weed inventory.**

Classification Value	% Cover
Trace (T)	<1%
Low (L)	1-5%
Moderate (M)	6-25%
High (H)	25-100%

These results provide MDT a tool for developing site specific weed control plans for this mitigation site. Results of the noxious weed inventory are provided on Figure 2 of Appendix A.

### **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**

Photographs were taken at the four photo points originally established in 2013 during the August site visit. Photo documentation included upstream and downstream bank conditions at the Highway 93 Bridge. All sites selected for photo-documentation were recorded using a GPS and compass direction noted to allow for repetition during future monitoring (Appendix B).

### **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).

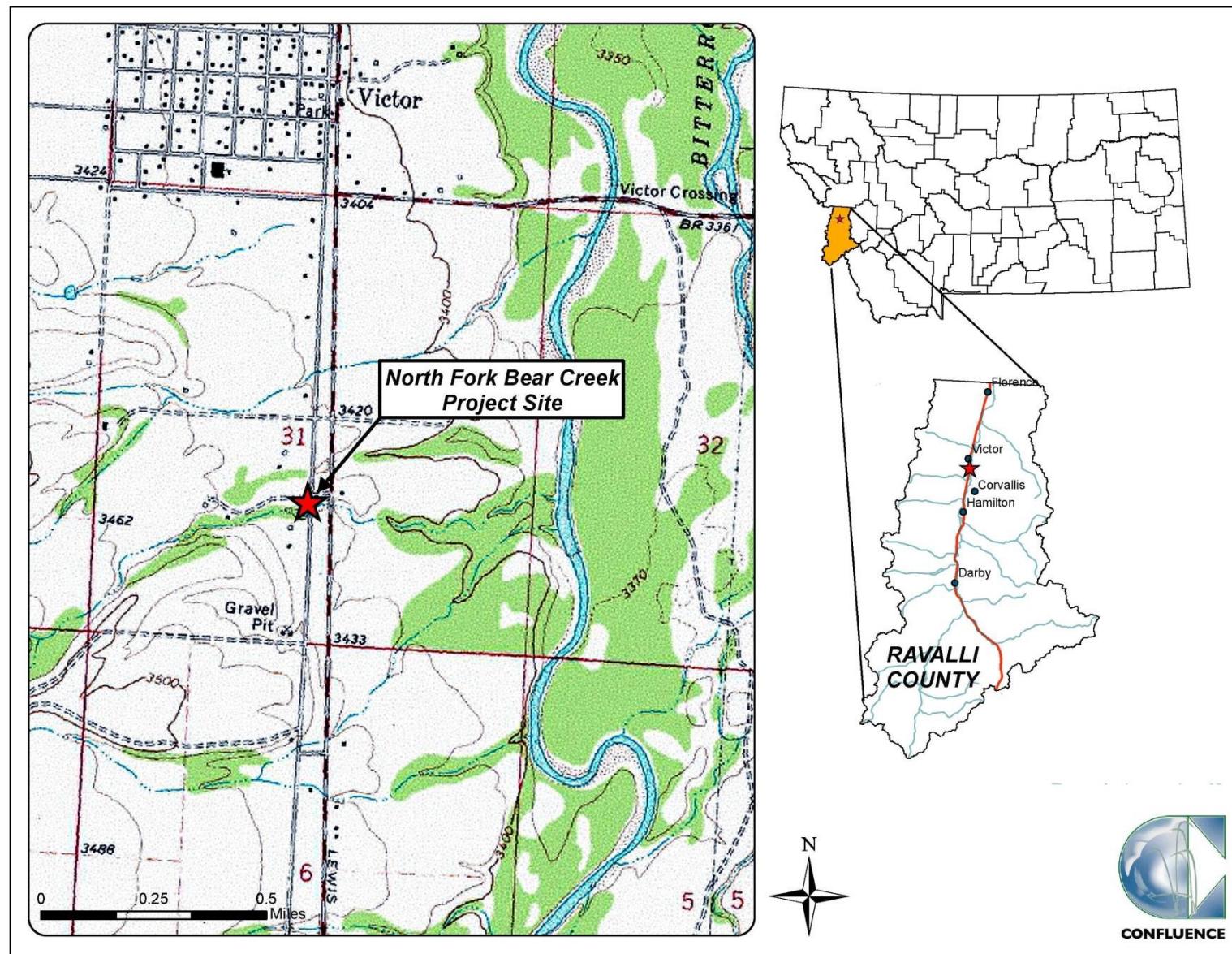


Figure 1. Project location of North Fork Bear Creek stream mitigation site.

## 4.0 RESULTS

### 4.1. Riparian Vegetation Inventory

Results of the 2013 through 2017 visual estimates of areal coverage are summarized in Table 2. In 2017, approximately 15% of the project site was bare ground, with 50% of the area vegetated with herbaceous species and 35% woody species. Overall results as compared to 2013 through 2017 were very similar, with a slight increase in percent woody cover from 27% to 35%. This result is due to continued maturation of woody species observed following five growing seasons since monitoring efforts began. The site exhibited a lower percentage of noxious weeds than observed during previous monitoring efforts, and was estimated at 30% of the total cover. Herbaceous vegetation observed at the North Fork Bear Creek site was not separated by annual, biennial, and perennial durations during the 2013 and 2014 monitoring years; therefore the total percent desirable cover parameter was not calculated.

**Table 2. Visual estimate of plant coverage at North Fork Bear Creek Stream Mitigation Site from 2013 through 2017.**

YEAR	Total % Riparian Cover	% Bare Ground	% Woody Cover	% Noxious Weed Cover	% Annual/Biennial Cover	% Herbaceous Non-Noxious Perennial Cover	% Desirable Cover <sup>1</sup>
2013	90	10	27	35	*	*	*
2014	90	10	30	35	*	*	*
2015	90	10	32	40	9	9	41
2016	92	8	34	45	7	7	40
2017	85	15	35	30	7	13	48

\*Data not collected in 2013 or 2014

<sup>1</sup> % Desirable Cover=Total % Riparian Cover - %Noxious Weed Cover - % Annual/Biennial Cover

Table 3 includes a comprehensive list of plant species observed along the new channel alignment and riparian buffer areas from 2013 through 2017. The comprehensive list includes 111 species, representing an increase by 2 species since 2016, 44 species since 2014, and 66 species since 2013. In 2017, 41% of species observed were hydrophytic based on the 2016 National Wetland Plant List (Lichvar *et al.* 2016).

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 3. Comprehensive list of plant species observed at the North Fork Bear Creek Stream Mitigation Site from 2013 through 2017.**

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

\* 2016 National Wetland Plant List; Western Mountains, Valleys, and Coast Region (WMVC) (Lichvar *et al.* 2016)

Duration: A=Annual; B=Biennial; P=Perennial; USDA PLANTS Database (2017)

New species identified in 2017 are **bolded**

Fifteen infestations of Montana Listed Priority 2B noxious weeds were observed within the project area, all of which were classified as low cover class (1-5%). Three infestations of Priority 1B noxious weeds were found within the riparian corridor and were also considered low cover class (Table 4 and Figure 2, Appendix A). Cheatgrass (*Bromus tectorum*), a Montana Priority 3 regulated weed species was also observed across the site. Two noxious weed species originally observed in 2014 (*Convolvulus arvensis* and *Cynoglossum officinale*) have not been observed during the past three monitoring events, and as a result, they are no longer considered present within the reach.

An estimated 30% of the project area has been colonized by noxious weed infestations. Weeds were observed on both stream banks, upstream and downstream of the Highway 93 Bridge. The percent cover estimates recorded for all vegetation categories, including noxious weeds, may have been influenced by a combination of factors, including, but not limited to, adjacent land management, previous herbicide applications, differences in annual precipitation and temperature, calibration training completed by field staff, and other unknown factors that make it difficult to determine the exact cause(s) for increases or decreases in coverage. While previous weed spraying efforts by MDT may have reduced areal coverage of noxious weeds, the 30% percent cover by eight noxious weed species remains a concern at this site.

**Table 4. Weeds observed within the North Fork Bear Creek riparian zone in 2017.**

Category*	Scientific Name	Common Name
Priority 1B	<i>Polygonum cuspidatum</i>	Knotweed Complex
	<i>Berteroia 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
	<i>Tanacetum vulgare</i>	Common Tansy
Priority 2B	<i>Bromus tectorum</i>	Cheatgrass

\*Based on the Montana Dept. of Agriculture's Noxious Weed List, February 2017

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 (*Salix* spp.) cuttings installed along the banks were unsuccessful. Only one of the cuttings has developed leafy stems, which have sprouted from the base of the plant. Upon inspection, all cuttings were installed to a depth of approximately one foot, with 4 to 5 feet of the stem extending above ground. The lack of specialized equipment to install willow stems in rocky/cobbly substrate was likely the limiting factor for installing the cuttings to the proper depth. High mortality of these cuttings can be attributed to the shallow planting depth and inability of the cuttings to quickly extend roots down to the low water table elevation.

#### **4.2. Bank Erosion Inventory**

Field examination of the North Fork Bear Creek project site documented one actively eroding stream bank within the project area. This newly eroding bank segment occurs immediately downstream of the Highway 93 Bridge on the right (south) bank. Erosion was noted along approximately 22' of the bank, which exhibits signs of undercutting and bank sloughing. The bank consists of cobble and gravel material and is vegetated with a mixture of herbaceous and woody species including common yarrow (*Achillea millefolium*), narrow-leaf cottonwood (*Populus angustifolia*), woods rose (*Rosa woodsii*), and spotted knapweed (*Centaurea stoebe*). Based on photo documentation, it appears the bank has retreated by approximately 1-2 feet in the past year (see photo points 3.2 and 3.3 in Appendix B). The relatively short extent of erosion and lack of infrastructure in jeopardy of being damaged by continued erosion here makes stabilization or correction efforts unwarranted at this time. No other erosion was noted along the project reach and all root wads installed appear to be intact and preventing lateral channel movement.

The North Fork of Bear Creek was flowing approximately 10 cfs during the July, 2017 monitoring event, however the channel was completely dry during the August, 2017 monitoring event (see all monitoring photos in Appendix B). 2017 was characterized by an above average winter snowpack followed by a hot, dry summer across the majority of Montana. The discharge observed in July was sufficient to connect pools formed by the channel scouring against the rootwads placed along the north bank, which contained several small trout (2-4", species not identified).

#### **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 fifth year of monitoring indicates two of the four performance standards are being met six years post-construction, including percent woody vegetation cover and stream bank stability (Table 5). Percent cover of a) desirable non-noxious 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 5. Performance results of North Fork Bear Creek six years following project completion.**

Monitoring Parameter	Performance Criteria	Status 6 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 <b>48%</b> (85% total cover - 30% weed cover - 7% annual/biennial).	No
	Greater than 25% aerial coverage of woody riparian shrubs and/or trees.	Woody riparian species cover estimated at <b>35%</b> of project area and increasing over past 5 years	Yes
	Less than 10% aerial coverage of site has Montana noxious weeds.	Noxious weed cover is estimated at <b>30%</b> of the project area.	No
Streambank Stability	Less than 25% of total bank length exhibiting signs of active erosion/cutting	Erosion inventory documented <b>5%</b> of project reach exhibits active erosion/cutting	Yes

### **5.1. Riparian Cover**

Desirable non-noxious perennial plants including riparian trees, shrubs, and forbs were estimated at 48% cover of the project site. This estimate was calculated by subtracting the sum of the visual estimates for noxious weed cover (30%), bare ground (15%), and annual/biennial cover (7%) from 100. While the trend in percent desirable cover from 2015 to 2017 appears to be moving in the right direction and is currently only 2% below success standards, the site is currently not meeting this performance criterion.

Percent cover of woody vegetation has increased by 1-3% per year since the initial monitoring event in 2013. The majority of woody plants include shrubs and trees that existed prior to relocating the channel and volunteer species that are colonizing the site. Although techniques used to install woody cuttings have resulted in very low survival rates, the combination of volunteer shrub establishment and mature tree cover currently stands at 35%, which exceeds the established success criteria for woody cover by 10%

Many infestations of 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. Future weed management efforts should take into account the presence of wildlife friendly fencing along the riparian corridor upstream and downstream of the U.S. 93 Bridge over the North Fork of Bear Creek.

### **5.2. Streambank Stability**

One relatively short bank segment appears to have retreated by approximately two feet in the past year. The eroding bank segment is 22 feet long and represents 5% of the overall bank length (not including banks beneath the highway bridge). This erosion is relatively short and does not currently jeopardize any infrastructure; as such, its repair is unwarranted at this time.

Root wads placed along the north bank both upstream and downstream of the bridge appear stable. Cobble placed atop one of the rootwads upstream of the bridge appeared to have partially washed out during 2014; however no additional bank erosion has been noted in this area during the past three years. Given the integrity of the channel, no measures are currently warranted to improve bank stability within the project reach, and the project site is currently meeting success criteria for bank stability.

## **6.0 LITERATURE CITED**

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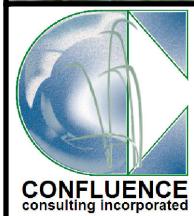
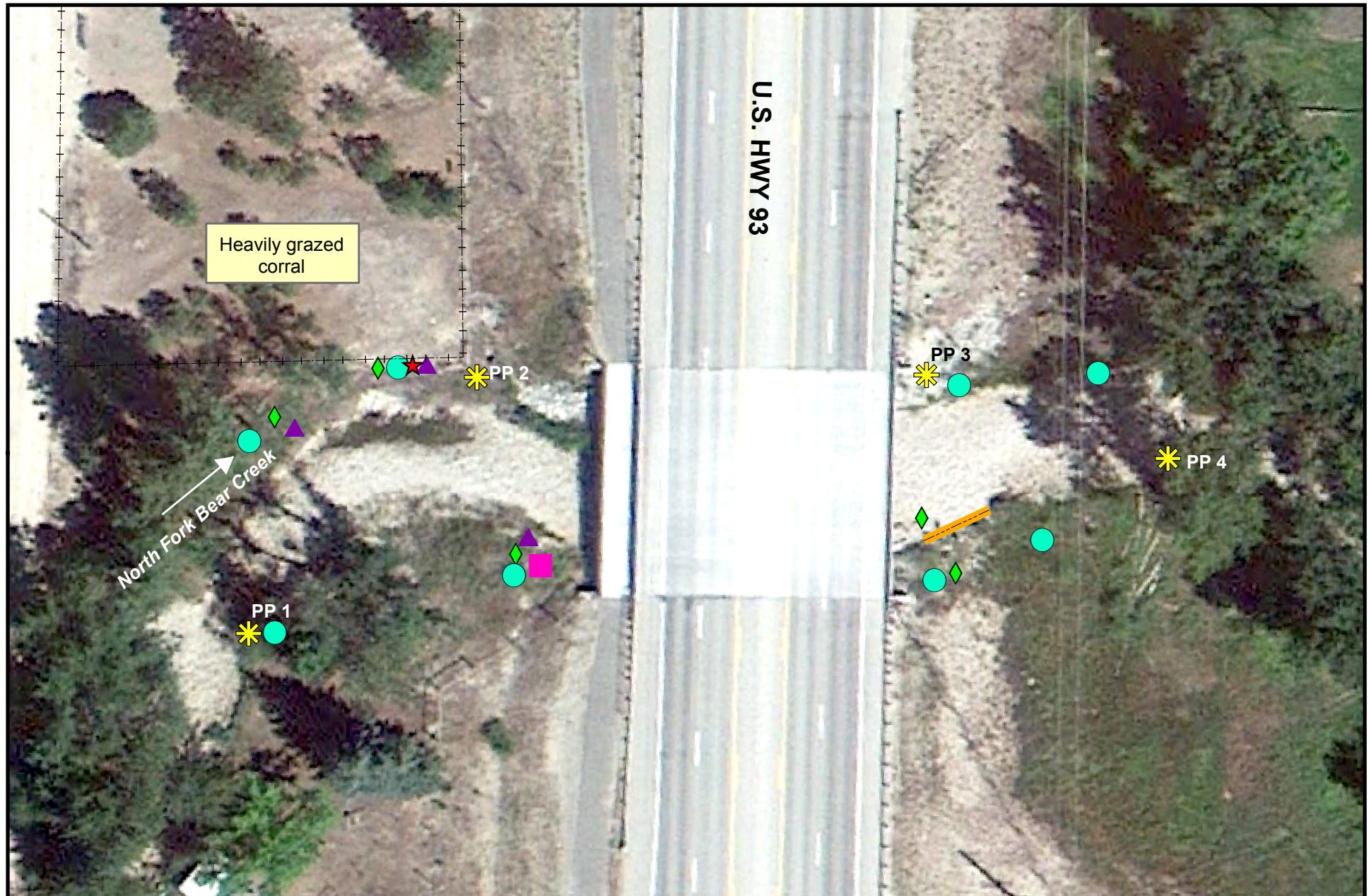
## **Appendix A**

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### **Project Site Map**

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



### Legend

- Photo Points
- Berteroia incana
- Centaurea stoebe

- Leucanthemum vulgare
- Polygonum cuspidatum
- Tanacetum vulgare

Note: 3 noxious weeds observed in trace amounts are not mapped

Eroding Bank

0 25 50 Feet



2017 Monitoring  
NF Bear Creek

Figure 2

Date: 9/22/2017

NFBear\_features2017.mxd

---

## **Appendix B**

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### **Project Area Photos**

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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 2017 Monitoring Events



**2013**

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



**2013**

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



**2013**

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

## **PHOTO INFORMATION**

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events



**2013**

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



**2013**

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



**2013**

**Photo Point 2.2:** View across channel of south streambank. **Compass:** 180 (South)

## **PHOTO INFORMATION**

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events



**2013**

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



**2013**

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



**2013**

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

## PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events



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



**2017**  
**Photo Point 3.3:** View across channel of south bank from north bridge abutment. **Compass:** 180 (South)



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



**2017**  
**Photo Point 4.1:** View from south bank looking upstream from downstream extent. **Compass:** 270 (West)



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



**2017**  
**Photo Point 4.2:** 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 2017 Monitoring Events



**2013**

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

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## **Appendix C**

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### **As Built Drawings and Design Schematics**

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**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

CI20

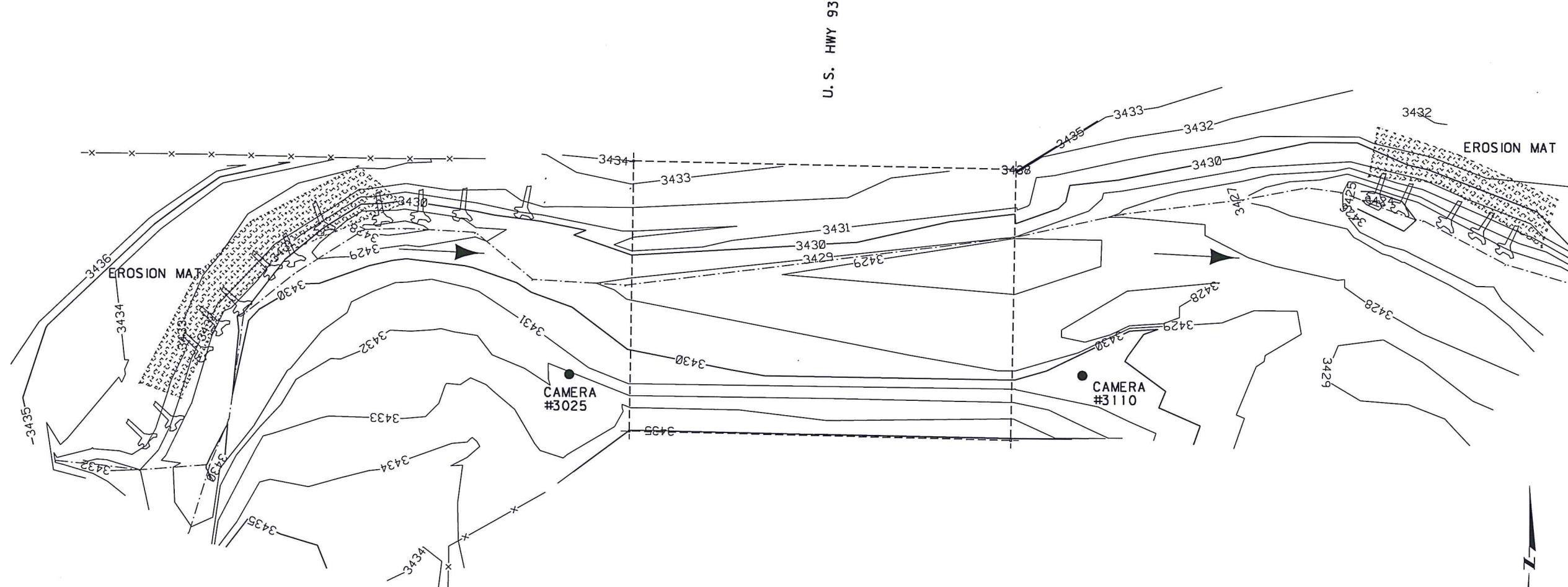
## CONTROL TABLE

FNT#	NORTHING	EASTING	ELEV.	DESCRIP
200012	400000.000	500000.000		

CL2015 820308.760 797947.813 3435.224 MDT AL CA

CG2015 819805.449 798080.492 3436.854 MDT AL C

## LEGEND



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



