MONTANA DEPARTMENT OF TRANSPORTATION
STREAM MITIGATION MONITORING REPORT

Mill Creek
Ravalli County, Montana

Project Constructed: 2011
Monitoring Report #5: December, 2017

Prepared for:

VISION ZERO
zero deaths · zero serious injuries
MONTANA DEPARTMENT OF TRANSPORTATION

Prepared by:

CONFLUENCE
consulting incorporated

MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT #5

YEAR 2017

Mill Creek
Ravalli County, Montana

MDT Project Number: NH7-(114)59
Control Number: 2015004

SPA Number: MDT-R2-15-2010
USACE Number: NOW-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

TABLE OF CONTENTS

FIGURES AND TABLES

APPENDICES

Cover: Mill Creek channel upstream of U.S. Hwy 93, taken in 2017

1.0 INTRODUCTION

The following report presents the results of the fifth year of post stream re-construction monitoring at the U.S. 93 stream crossing at Mill Creek near Hamilton, Montana. This report includes an evaluation of monitoring results in comparison to project performance standards outlined in the approved U.S. Army Corps of Engineers (USACE) 404 permit for the project. Requirements outlined in this permit require five years of post-construction monitoring 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 the construction of the Bear Creek Road-South segment of U.S. Highway 93, the Montana Department of Transportation (MDT) relocated a segment of Mill Creek to align with a new permanent bridge. The realignment of Mill Creek included deactivating and filling approximately 630 feet of the channel and constructing approximately 581 feet of new channel through a relic flood swale. Permanent impacts to Mill Creek were authorized by the USACE, as outlined in USACE permit number NWO-1997-90821-MTH and SPA 124 Authorization number MDT-R2-15-2010.

Special conditions specified in this permit included monitoring of the relocated segment of Mill Creek for five years following channel construction to document streambank stability and the success of riparian vegetation establishment. Performance success criteria outlined in the monitoring plan for the Mill Creek site include:

1. **Riparian vegetation coverage**
    a) Minimum of 80% total vegetative coverage by the end of the third growing season.
    b) Minimum of 50% areal coverage by woody species by the end of the third growing season.
2. **Streambank stability** – any unstable banks within the relocated channel segment will require corrective actions.

Additional reporting requirements outlined in the monitoring plan include:

3. **As-built survey** - as built drawings of the relocated channel at a 1:50 scale or smaller and planting schematic with a planted species list and number of plants planted.
4. **Monitoring stations** - establishment of 4 monitoring stations 75' apart with surveyed cross sections and bank pins installed as permanent reference points.
5. **Photo points** - color photos at each monitoring station showing both banks and upstream and downstream views.

Results of the fourth year monitoring of the Mill Creek project are summarized in Section 4 and compared to performance standards in Section 5. Additional reporting

requirements including a map indicating the endpoints of riparian belt transects and perpendicular transect surveys, survey results at four perpendicular transects and a longitudinal profile, photo-documentation of the project site, a 2013 topographic survey of the project site, and planting plan from the approved design are included in Appendices as supporting information to document the site's condition.

2.0 SITE LOCATION

The relocated segment of Mill Creek flows beneath a newly constructed bridge on U.S. Highway 93 approximately 7 miles north of Hamilton, Montana (Figure 1). The project reach includes approximately 500 feet of Mill Creek upstream of the Highway 93 Bridge and extends approximately 100 feet downstream of the bridge. The project is located in Section 19, Township 7 North, Range 20 West, in Ravalli County, Montana. Note the topographic map in Figure 1 refers to Mill Creek as Fred Burr Creek below the confluence of these streams. The National Hydrography Dataset indicates the project area is on Fred Burr Creek, although the major contributing stream and larger watershed upstream of the confluence of these streams is Mill Creek.

3.0 MONITORING METHODS

Monitoring field crews visited the project site on July 12, 2017 while topographic survey crews visited the site on July 19, 2017. The following data were collected at the Mill Creek stream mitigation site:

3.1. Riparian Vegetation Inventory - Belt Transects

Performance of riparian vegetation coverage was monitored by establishing two riparian belt transects in 2013. These transects were re-surveyed in 2017 to document areal percent cover of total vegetation, woody vegetation, and noxious weeds. Visual estimates of all vegetation species, woody species, and noxious weeds 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). The belt transect on the right (south) bank is parallel to the downstream extent of the project reach for 140 feet. The left (north) bank belt transect doglegs to maintain a parallel alignment with the channel for 435 feet. The extent of each riparian transect is shown in Figure 3 of Appendix A.

All noxious weed infestations, with the exception of isolated weed occurrences, were identified and mapped on aerial photographs, with species noted. Observations of isolated noxious weed occurrences 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 4 of Appendix A.

3.2. Bank Erosion Inventory

Streambank stability performance was monitored by conducting a visual erosion inventory within and upstream of the project reach. Each eroding bank within the project reach was photo-documented, with eroding bank length and potential causes of bank erosion noted. A qualitative erosion severity rating was generated by observing substrate composition of the bank, vegetation composition, and whether depositional features such as point bars were developing near the erosional area.

3.3. Perpendicular Transects and Longitudinal Profile Surveys

Four perpendicular transects (cross sections) were established in 2013 to document vertical and lateral stability within the project reach. Each of the four transects was re-surveyed from 2014 – 2017 to document vertical and lateral adjustments at two riffles and at two pools.

A longitudinal profile was surveyed down the thalweg of the channel from 2014 through 2017 to document aggradation, degradation, and habitat complexity along the project reach. All transects and longitudinal profiles were surveyed using a Trimble R8 GPS with rover and base station units, with survey points taken at inflection points along each transect and profile. A total station survey unit was used to shoot longitudinal profile points beneath the Highway 93 Bridge. All surveys tied into benchmark pins established by MDT during construction of the project. Photographs were taken facing upstream, downstream, and across the channel at each transect to further document site conditions and complement permanent photo-documentation points.

3.4. Photo-Documentation

Permanent photo documentation points were established during the first monitoring event in 2013. Photos were re-taken at all photo points to document vegetation establishment and stream bank conditions within the project site. Photos were also taken at each eroding bank to document erosion severity and whether any of the banks began to heal after the initial erosion was noted.

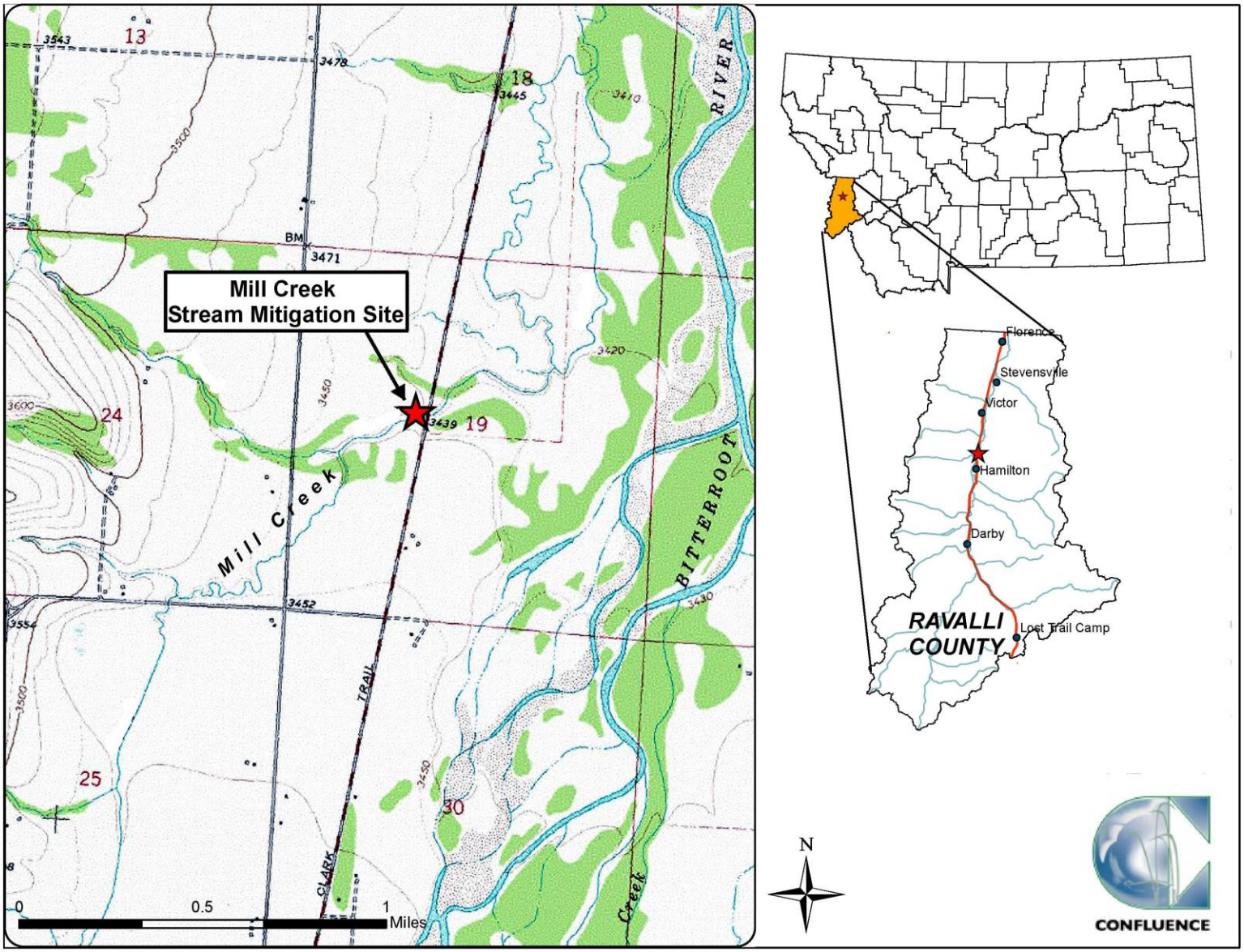


Figure 1. Project location of Mill Creek stream mitigation site.

4.0 RESULTS

4.1. Riparian Vegetation Inventory-Belt Transects

Table 2 summarizes the vegetation composition of each riparian transect, including areal percent cover of total vegetation, woody vegetation, and noxious weeds. In 2017, the total percent riparian cover was 84%, and included 56% cover by herbaceous species and 28% cover by woody species. The site exhibited a lower percentage of noxious weed cover than observed during the previous four monitoring events, and was estimated at 13%. Noxious weeds infestations were more prevalent on the left (north) bank of the project reach where construction activities occurred. 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.

Table 2. Riparian vegetation composition of Mill Creek from 2013 through 2017.

Belt Transect	Length (ft)	Total % Riparian Cover					% Woody Cover					% Noxious Weed Cover				
		2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Right (south bank)	140	100	100	96	97	97	60	60	60	62	62	1	1	2	3	3
Left (north bank)	435	75	80	80	85	80	15	15	15	16	17	15	20	25	27	16
Area weighted Total	575	81	85	84	88	84	26	26	26	27	28	11	15	19	21	13

Table 3 includes a comprehensive list of plant species observed along the new channel alignment and riparian buffer areas from 2013 through 2017. In 2017, 119 species were observed, representing an increase of 10 species since the 2016 monitoring event. Six of the ten new species observed in 2017 were native and considered beneficial to the restoration efforts within the project area as they increase overall species diversity and enhance riparian habitat complexity. These newly observed plant species included Saskatoon service-berry (*Amelanchier alnifolia*), Bebb's sedge (*Carex bebbii*), narrow-leaf mountain-trumpet (*Collomia linearis*), starry false solomon's-seal (*Maianthemum stellatum*), hairy evening-primrose (*Oenothera villosa*), and bluebush wheatgrass (*Pseudoroegneria spicata*). Fifty-seven of the species (48%) observed in 2017 were considered hydrophytic based on the 2016 National Wetland Plant List (NWPL) (Lichvar *et al*. 2016).

The vegetation inventory along Mill Creek identified eight noxious weeds and one state-regulated species (Table 4). Isolated occurrences of houndstongue (*Cynoglossum officinale*) and St. Johnswort (*Hypericum perforatum*) were observed for the first time within the project area during the 2017 monitoring event. In 2013 and 2014, Field Pepper-Grass (*Lepidium campestre*) was incorrectly identified as Broad-Leaf Pepperwort (*Lepidium latifolium*), and has subsequently been removed from the list of noxious weeds present at this site. Noxious weed infestations mapped within the project area ranged from trace (less than 1 percent) to low (1 to 5 percent) cover classes. Locations of all noxious weed infestations, with the exception of isolated weed occurrences, are shown on Figure 4 of Appendix A.

Table 3. Comprehensive list of plant species identified at the Mill Creek stream mitigation site from 2013 through 2017.

Scientific Name	Common Name	WMVC Indicator Status*
Achillea millefolium	Common Yarrow	FACU
Agrostis gigantea	Black Bent	FAC
Agrostis scabra	Rough Bent	FAC
Agrostis stolonifera	Spreading Bent	FAC
Algae, brown	Algae, brown	NL
Algae, green	Algae, green	NL
Alnus incana	Speckled Alder	FACW
Alopecurus aequalis	Short-Awn Meadow-Foxtail	OBL
Alyssum alyssoides	Pale Alyssum	NL
Amelanchier alnifolia	**Saskatoon Service-Berry**	**FACU**
Antennaria parvifolia	Nuttall's Pussytoes	NL
Artemisia absinthium	Absinthium	NL
Aster sp.	Aster	NL
Bassia scoparia	Burningbush	FAC
Berteroa incana	Hoary False-Alyssum	NL
Betula pumila	Bog Birch	OBL
Bromus arvensis	Field Brome	UPL
Bromus inermis	Smooth Brome	UPL
Bromus japonicus	Japanese Brome	NL
Bromus tectorum	Cheatgrass	NL
Calamagrostis canadensis	Bluejoint	FACW
Calamagrostis stricta	Slim-Stem Reed Grass	FACW
Camelina microcarpa	Little-Pod False Flax	FACU
Carduus nutans	Nodding Plumeless-Thistle	UPL
Carex aquatilis	Leafy Tussock Sedge	OBL
Carex bebbii	**Bebb's Sedge**	**OBL**
Carex nebrascensis	Nebraska Sedge	OBL
Carex sp.	Sedge	NL
Carex stipata	Stalk-Grain Sedge	OBL
Carex utriculata	Northwest Territory Sedge	OBL
Centaurea stoebe	Spotted Knapweed	NL
Cerastium arvense	**Field Mouse-Ear Chickweed**	**FACU**
Chamerion angustifolium	Fireweed	NL
Cirsium arvense	Canadian Thistle	FAC
Cirsium vulgare	Bull Thistle	FACU
Collomia linearis	**Narrow-Leaf Mountain-Trumpet**	**FACU**
Cornus alba	Red Osier	FACW
Crataegus douglasii	Black Hawthorn	FAC
Cynoglossum officinale	**Gypsy-Flower**	**FACU**
Dactylis glomerata	Orchard Grass	FACU
Dasiphora fruticosa	Golden-Hardhack	FAC
Deschampsia caespitosa	Tufted Hairgrass	FACW
Descurainia sophia	Herb Sophia	NL
Eleocharis palustris	Common Spike-Rush	OBL
Elymus canadensis	Nodding Wild Rye	FAC
Elymus glaucus	Blue Wild Rye	FACU
Elymus repens	Creeping Wild Rye	FAC
Epilobium ciliatum	Fringed Willowherb	FACW
Equisetum arvense	Field Horsetail	FAC
Equisetum hyemale	Tall Scouring-Rush	FACW
Erodium cicutarium	Stork's Bill	NL
Euphorbia esula	Leafy Spurge	NL
Festuca idahoensis	Bluebunch Fescue	FACU
Filago arvensis	Field Fluffweed	NL
Fragaria virginiana	Virginia Strawberry	FACU
Glyceria striata	Fowl Manna Grass	OBL
Geum macrophyllum	Large-Leaf Avens	FAC
Geum sp.	Avens	NL
Holcus lanatus	Common Velvet Grass	FAC

Scientific Name	Common Name	WMVC Indicator Status*
Hypericum perforatum	**Common St. John's-Wort**	**FACU**
Juncus balticus	Baltic Rush	FACW
Juncus effusus	Lamp Rush	FACW
Juncus ensifolius	Dagger-Leaf Rush	FACW
Juncus sp.	Rush	NL
Juncus tenuis	Lesser Poverty Rush	FAC
Lactuca serriola	Prickly Lettuce	FACU
Lepidium campestre	Field Pepper-Grass	NL
Leucanthemum vulgare	Ox-Eye Daisy	FACU
Lolium perenne	Perennial Rye Grass	FAC
Lotus corniculatus	Garden Bird's-Foot-Trefoil	FAC
Lupinus sericeus	Pursh's Silky Lupine	NL
Lycopus asper	Rough Water-Horehound	OBL
Maianthemum stellatum	**Starry False Solomon's-Seal**	**FAC**
Medicago lupulina	Black Medick	FACU
Melilotus officinalis	Yellow Sweet-Clover	FACU
Mentha arvensis	American Wild Mint	FACW
Mimulus guttatus	Seep Monkey-Flower	OBL
Myosotis laxa	Bay Forget-Me-Not	OBL
Oenothera villosa	**Hairy Evening-Primrose**	**FAC**
Onopordum acanthium	Scotch Thistle	NL
Pascopyrum smithii	Western-Wheat Grass	FACU
Persicaria amphibia	Water Smartweed	OBL
Persicaria sp.	Smartweed	NL
Phalaris arundinacea	Reed Canary Grass	FACW
Phleum pratense	Common Timothy	FAC
Pinus ponderosa	Ponderosa Pine	FACU
Plantago major	**Great Plantain**	**FAC**
Poa compressa	Flat-Stem Blue Grass	FACU
Poa palustris	Fowl Blue Grass	FAC
Poa pratensis	Kentucky Blue Grass	FAC
Populus angustifolia	Narrow-Leaf Cottonwood	FACW
Populus balsamifera	Balsam Poplar	FAC
Prunella vulgaris	Common Selfheal	FACU
Pseudoroegneria spicata	**Bluebunch Wheatgrass**	**NL**
Ranunculus aquatilis	White Water-Crowfoot	OBL
Ranunculus sp.	Buttercup	NL
Ribes lacustre	Bristly Black Gooseberry	FAC
Rosa woodsii	Woods' Rose	FACU
Rumex acetosella	Common Sheep Sorrel	FACU
Rumex crispus	Curly Dock	FAC
Salix bebbiana	Gray Willow	FACW
Salix exigua	Narrow-Leaf Willow	FACW
Salix lasiandra	Pacific Willow	FACW
Scirpus microcarpus	Red-Tinge Bulrush	OBL
Silene vulgaris	Maiden's-tears	NL
Sisymbrium altissimum	Tall Hedge-Mustard	FACU
Solanum dulcamara	Climbing Nightshade	FAC
Solidago canadensis	Canadian Goldenrod	FACU
Sonchus arvensis	Field Sow-Thistle	FACU
Symphoricarpos albus	Common Snowberry	FACU
Tanacetum vulgare	Common Tansy	FACU
Taraxacum officinale	Common Dandelion	FACU
Thinopyrum intermedium	Intermediate Wheatgrass	NL
Thlaspi arvense	Field Pennycress	UPL
Tragopogon pratensis	Meadow Goat's-beard	NL
Trifolium pratense	Red Clover	FACU
Trifolium repens	White Clover	FAC
Verbascum thapsus	Great Mullein	FACU
Veronica americana	American-Brooklime	OBL

*2016 National Wetland Plant List; *Western Mountains, Valleys, and Coasts* (WMVC) (Lichvar *et al.* 2016)
New species identified in 2017 are **bolded**.

Table 4. Montana State listed noxious weed and regulated species observed in 2017 at the Mill Creek Stream Mitigation Site.

Category*	Scientific Name	Common Name
Priority 2B	*Berteroa incana*	Hoary Alyssum
	Centaurea stoebe	Spotted Knapweed
	Cirsium arvense	Canada Thistle
	Cynoglossum officinale	**Houndstongue**
	Hypericum perforatum	**St. Johnswort**
	Euphorbia esula	Leafy Spurge
	Leucanthemum vulgare	Oxeye Daisy
	Tanacetum vulgare	Common Tansy
Priority 3 State Regulated	*Bromus tectorum*	Cheatgrass

*Based on the Montana Dept. of Agriculture's Noxious Weed List, February 2017
New species identified in 2017 are **bolded.**

4.2. Bank Erosion Inventory

Previous monitoring reports documented four eroding banks within the project reach and two additional eroding banks immediately upstream of the project reach. Locations of all eroding banks are illustrated on Figure 3 in Appendix A. The following section describes bank conditions at each currently and previously mapped eroding bank segment as observed during the 2017 monitoring event.

Banks EBL1 and EBL2 were originally documented as two separate eroding bank segments that combined into one long, 247-foot eroding bank in 2014 (herein referred to as EBL1-2). These eroding bank areas occur on private land upstream of the project reach, but has been documented in previous monitoring reports due to the potential of this bank affecting the project reach. The upper 150 feet of EBL1-2 has shown relatively little change over the past four monitoring years, has migrated northward approximately one foot since 2014 (see Additional Photo 1 in Appendix C). The lower 100 feet of the bank has migrated northward at a more rapid pace than the upper bank segment since 2014, especially in the vicinity of a large ponderosa pine tree that fell into the channel in 2016. The bank has migrated northward approximately six feet in the past year adjacent to the exposed root ball of this tree (see Additional Photo 2 and 8 in Appendix C).

Bank erosion at EBL1-2 is due to adjacent point bar formation forcing the channel against a relatively high, herbaceous vegetated stream bank along a relatively sharp meander bend. Root wads and large rocks placed on, but not keyed into the toe of the banks are causing increased scour against the bank toe. Bank erosion on sharp meander bends is commonly observed in naturally migrating streams with high bedload such as Mill Creek. The vegetation community along these banks include speckled alder, Kentucky bluegrass, smooth brome, sedges, common yarrow, western-wheat grass, Canadian goldenrod, and ox-eye daisy, most of which are upland species less capable of withstanding erosive forces. The bank retreated between 3 and 7 feet from 2013 to 2014 an additional 2-5 feet from 2014 to 2015 and approximately 3-5 feet

further since 2016. Based on the combination of eroding factors, severity of erosion along EBL1-2 is considered high. Although this bank has consistently retreated, it's effect on the restored channel segment below it does not appear to be consequential. Rather, the eroding bank has resulted in the recruitment of large woody debris to the channel, which is beneficial toward the development of diverse aquatic habitat. The alignment of the channel along EBL1-2 has not induced additional erosion further downstream, and as a result of these factors, corrective actions are not warranted.

Signs of active erosion at EBL3 were originally observed in 2014 at the head of the former channel alignment which is now backfilled with gravel, cobble, and soil. Erosion was observed along approximately 90 feet between the upstream extent of the backfill and the root ball of a fallen tree. The vegetation community along this bank consists of short-awn meadow foxtail, white and red clover, Kentucky bluegrass, common tansy, and ox-eye daisy. Erosion along this bank has not advanced in length or continued lateral movement in the past three years (see Additional Photo 3 and 4 in Appendix C). Based on the lack of continued lateral erosion noted since 2014, bank EBL3 has been removed from the list of actively eroding banks and is no longer featured on Figure 3 of Appendix A

Lateral erosion at bank EBL4 appears to have continued over the past two years, as evidenced by the adjacent root balls detaching from the bank (see Additional Photo 5 in Appendix C). The bank has retreated approximately 6-8 feet since 2013, although the eroding bank length of 64 feet has not increased. Bank instability at this location was potentially caused by removal of the trees for use in log revetment construction, or from natural channel adjustments following construction. The dominant vegetation along the bank includes reed canary grass and smooth brome, the former of which offers dense roots capable of withstanding erosion more effectively than most species. Erosion severity along this bank is considered low, as it does not jeopardize any infrastructure elements or the newly installed bridge downstream. As a result of the erosion occurring likely as a result of natural channel adjustments, no corrective actions are warranted at this location.

Eroding bank EBR1 occurs directly across the channel from EBL4. Previous monitoring efforts documented fallen trees both into the channel and away from the channel along this bank, although it appears no additional erosion has occurred along the bank since 2014 (See Additional Photo 6 in Appendix C). Based on the lack of continued bank erosion along EBR1 as noted in the past four years, it has been removed from the list of actively eroding banks and no longer appears on Figure 3 in Appendix A.

Erosion at EBR2 was originally noted in 2014 along 65 feet of the channel across from the head of the deactivated stream channel. Erosion at this location was tied to channel adjustments and scour along the outside of a meander. No additional erosion along this bank segment has been noted over the past three years (see Additional Photo 7 in Appendix C), and as such, it has been removed from the list of actively eroding banks.

A newly eroding bank was observed in 2017 immediately downstream of a woody debris jam. This eroding bank segment, referred to as EBR3 occurs on the outside bank and is characterized by upper bank sloughing and toe scour. Vegetation along the upper bank includes reed canary grass, oxeye daisy, woods rose, wheatgrass, brome, small cottonwood saplings, and young willows. Roots of these species do not extend deep enough to provide sufficient protection from scour during high flows, and the bank appears to have retreated approximately two feet in the past year. The erosion along this bank is resulting from natural channel adjustments to instream habitat development and woody debris recruitment. The total eroding bank length along EBR3 is 47 feet. Erosion along this bank does not currently threaten any infrastructure and its severity is considered low. An updated eroding bank inventory within the Mill Creek project site can be summarized as follows:

Table 5. Eroding bank summary for Mill Creek, 2017.

Bank Segment[1]	Length (ft)	Bank actively Eroding	Bank no longer eroding
EBL3	90		X
EBL4	64	X	
EBR1	58		X
EBR2	65		X
EBR3	47	X	
Total active eroding bank length	111 feet		
Total bank length within project reach	1,450 feet		
Percent of banks actively eroding	8%		

1. Table does not include EBL1-2, as it lies outside of the project boundary.

4.3. Longitudinal Profile and Perpendicular Transect Surveys

A longitudinal profile of the channel thalweg surveyed each year 2014 -2017 is provided in Figure 2, while plots for each surveyed transect are included in Appendix B. Originally, transects #2 and #3 occurred at scour pools formed by woody debris jams, while transects #1 and #4 were surveyed at riffles. A discussion of monitoring results at each transect and longitudinal profile is provided in the following section.

The channel at riffle transect #1 was originally positioned at a riffle; however, survey data from 2013-2015 indicated the channel transitioned to more of a pool feature by forming a point bar on the left side of the channel and thalweg near the right bank. In 2016, a large ponderosa tree fell into the channel just upstream from transect #1, resulting in a mid-channel gravel bar deposit forming near this transect. In 2017, the mid channel bar further developed, nearly causing a split flow during low flows.

Transect #2 was originally established at a pool adjacent to a woody debris jam formed along the left (north) bank. During the past two years, gravel deposits at transect #2

have converted this segment of the channel into a feature more characteristic of a riffle, with relatively constant elevation spanning the channel width. A shallow thalweg continues to persist along the left bank, indicating the channel is scouring more along that side of the channel. The filling of the pool that previously existed here may partially be attributed to the gravel bar forming immediately upstream as a result of the downed ponderosa pine tree.

A deep pool has developed at transect #3 adjacent to a woody debris jam that has formed in the middle of the channel. The pool has deepened by three feet in the past year, providing further evidence that Mill Creek has an ability to naturally scour and deposit stream materials to develop complex habitat. Inspection of the longitudinal profile indicates this transect occurs within what is now the deepest pool within the project reach at Station 3+00.

Transect #4 occurs at a riffle just above the last meander bend upstream of the U.S. Highway 93 Bridge. Repeated surveys at this transect between 2013 and 2017 reveal little adjustment to the stream bed and banks, although the bed appears to have aggraded by 3-4" in the past year. Although gravel has deposited across the width of the channel since 2016, inspection of the longitudinal profile does not indicate widespread aggradation along the downstream extent of the project reach. The deposit across transect #4 is more likely due to the deep pool scour that occurred immediately upstream of the transect. Gravel that scoured from this pool has since deposited in the next riffle downstream, and is likely to continue moving downstream during subsequent flood events.

Inspection of the stream bed longitudinal profile and cross sections at each of the four monitoring transects over the past five years reveal stream bed adjustments are occurring along the length of the relocated channel. Adjustments to the bed and banks of a stream channel like Mill Creek can be attributed to natural erosion and depositional processes that can be affected by woody debris recruitment, point and mid-channel bar formation, and lateral channel adjustments. This reach of Mill Creek, as well as a lengthy segment of channel observed upstream, exhibits many gravel and cobble point bars and islands, which are indicative of a watershed with a large supply of bedload. Observations of the stream banks along the project reach indicates gravel and cobble material is also generated during lateral bank migrations. As a result of the high bedload composition of Mill Creek, the stream bed forms vary from year to year, with scour and depositional processes influenced by evolving meander patterns and woody debris complexes. Creeks transporting a large supply of cobble and gravel tend to laterally migrate more rapidly as bars develop and woody debris is recruited to the channel. The Mill Creek monitoring reach includes several large trees and woody debris complexes, which generate bedform complexity and aquatic habitat variability. As a result of these factors, continued channel adjustments and bank erosion are likely to naturally occur within the monitoring reach, which should be considered a healthy response of the channel to natural alluvial processes. As a result, corrective actions to halt natural bank erosion and bedform diversity in the restored channel segment are unwarranted and the channel should be allowed to naturally develop.

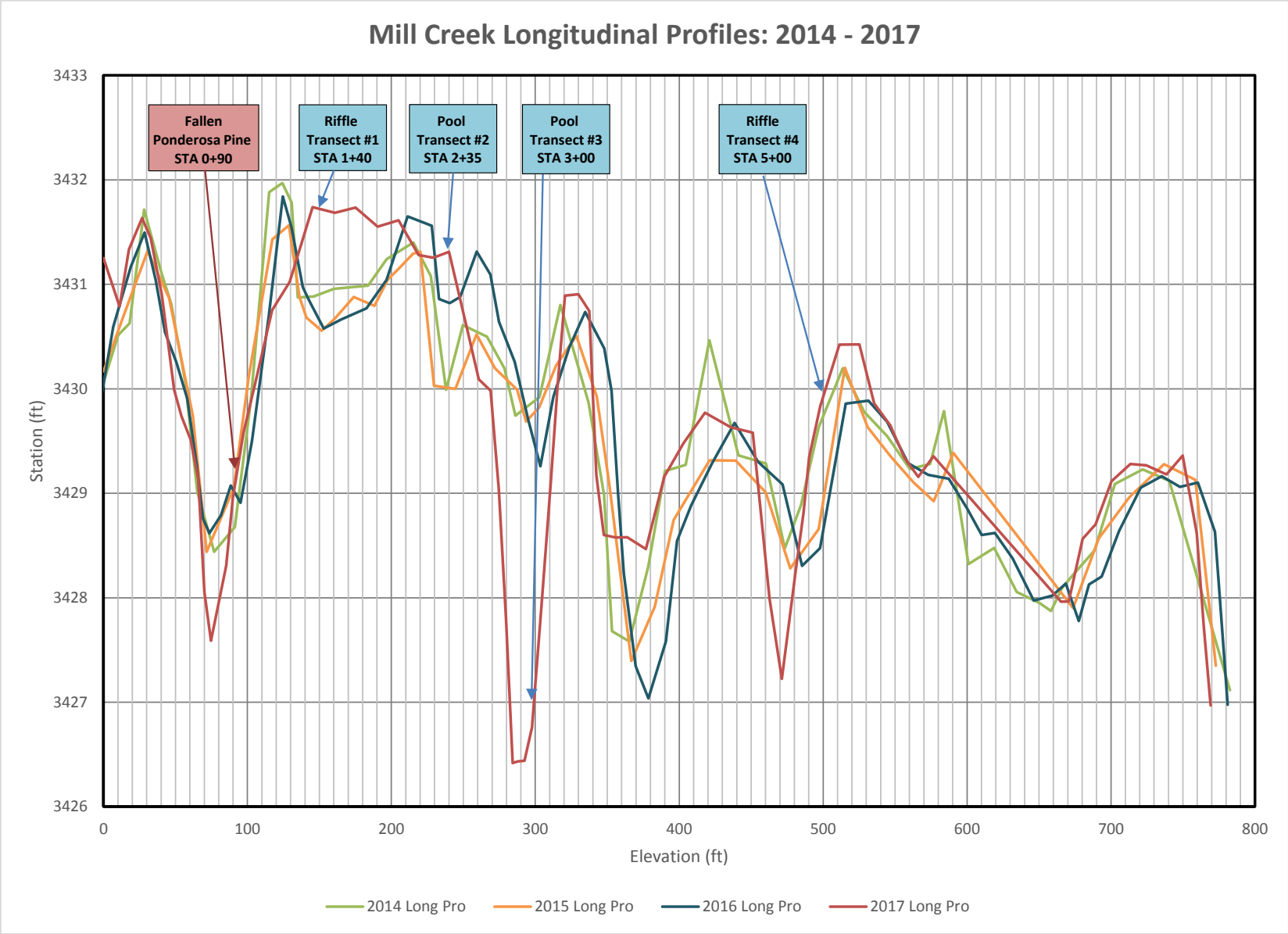


Figure 2. Thalweg longitudinal profile along Mill Creek, 2014 – 2017.

5.0 COMPARISON OF RESULTS TO PERFORMANCE STANDARDS

Monitoring of the Mill Creek Stream Mitigation site is intended to document whether the reconstructed segment of the channel is meeting performance standards outlined in the approved U.S. Army Corps permit for the project. Table 6 summarizes the status of each performance criteria following the fifth year of monitoring and six years following completion of the project. Additional reporting requirements, including results of the perpendicular transects, bed profile survey, photo-documentation, and as-built topographic schematics are included as appendices to this report and offer additional documentation of the site's current condition.

Table 6. Status of performance standards

Parameter	Success Criteria	Status	Meeting Performance Criteria?
Riparian Cover	80% total vegetative coverage after 3rd year	Total vegetative cover of the project site is **84%** following fifth year of monitoring (97% of south bank and 80% of north bank).	Yes
	50% woody species coverage after 3rd year	Woody cover of the project site is **28%** following fifth year of monitoring (62% of south bank and 17% of north bank).	No
Streambank Stability	Unstable banks identified within the project reach will require corrective action	Two eroding bank segments were observed in 2017 totaling 8% of the total bank length within the project reach.	Although erosion is occurring within project reach, it occurs as a result of natural channel processes.

5.1. Riparian Cover

Vegetation along the south bank of Mill Creek was minimally disturbed during construction of the new channel alignment and was limited to a short (approximately 50') reach immediately adjacent to the new highway bridge. This channel segment has been stabilized with rock to protect the bridge infrastructure. Woody vegetation establishment along the north bank has yet to develop as planned.

Total vegetation cover observed along the north bank riparian transect was 80%. Patches of bare ground were observed along the deactivated channel alignment and within and adjacent to noxious weed infestations. Bare ground was also observed beneath mature ponderosa pine trees, although the layer of pine needles beneath these trees is a natural cause for bare ground cover. When factoring in the undisturbed south bank, total vegetation cover across the site was 84%, which exceeds the 80% success threshold for riparian cover throughout the site.

Woody vegetation cover along the north bank was estimated at 17% cover, which falls well below the success criteria threshold of 50%. No woody vegetation was observed along the backfilled channel segment, and few woody shrubs were observed along the north bank of the newly aligned channel. Several mature ponderosa pine trees remain along the north bank and provide the majority of the woody species composition. Woody vegetation cover along the south bank was estimated at 62%. The area weighted average of woody vegetation cover for the north and south bank belt transects

was 28%. Woody vegetation cover meets the performance criterion along the south bank but does not along north bank.

5.2. Bank Erosion Inventory

Three of the four eroding bank segments previously identified within the project reach showed no active erosion over the past three years, and have subsequently been removed from the list of actively eroding banks. Eroding bank EBL4 has continued to erode northward, and a new, 45-foot eroding bank segment was identified within the project reach adjacent to a woody debris jam. Overall, 8% of the total bank length is currently classified as eroding, and can be attributed to natural scour and depositional processes at play within Mill Creek. Neither of the eroding bank segments currently jeopardize highway infrastructure; therefore, repairs are unwarranted.

At least some portion of bank EBL1-2, which lies immediately upstream of the project reach, has continued to erode northward each year since the inaugural monitoring event in 2013. This bank occurs upstream of the relocated channel segment, and has been continuously observed due to its influence on the monitoring reach immediately downstream. The majority of EBL1-2 has eroded between 1-2 feet in the past year, with the exception of the bank segment immediately adjacent to the downed ponderosa pine tree, which has eroded an additional six feet since 2016. While recruitment of woody debris is considered a positive effect on the channel due to its ability to help develop diverse pool and riffle habitats, this tree is large enough to trap other woody material and result in more accelerated channel migration in its vicinity.

The severity of bank erosion within the project reach is considered low due to relatively slow migration rates occurring as a result of natural processes that do not currently jeopardize infrastructure. Erosion along the banks within the project reach are due to processes that occur in naturally functioning channels with high bedload and snowmelt driven hydrology. Bedload deposition and scour created by meander bends and woody debris will continue resulting in minor lateral movement of the stream banks. Given the degree of active erosion currently observed, corrective actions do not seem warranted.

6.0 LITERATURE CITED

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. *Measuring and monitoring plant populations*. Bureau of Land Management (BLM) Technical Reference 1730-1. Washington, DC: U.S. Department of the Interior.

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. *The National Wetland Plant List*: *2016 Update of Wetland Ratings.* Phytoneuron 2016-30: 1-17. Published 28 April 2016. ISSN 2153 733X

Montana Department of Agriculture. *Montana Noxious Weed List*. February 2017. Accessed September 2017 at: http://agr.mt.gov/Portals/168/Documents/Weeds/2017%20Noxious%20Weed%20List.pdf.

Appendix A

Project Maps

MDT Stream Mitigation Monitoring
Mill Creek
Ravalli County, Montana

Legend

- Channel Thalweg
- \+ Major Station (100')
- ○ Minor Station (25')
- Photo Points
- Eroding Banks
- Pool and Riffle Transects
- Riparian Transects

CONFLUENCE
consulting incorporated

2017 Monitoring Features Mill Creek

Figure 3

Date: 9/26/2017

MillCreek_features2017

CONFLUENCE
consulting incorporated

Legend

- *Berteroa incana*
- *Centaurea stoebe*
- *Cirsium arvense*
- *Leucanthemum vulgare*
- *Tanacetum vulgare*

N

0 25 50 100 150 200 Feet

2017 Monitoring Noxious Weeds Mill Creek

Figure 4

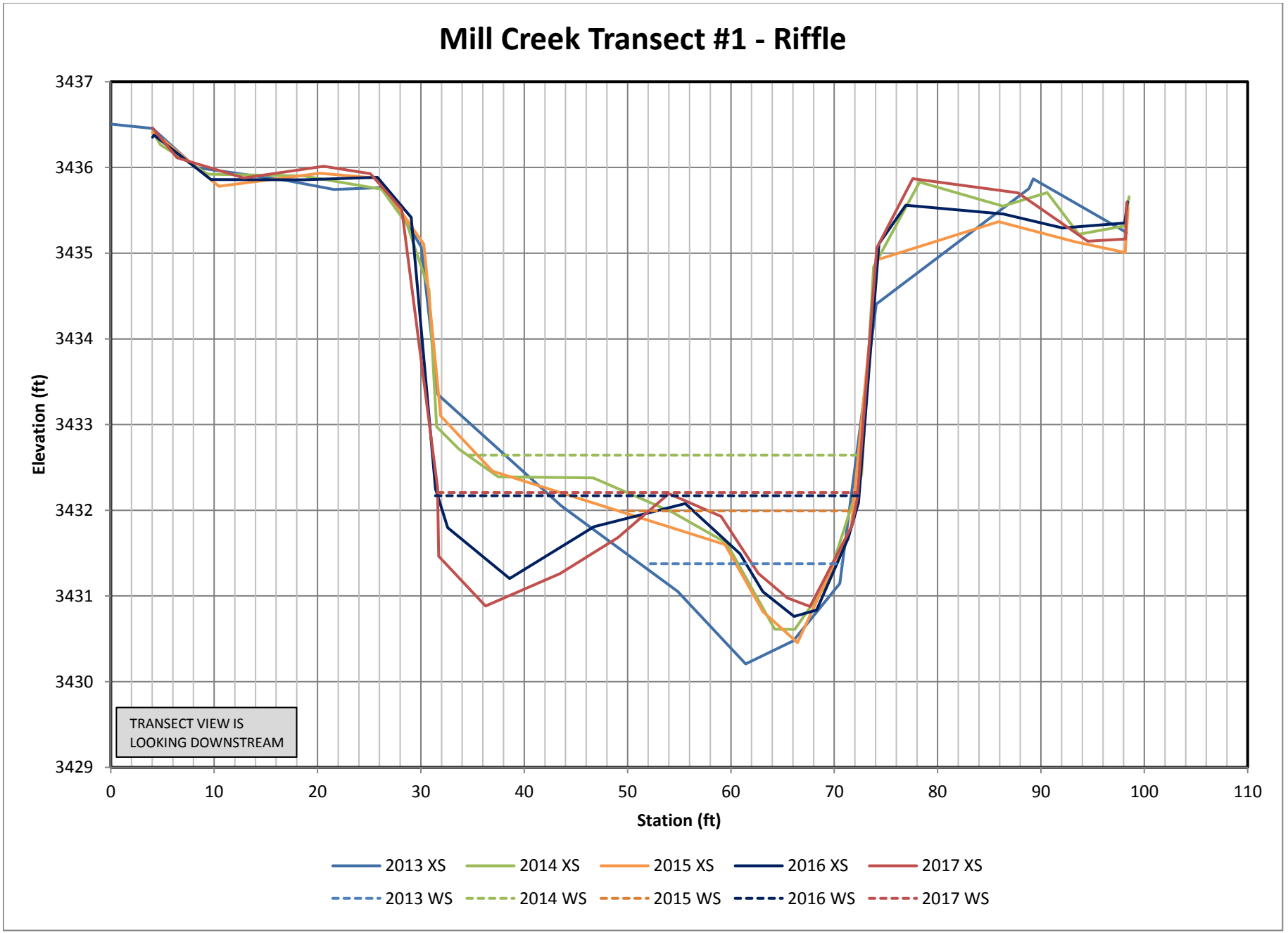
Date: 09/12/2017

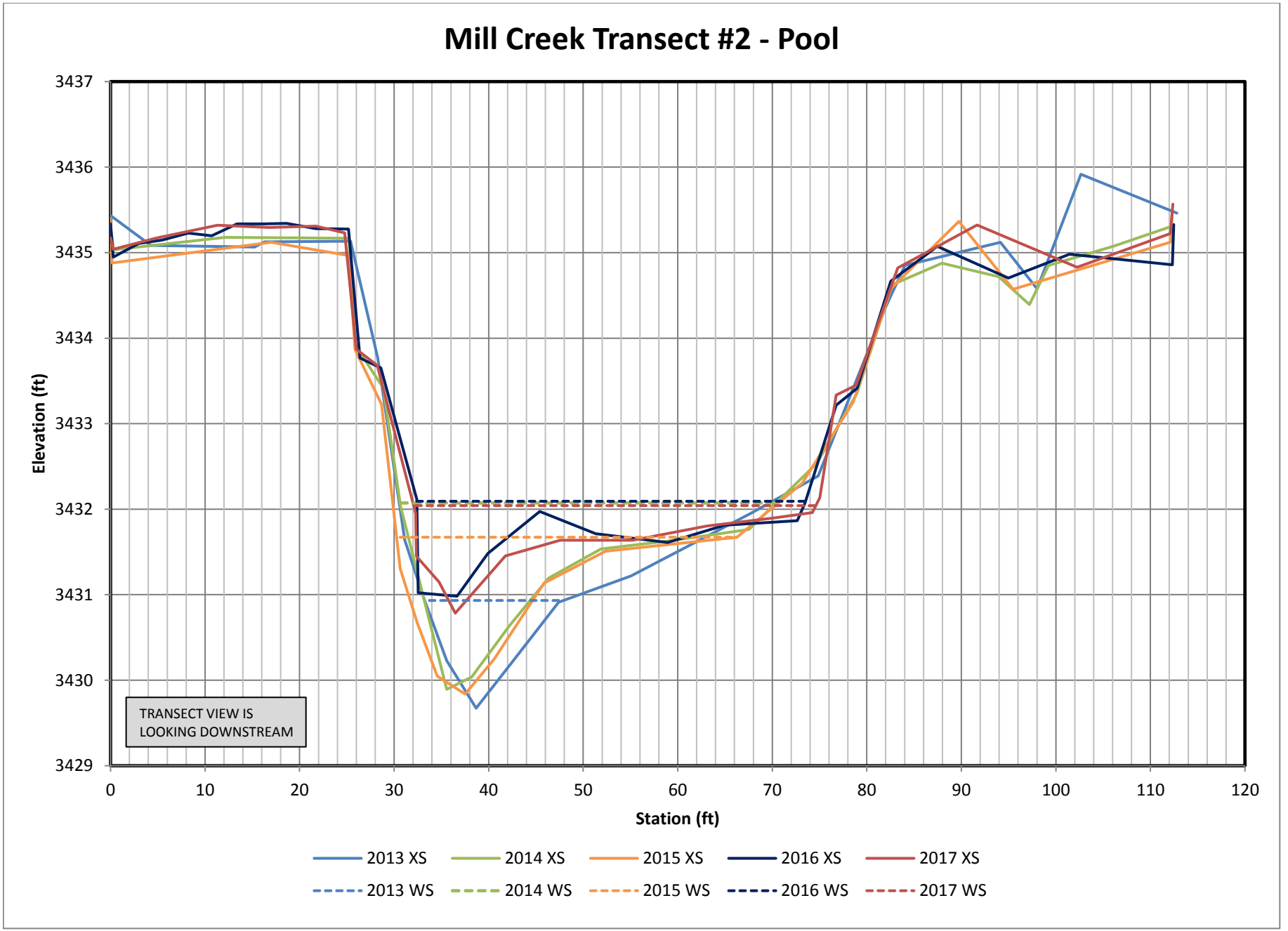
MillCreek_Weeds2017.mxd

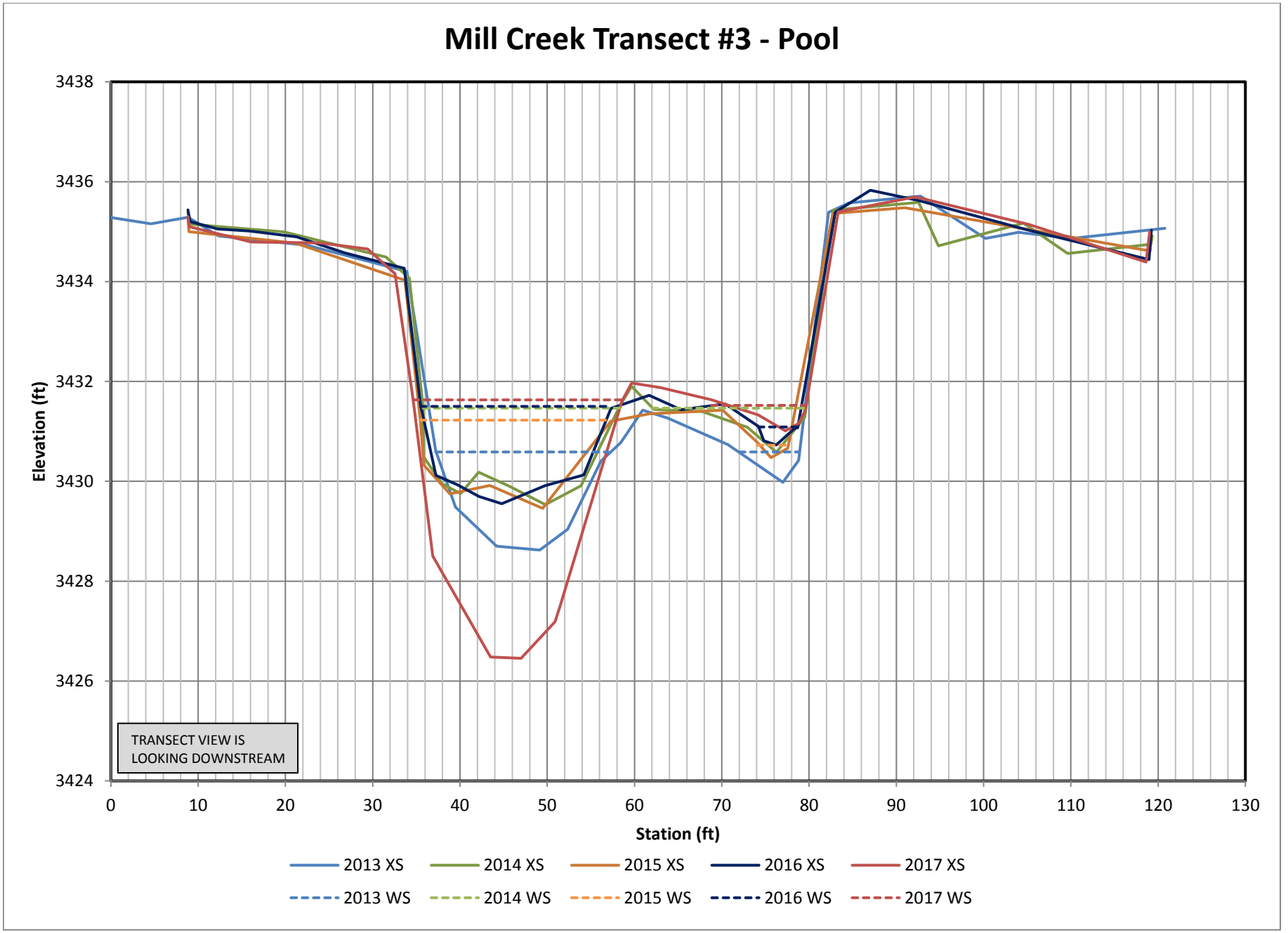
Appendix B

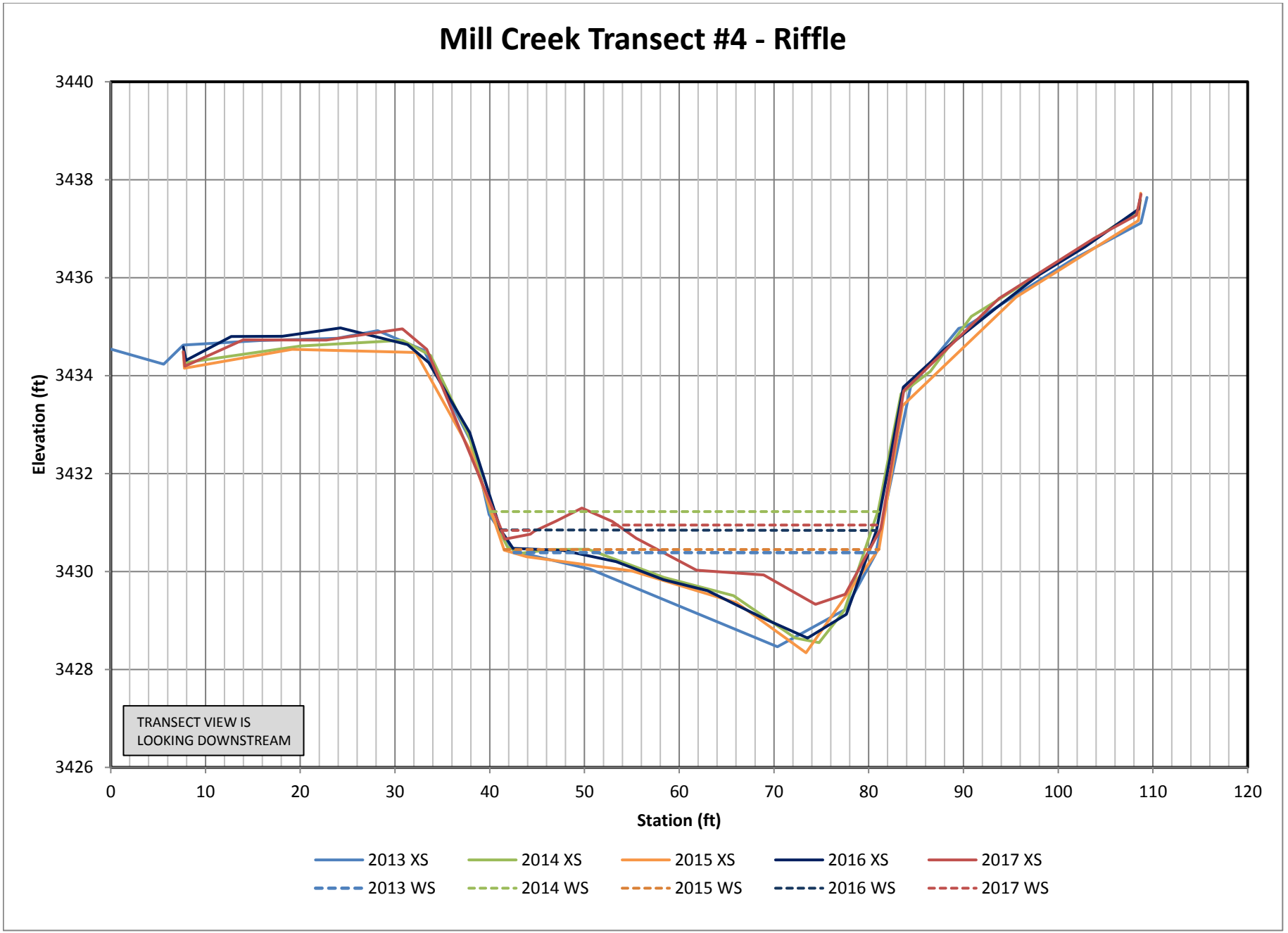
Perpendicular Transect and Longitudinal Profile Plots

MDT Stream Mitigation Monitoring
Mill Creek
Ravalli County, Montana


Mill Creek Transect #1 - Riffle
Elevation (ft)
3437
3436
3435
3434
3433
3432
3431
3430
3429
0
10
20
30
40
50
60
70
80
90
100
110
Station (ft)
TRANSECT VIEW IS LOOKING DOWNSTREAM
2013 XS
2014 XS
2015 XS
2016 XS
2017 XS
2013 WS
2014 WS
2015 WS
2016 WS
2017 WS


Mill Creek Transect #2 - Pool
Elevation (ft)
3437
3436
3435
3434
3433
3432
3431
3430
3429
0
10
20
30
40
50
60
70
80
90
100
110
120
Station (ft)
TRANSECT VIEW IS LOOKING DOWNSTREAM
2013 XS
2014 XS
2015 XS
2016 XS
2017 XS
2013 WS
2014 WS
2015 WS
2016 WS
2017 WS


Mill Creek Transect #3 - Pool
Elevation (ft)
3438
3436
3434
3432
3430
3428
3426
3424
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Station (ft)
TRANSECT VIEW IS LOOKING DOWNSTREAM
2013 XS
2014 XS
2015 XS
2016 XS
2017 XS
2013 WS
2014 WS
2015 WS
2016 WS
2017 WS


Mill Creek Transect #4 - Riffle
Elevation (ft)
3440
3438
3436
3434
3432
3430
3428
3426
0
10
20
30
40
50
60
70
80
90
100
110
120
Station (ft)
TRANSECT VIEW IS
LOOKING DOWNSTREAM
2013 XS
2014 XS
2015 XS
2016 XS
2017 XS
2013 WS
2014 WS
2015 WS
2016 WS
2017 WS

Appendix C

Project Site Photos

MDT Stream Mitigation Monitoring
Mill Creek
Ravalli County, Montana

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 1.1: View east (downstream) of Hwy 93 Bridge. **Compass**: 45 (Northeast)

2013 **2017**

Photo Point 1.2: View from southeast corner of bridge looking downstream. **Compass**: 45 (Northeast)

2013 **2017**

Photo Point 2.1: View across channel from west side of bridge . **Compass:** 113 (East-Southeast)

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 2.2: View from west side of bridge looking across stream channel. **Compass**: 225 (Southwest)

2013 **2017**

Photo Point 2.3: View from Photo Point 2 looking upstream. **Compass**: 248 (West-Southwest)

2013 **2017**

Photo Point 2.4: View of deactivated channel alignment **Compass**: 270 (West)

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 2.5: View of deactivated channel alignment. **Compass**: 248 (West-Southwest)

2013 **2017**

Photo Point 3.1: View of deactivated channel segment from Photo point 3. **Compass**: 68 (East-Northeast)

2013 **2017**

Photo Point 3.2: View of deactivated channel plug**. Compass**: 45 (East)

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 3.3: View of deactivated channel plug from Photo Point 3. **Compass**: 0 (North)

2013 **2017**

Photo Point 3.4: View of deactivated channel plug from Photo Point 3. **Compass**: 315 (Northwest)

2013 **2017**

Photo Point 3.5: View of upstream extent of deactivated channel segment **Compass**: 270 (West)

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 3.6: View of north bank (foreground) and woody debris in the channel. **Compass**: 248 (WSW)

2013 **2017**

Photo Point 3.7: View of north bank (foreground) and woody debris in the channel. **Compass**: 180 (South)

2013 **2017**

Photo Point 3.8: View looking across deactivated channel segment. **Compass**: 90 (East)

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 4.2: View across stream channel toward south bank. **Compass**: 180 (South)
Note: toppled Ponderosa pine tree obscures view on left side of photo

2013 **2017**

Photo Point 4.3: View of point bar formation from Photo Point 4. **Compass**: 225 (Southwest)

2013 **2017**

Photo Point 4.4: View of boulders, logs, and root wads placed on bank. **Compass**: 248 (West-Southwest)

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 5.1: View looking upstream of south bank taken from bridge. **Compass**: 248 (West-Southwest)

2013 **2017**

Photo Point 5.2: View looking upstream from bridge. **Compass**: 203 (South-Southwest)

2013 **2017**

Photo Point 5.3: View looking upstream from bridge. **Compass**: 203 (South-Southwest)

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

2013

2017

Additional Photo 1:EUpper end of eroding Bank EBL1 -2

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

2013

2017

Additional Photo 2: Lower end of eroding Bank EBL1-2

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2014 and 2017 Monitoring Events

2014

2017

Additional Photo 3: Upper section of Eroding Streambank EBL3

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2014 and 2017 Monitoring Events

CONFLUENCE

2014

2017

Additional Photo 4: Lower section of Eroding Streambank EBL3

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Additional Photo 5: Eroding streambank EBL4

2013 **2017**

Additional Photo 6: Eroding streambank EBR1

2013 **2017**

Additional Photo 7: Eroding streambank EBR2

PHOTO INFORMATION

PROJECT NAME: Mill Creek Stream Mitigation Site

DATE: 2016 and 2017 Monitoring Events

2016

2017

Additional Photo 8: Ponderosa pine in channel near downstream end of EBR2

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T1 LOOKING NORTH UPSTREAM FROM T1 SOUTH

T1 LOOKING SOUTH DOWNSTREAM FROM T1 NORTH

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T1 LOOKING WEST UPSTREAM FROM SOUTH BANK

T1 LOOKING EAST DOWNSTREAM FROM SOUTH BANK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T1 LOOKING WEST UPSTREAM FROM MIDDLE OF CREEK

T1 LOOKING EAST DOWNSTREAM FROM MIDDLE OF CREEK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T1 LOOKING WEST UPSTREAM FROM NORTH BANK

T1 LOOKING EAST DOWNSTREAM FROM NORTH BANK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T2 LOOKING NORTH UPSTREAM FROM T2 SOUTH

T2 LOOKING SOUTH DOWNSTREAM FROM T2 NORTH

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T2 LOOKING WEST UPSTREAM FROM SOUTH BANK

T2 LOOKING EAST DOWNSTREAM FROM SOUTH BANK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T2 LOOKING WEST UPSTREAM FROM MIDDLE OF CREEK

T2 LOOKING EAST DOWNSTREAM FROM MIDDLE OF CREEK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T2 LOOKING WEST UPSTREAM FROM NORTH BANK

T2 LOOKING EAST DOWNSTREAM FROM NORTH BANK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T3 LOOKING NORTH UPSTREAM FROM T3 SOUTH

T3 LOOKING SOUTH DOWNSTREAM FROM T3 NORTH

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T3 LOOKING WEST UPSTREAM FROM SOUTH BANK

T3 LOOKING EAST DOWNSTREAM FROM SOUTH BANK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T3 LOOKING WEST UPSTREAM FROM MIDDLE OF CREEK

T3 LOOKING EAST DOWNSTREAM FROM MIDDLE OF CREEK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T3 LOOKING WEST UPSTREAM FROM NORTH BANK

T3 LOOKING EAST DOWNSTREAM FROM NORTH BANK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T4 LOOKING NORTH UPSTREAM FROM T4 SOUTH

T4 LOOKING SOUTH DOWNSTREAM FROM T4 NORTH

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T4 LOOKING WEST UPSTREAM FROM SOUTH BANK

T4 LOOKING EAST DOWNSTREAM FROM SOUTH BANK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T4 LOOKING WEST UPSTREAM FROM MIDDLE CREEK

T4 LOOKING EAST DOWNSTREAM FROM MIDDLE CREEK

PROJECT NAME: 2017 MDT STREAM MITIGATION—MILL CREEK

DATE: 7-19-17

T4 LOOKING WEST UPSTREAM FROM NORTH BANK

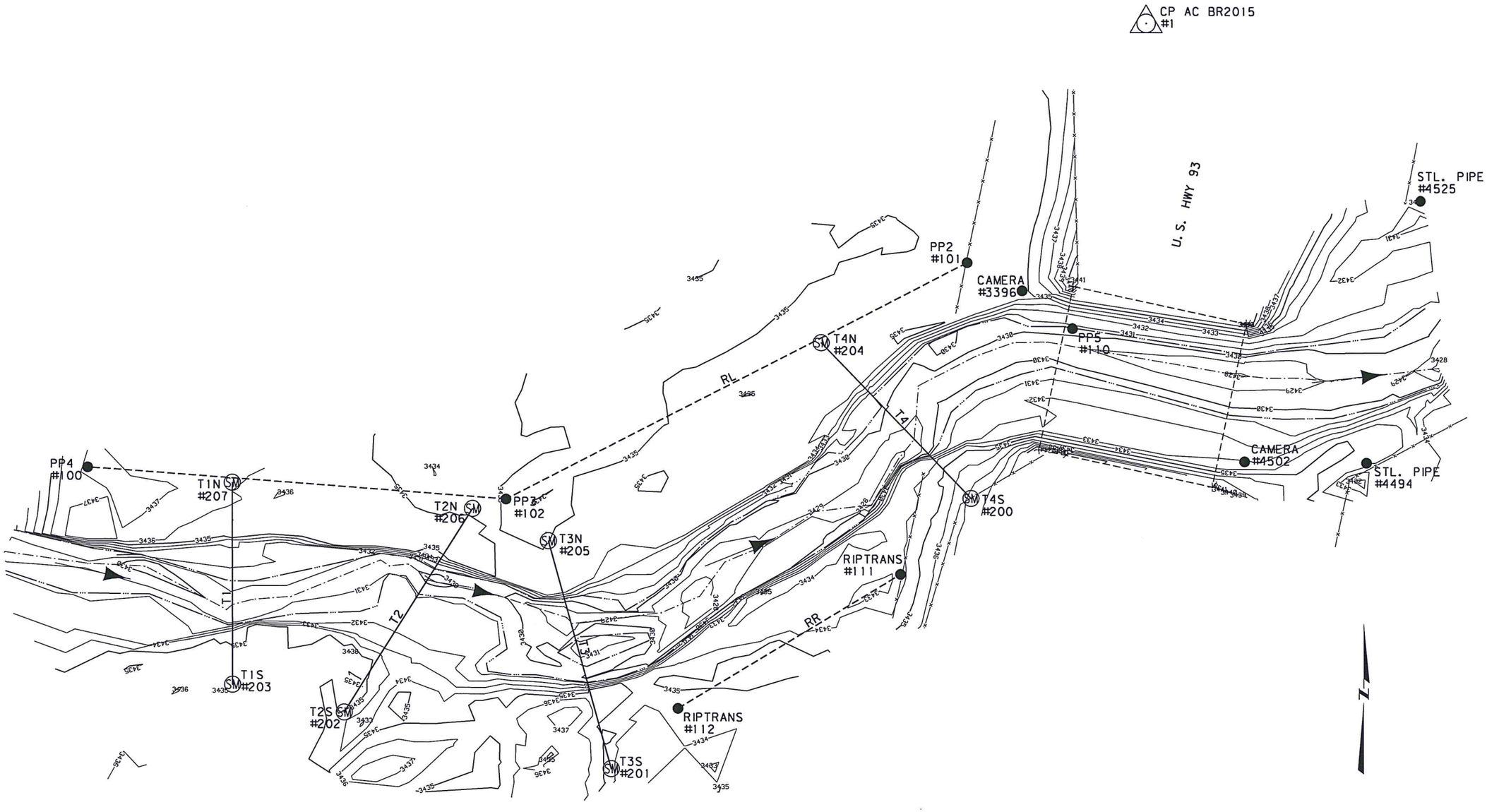
T4 LOOKING EAST DOWNSTREAM FROM NORTH BANK

Appendix D

As-Built Surveys & Planting Schematics

MDT Stream Mitigation Monitoring
Mill Creek
Ravalli County, Montana

CONTROL TABLE				
PNT#	NORTHING	EASTING	ELEV.	DESCRIPTION
1	800550.322	796062.299	3440.783	CP AC BR2015
2	799324.627	795743.954	3443.762	CP AC BS2015



SURVEYOR NOTES:

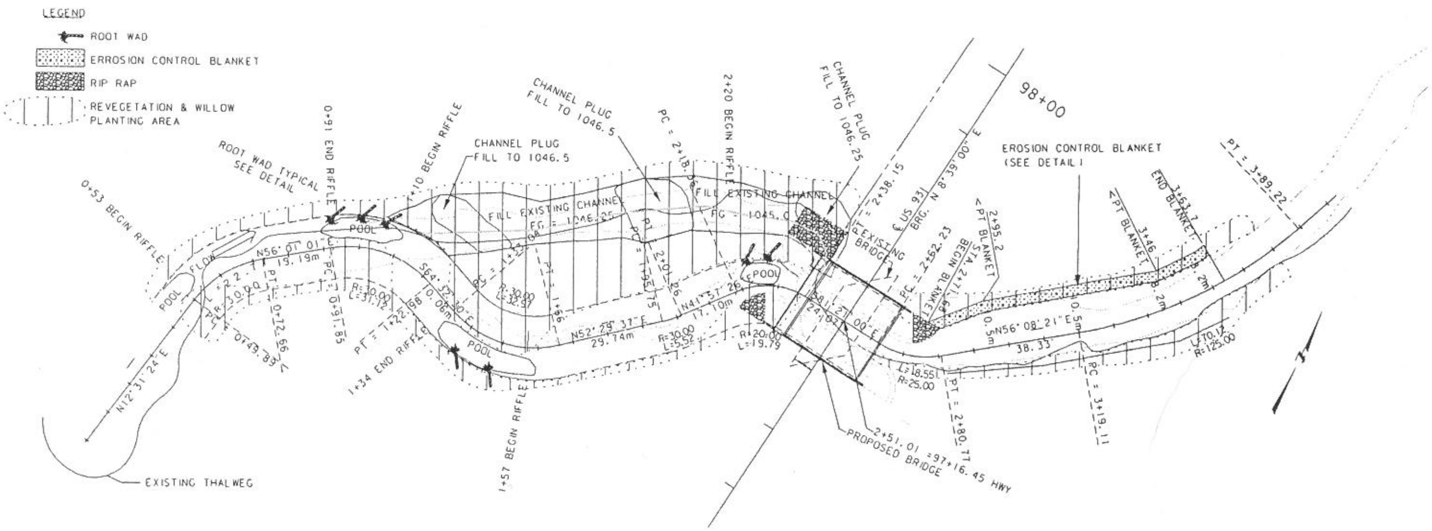
1. THIS SURVEY IS BASED ON FOUND MDT ALUMINUM CAPS STAMPED BR2015 AND BS2015 BUT THEY DO NOT HAVE ESTABLISHED MDT COORDS AND ELEVATIONS. THEREFORE LOCAL CONTROL WAS ESTABLISHED FOR THIS SITE WITH TRIMBLE GPS RTK SURVEY AND THE APPROXIMATE ASSUMED ELEVATION AT MDT ALUM CAP BR2015.
2. THE COORDINATES SHOWN HEREON ARE BASED ON MONTANA STATE PLANE GRID

0 25 50 75 100

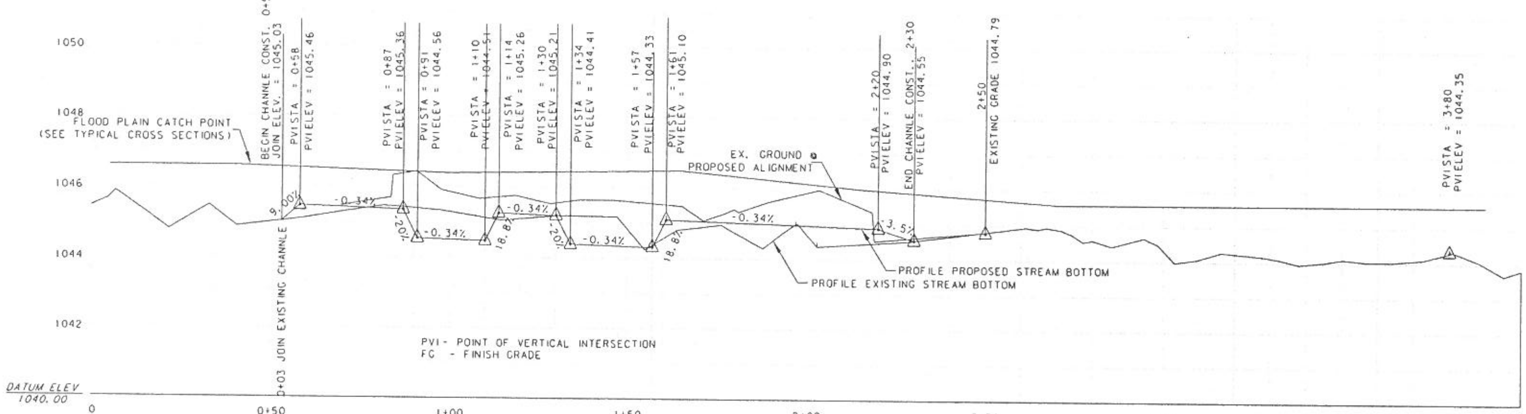
3	MDT MONTANA DEPARTMENT OF TRANSPORTATION	...\MILL CREEK\MillcreekPLAN .dgn	DESIGNED BY	ARNE W		MILL CREEK TOPO	MDT STREAM MITIGATION MONITORING SURVEY
2		12/9/2013	REVIEWED BY				
1		11:04:43 AM awiebe	CHECKED BY	LARRY R			

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	NH 7-1(94)54	24

BEAR CREEK ROAD - SOUTH



PLAN



PROFILE

COORDINATE TABLE

STATION		NORTHING	EASTING
0+00.00	POT	30 048.8339	55 813.2378
0+49.89	PC	30 097.5369	55 824.0557
0+61.86	PI	30 109.2191	55 826.6506
0+72.66	PT	30 115.9079	55 836.5735
0+91.85	PC	30 126.6342	55 852.4861
1+08.98	PI	30 136.2068	55 866.6871
1+22.98	PT	30 128.8451	55 882.1502
1+33.04	PC	30 124.5211	55 891.2326
1+51.41	PI	30 116.6240	55 907.8201
1+66.00	PT	30 127.8094	55 922.3938
1+95.75	PC	30 145.9183	55 945.9883
1+98.51	PI	30 147.6025	55 948.1827
2+01.26	PT	30 149.6596	55 950.0321
2+18.36	PC	30 162.3748	55 961.4637
2+29.15	PI	30 170.3985	55 968.6774
2+38.15	PT	30 168.7758	55 979.3445
2+62.23	PC	30 165.1551	56 003.1444
2+71.95	PI	30 163.6925	56 012.7585
2+80.77	PT	30 169.1110	56 020.8338
3+19.11	PC	30 190.4690	56 052.6647
3+55.11	PI	30 210.5314	56 082.5648
3+89.22	PT	30 243.4254	56 097.2103
4+03.47	POT	30 256.4436	56 103.0064

MILL CREEK
CHANNEL
RESTORATION
DETAIL
STA. 97+16
SHEET 1 OF 3
NO SCALE

LAND & WATER CONSULTING, INC.

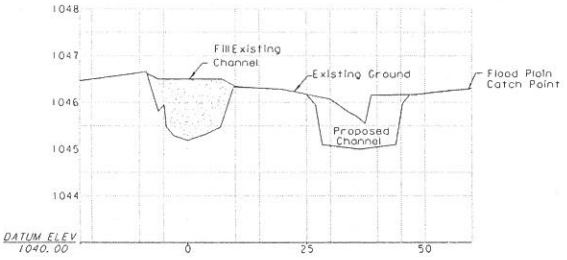
MONTANA CADD

MDT MONTANA DEPARTMENT OF TRANSPORTATION

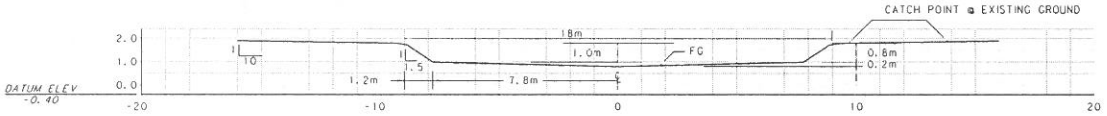
c:\dgn\a015rodel207.dgn
2/17/2011
12:09:18 PM
2 | 3 | EPS - U2160

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	NH 7-1194154	25

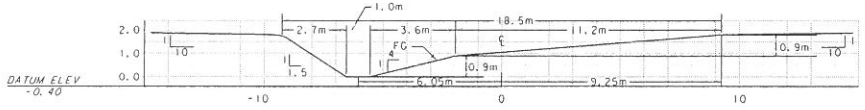
BEAR CREEK ROAD - SOUTH



CROSS SECTIONS 1+97



TYPICAL RIFFLE CROSS SECTION



TYPICAL POOL LEFT CROSS SECTION

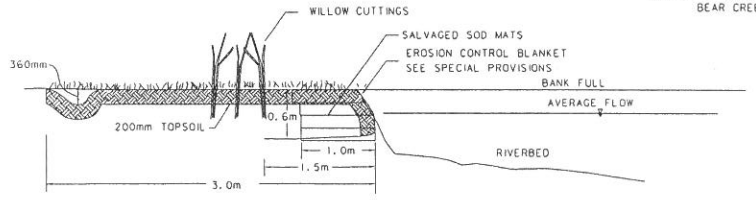
NOTES:

① SEE PLANS FOR POOL LOCATION. POOL LEFT (PL) SHOWN; MIRROR ABOUT CENTERLINE (℄) FOR POOL RIGHT LOOKING DOWNSTREAM.

② TRANSITION 4.0m BETWEEN POOL ↕ RIFFLE.

③ ROUND SLOPES FOR NATURAL APPEARANCE.

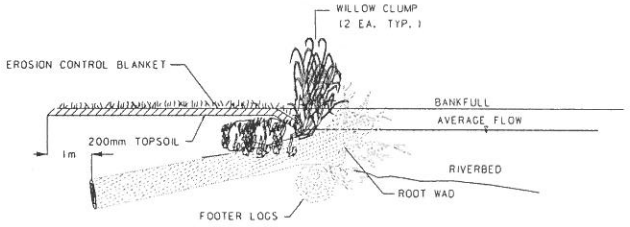
STATION From	STATION To	POOL LEFT	RIFFLE (INCLUDES 4m TRANSITION)	POOL RIGHT
0+00	0+53			
0+53	0+91		X	
0+91	1+10	X		
1+10	1+34		X	
1+34	1+57			X
1+57	2+20		X	
2+20	2+30	X		
2+30	5+00			



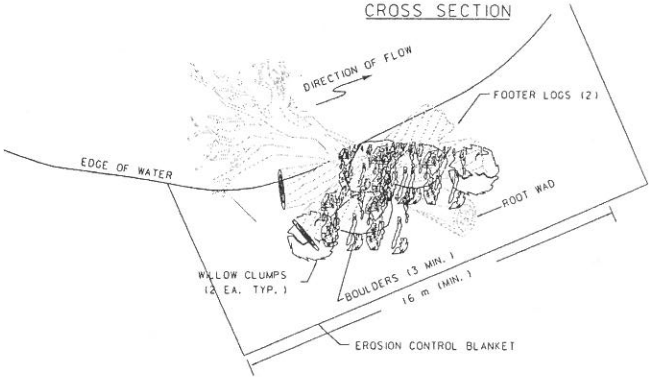
1. SUB EXCAVATE BANKS 0.6 METERS.
2. LAY LOWER BLANKET MINIMUM 1.5 METERS FROM EDGE OF BANK.
3. BACK FILL WITH NATIVE MATERIAL AND 0.2 METERS TOPSOIL.
4. FACE STREAM BANK BACKFILL WITH 1.0 METERS OF SALVAGED SOD MATS.
5. WRAP BLANKET AND EXTEND 3.0 METERS MIN. FROM BANK EDGE.

EROSION CONTROL BLANKET TYPICAL

MILL CREEK



CROSS SECTION



PLAN

ROOT WAD TYPICAL

MILL CREEK

MILL CREEK CHANNEL RESTORATION DETAIL
STA. 97+16
SHEET 2 OF 3
NO SCALE

MONTANA DEPARTMENT OF TRANSPORTATION
MDT
MONTANA CADD
LAND & WATER CONSULTING, INC.

G:\lgm\0715\dwf\07_dwg
2/17/2017
12:09:20 PM
1 = 1 EPS - 10160