
MONTANA DEPARTMENT OF TRANSPORTATION STREAM MITIGATION MONITORING REPORT

*Sweathouse Creek
Ravalli County, Montana*

*Year Project Completed: 2011
Monitoring Report #4: December, 2016*



Prepared for:



Prepared by:



MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT #4

YEAR 2016

*Sweathouse Creek
Ravalli County, Montana*

MDT Project Number: NH 7-1(114)59
Control Number: CN 2015004

USACE Permit Number: NOW-1997-90821
SPA Number: MDT-R2-15-2010

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Cover Photo: Realigned channel of Sweathouse Creek taken in July, 2016.

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1.0 INTRODUCTION

The following report presents results of the fourth year of post stream re-construction monitoring at the U.S. Highway 93 stream crossing at Sweathouse 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. The project was constructed in 2011; therefore, these results provide documentation of the site's condition five years following the project's completion.

As part of the U.S. Army Corps of Engineers (USACE) 404 permit application, the Montana Department of Transportation (MDT) requested authorization for a bridge removal and replacement over Sweathouse Creek, a channel alignment modification on Sweathouse Creek, removal and replacement of six irrigation siphons, and wetland fill at various locations throughout the project. The Sweathouse crossing included replacing the 30-foot wide bridge with a 96-foot wide bridge, backfilling a 394-foot section of Sweathouse Creek and constructing a new channel alignment 397 feet long with three root wads on the left bank and four root wads on the right bank. The USACE permit requires 5 years of annual monitoring of streambank stability and riparian vegetation areal coverage.

Performance standards outlined in the mitigation plan for the Sweathouse Creek crossing at U.S. Highway 93 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 included 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. **Perpendicular transects** – establishment of 4 transects 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.

Monitoring methods used to document the site's conditions are described in Section 3; results of the fourth year of monitoring in 2016 are presented in Section 4, and are

compared to the adopted performance standards in Section 5. Additional site information including plots of perpendicular transect and longitudinal profile surveys, photo logs, and as-built schematics are included as appendices to this report.

2.0 SITE LOCATION

The project reach includes approximately 330 feet of Sweathouse Creek, extending 30 feet upstream and 200 feet downstream from the U.S. Highway 93 Bridge (100 feet beneath the bridge). The new bridge is approximately 0.25 miles north of Victor, Montana. The project site is located in Section 30, Township 8 North, Range 20 West in Ravalli County, Montana (Figure 1).

3.0 MONITORING METHODS

Monitoring field crews visited the project site on July 25, 2016 while survey crews visited the site on July 28, 2016. In order to document the site's condition as compared to the performance standards and meet all other monitoring requirements, the following data were collected:

3.1. Riparian Vegetation Inventory - Belt Transects

Visual estimates of total vegetation, woody vegetation, and noxious weeds were performed within riparian belt transects that extended 25 feet on either side of the active stream channel. Percent cover was recorded for each vegetation category based on ocular estimates. The belt transect on the right (south) bank runs parallel to the downstream extent of the project reach for 200 feet, while the riparian transect on the left (north) bank is 114 feet long (Figure 2, Appendix A).

3.2. Bank Erosion Inventory

Both stream banks within the project reach were visually inspected to document eroding banks. Each eroding bank within the project reach was photo-documented. Data collected at eroding banks included bank length, photographs and potential causes of bank erosion.

3.3. Perpendicular Transects

Four perpendicular transects (cross sections) established in 2013 were re-surveyed to document whether the channel adjusted vertically or laterally. Transects were positioned at two riffles and two pools to document variability in aquatic habitat and channel dimensions. These habitat features did not necessarily exist 75' apart; therefore the spacing between transects varied from that suggested in the additional reporting requirements for this monitoring site.

3.4. Longitudinal Profile

A longitudinal profile of the channel thalweg was surveyed to document bedform complexity and aquatic habitat conditions present within the monitoring reach.

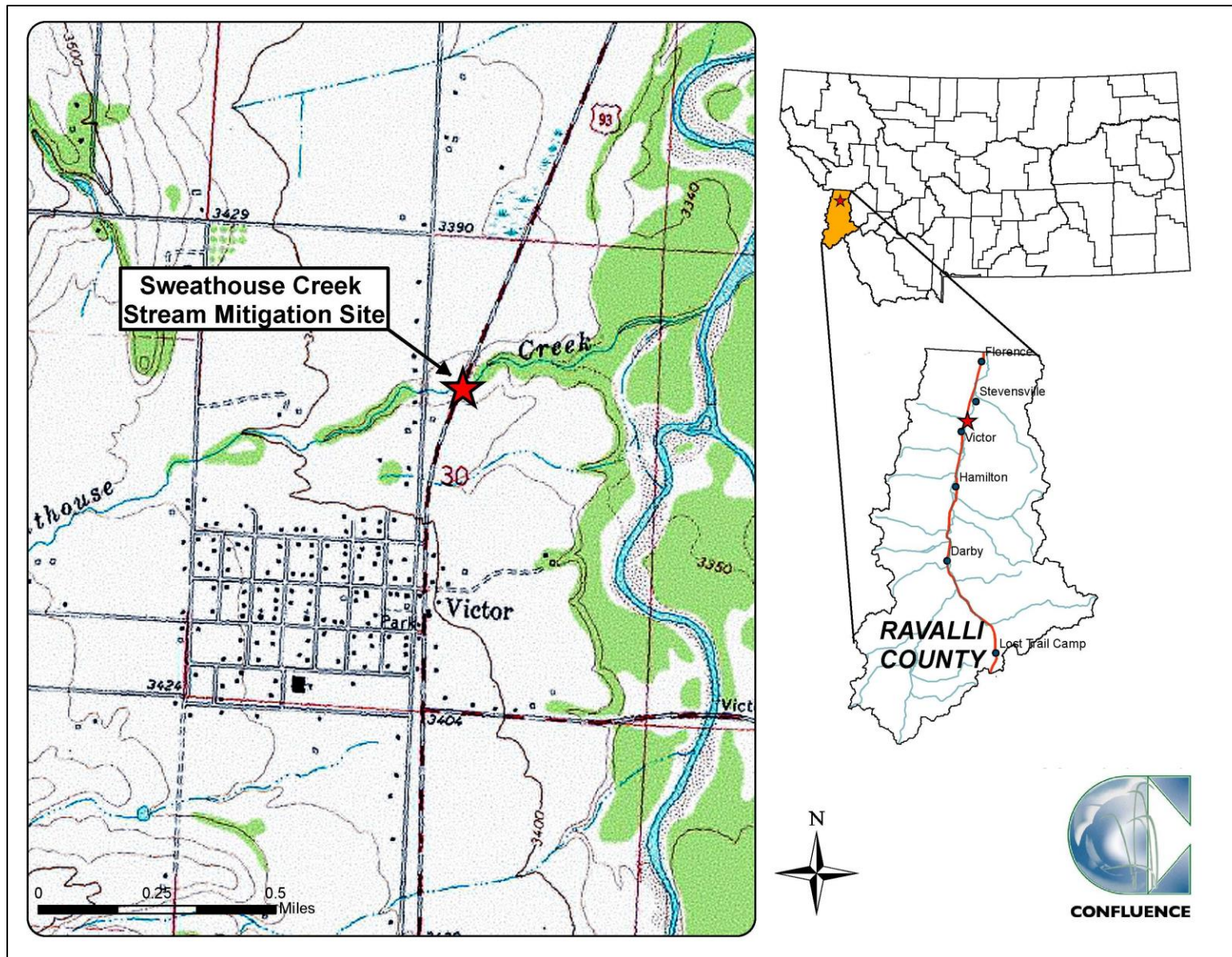


Figure 1. Project location of Sweathouse Creek stream mitigation site.

3.5. Photo-Documentation

Photos were taken at seven photo points established during the first monitoring event in 2013 to document vegetation establishment and stream bank conditions within the project site. Photos were also taken at each perpendicular cross section in the upstream and downstream direction, as well as toward each stream bank.

4.0 RESULTS

4.1. Riparian Vegetation Inventory

The two riparian belt transects included a 200-foot transect along the right (south) side of the channel running from the Highway 93 Bridge to the downstream extent of the project reach, and a 114-foot transect on the left (north) bank. The extents of the riparian transects are illustrated on Figure 2 in Appendix A. Table 1 summarizes the vegetation composition of each riparian transect, including areal percent cover of total vegetation, woody vegetation, and noxious weeds. In 2016, the total percent riparian cover remained at 97%, and included 86% cover by herbaceous species and 11% by woody species. Noxious weed cover rose from 4% in 2013 to 8% in 2016.

Table 1. Percent cover of riparian belt transects at the Sweathouse Creek site from 2013 through 2016.

Belt Transect	Length (ft)	Total % Riparian Cover				% Woody Cover				% Noxious Weed Cover			
		2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
Right (south bank)	200	97	96	97	97	14	10	12	12	5	5	5	7
Left (north bank)	114	98	98	98	98	7	7	10	10	3	3	8	10
Total	334	97	97	97	97	11	9	11	11	4	4	6	8

Table 2 includes a comprehensive list of plant species observed along the new channel alignment and riparian buffer areas. In 2016, 116 species were observed, representing an increase of 17 species since 2015, 31 species since 2014, and 61 species since the initial monitoring event in 2013. In 2016, 53% of the species observed were hydrophytic based on the 2016 National Wetland Plant List (NWPL) (Lichvar et al., 2016).

Table 2. Comprehensive list of plant species identified at the Sweathouse Creek stream mitigation site from 2013 through 2016.

Scientific Name	Common Name	WMVC Indicator Status*	Scientific Name	Common Name	WMVC Indicator Status*
<i>Achillea millefolium</i>	Common Yarrow	FACU	<i>Medicago lupulina</i>	Black Medick	FACU
<i>Agropyron cristatum</i>	Crested Wheatgrass	NL	<i>Medicago sativa</i>	Alfalfa	UPL
<i>Agrostis scabra</i>	Rough Bent	FAC	<i>Melilotus albus</i>	White Sweetclover	NL
<i>Agrostis stolonifera</i>	Spreading Bent	FAC	<i>Melilotus officinalis</i>	Yellow Sweet-Clover	FACU
<i>Algae, brown</i>	Algae, brown	NL	<i>Mentha arvensis</i>	American Wild Mint	FACW
<i>Algae, green</i>	Algae, green	NL	<i>Mimulus guttatus</i>	Seep Monkey-Flower	OBL
<i>Alnus incana</i>	Speckled Alder	FACW	<i>Myriophyllum</i> sp.	Water-Milfoil	NL
<i>Alopecurus aequalis</i>	Short-Awn Meadow-Foxtail	OBL	<i>Oenothera villosa</i>	Hairy Evening-Primrose	FAC
<i>Alopecurus pratensis</i>	Field Meadow-Foxtail	FAC	<i>Onopordum acanthium</i>	Scotch Thistle	NL
<i>Alyssum alyssoides</i>	Pale Alyssum	NL	<i>Pascopyrum smithii</i>	Western-Wheat Grass	FACU
<i>Arctium minus</i>	Lesser Burdock	UPL	<i>Persicaria amphibia</i>	Water Smartweed	OBL
<i>Betula pumila</i>	Bog Birch	OBL	<i>Persicaria</i> sp.	Smartweed	NL
<i>Bromus tectorum</i>	Cheatgrass	NL	<i>Phalaris arundinacea</i>	Reed Canary Grass	FACW
<i>Calamagrostis canadensis</i>	Buejoint	FACW	<i>Phleum pratense</i>	Common Timothy	FAC
<i>Carex aquatilis</i>	Leafy Tussock Sedge	OBL	<i>Plantago lanceolata</i>	English Plantain	FACU
<i>Carex</i> sp.	Sedge	NL	<i>Plantago major</i>	Great Plantain	FAC
<i>Carex stipata</i>	Stalk-Grain Sedge	OBL	<i>Poa palustris</i>	Fowl Blue Grass	FAC
<i>Carex utriculata</i>	Northwest Territory Sedge	OBL	<i>Poa pratensis</i>	Kentucky Blue Grass	FAC
<i>Centaurea stoebe</i>	Spotted Knapweed	NL	<i>Populus angustifolia</i>	Narrow-Leaf Cottonwood	FACW
<i>Cerastium</i> sp.	Chickweed	NL	<i>Populus balsamifera</i>	Balsam Poplar	FAC
<i>Chenopodium album</i>	Lamb's-Quarters	FACU	<i>Populus tremuloides</i>	Quaking Aspen	FACU
<i>Cicuta douglasii</i>	Western Water-Hemlock	OBL	<i>Prunus emarginata</i>	Bitter Cherry	FACU
<i>Cirsium arvense</i>	Canadian Thistle	FAC	<i>Ranunculus acris</i>	Tall Buttercup	FAC
<i>Cirsium vulgare</i>	Bull Thistle	FACU	<i>Ranunculus aquatilis</i>	White Water-Crowfoot	OBL
<i>Comus alba</i>	Red Osier	FACW	<i>Ranunculus</i> sp.	Buttercup	NL
<i>Cystopteris fragilis</i>	Brittle Bladder Fern	FACU	<i>Ribes setosum</i>	Inland Gooseberry	NL
<i>Dactylis glomerata</i>	Orchard Grass	FACU	<i>Rosa woodsii</i>	Woods' Rose	FACU
<i>Dasiphora fruticosa</i>	Golden-Hardhack	FAC	<i>Rubus idaeus</i>	Common Red Raspberry	FACU
<i>Deschampsia cespitosa</i>	Tufted Hairgrass	FACW	<i>Rubus parviflorus</i>	Western Thimble-Berry	FACU
<i>Descurainia sophia</i>	Herb Sophia	NL	<i>Rumex acetosa</i>	Garden Sorrel	FAC
<i>Eleocharis palustris</i>	Common Spike-Rush	OBL	<i>Rumex crispus</i>	Curly Dock	FAC
<i>Elymus cinereus</i>	Great Basin Wildrye	NL	<i>Salix amygdaloides</i>	Peach-Leaf Willow	FACW
<i>Elymus hispidus</i>	Intermediate Wheatgrass	NL	<i>Salix babylonica</i>	Chinese Willow	FACW
<i>Elymus repens</i>	Creeping Wild Rye	FAC	<i>Salix boothii</i>	Booth's Willow	FACW
<i>Epilobium ciliatum</i>	Fringed Willowherb	FACW	<i>Salix drummondiana</i>	Drummond's Willow	FACW
<i>Equisetum arvense</i>	Field Horsetail	FAC	<i>Salix exigua</i>	Narrow-Leaf Willow	FACW
<i>Galium aparine</i>	Sticky-Willy	FACU	<i>Salix lasiandra</i>	Pacific Willow	FACW
<i>Geum macrophyllum</i>	Large-Leaf Avena	FAC	<i>Schoenoplectus acutus</i>	Hard-Stem Club-Rush	OBL
<i>Glyceria grandis</i>	American Manna Grass	OBL	<i>Scirpus microcarpus</i>	Red-Tinge Bulrush	OBL
<i>Glyceria striata</i>	Fowl Manna Grass	OBL	<i>Scrophularia lanceolata</i>	Lance-Leaf Figwort	FAC
<i>Holcus lanatus</i>	Common Velvet Grass	FAC	<i>Silene latifolia</i>	Bladder Campion	NL
<i>Hordeum jubatum</i>	Fox-Tail Barley	FAC	<i>Silene vulgaris</i>	Maiden's-tears	NL
<i>Hypericum perforatum</i>	Common St. John's-Wort	FACU	<i>Sisymbrium altissimum</i>	Tall Hedge-Mustard	FACU
<i>Impatiens aurella</i>	Pale-Yellow Touch-Me-Not	FACW	<i>Solanum dulcamara</i>	Climbing Nightshade	FAC
<i>Juncus balticus</i>	Baltic Rush	FACW	<i>Solidago canadensis</i>	Canadian Goldenrod	FACU
<i>Juncus compressus</i>	Round-Fruit Rush	OBL	<i>Sonchus arvensis</i>	Field Sow-Thistle	FACU
<i>Juncus effusus</i>	Lamp Rush	FACW	<i>Symphoricarpos occidentalis</i>	Western Snowberry	FAC
<i>Juncus ensifolius</i>	Dagger-Leaf Rush	FACW	<i>Tanacetum vulgare</i>	Common Tansy	FACU
<i>Juncus</i> sp.	Rush	NL	<i>Taraxacum officinale</i>	Common Dandelion	FACU
<i>Lathyrus sylvestris</i>	Flat Pea	NL	<i>Thalictrum occidentale</i>	Western Meadow-Rue	FACU
<i>Linaria vulgaris</i>	Butter-and-eggs	NL	<i>Thinopyrum ponticum</i>	Tall Wheatgrass	NL
<i>Lemna minor</i>	Common Duckweed	OBL	<i>Thlaspi arvense</i>	Field Pennycress	UPL
<i>Lepidium campestre</i>	Field Pepper-Grass	NL	<i>Tragopogon dubius</i>	Meadow Goat's-beard	NL
<i>Lepidium perfoliatum</i>	Clasping Pepperwort	FACU	<i>Trifolium pratense</i>	Red Clover	FACU
<i>Leucanthemum vulgare</i>	Ox-Eye Daisy	FACU	<i>Trifolium repens</i>	White Clover	FAC
<i>Leymus cinereus</i>	Great Basin Lyme Grass	FAC	<i>Typha latifolia</i>	Broad-Leaf Cat-Tail	OBL
<i>Lupinus</i> sp.	Lupine	NL	<i>Verbascum thapsus</i>	Great Mullein	FACU
<i>Lycopus asper</i>	Rough Water-Horehound	OBL	<i>Veronica americana</i>	American-Brooklime	OBL

*Based on 2016 NWPL (Lichvar *et al.*, 2016)
New species identified in 2016 are **bolded**.

One infestation of tall buttercup (*Ranunculus acris*), a Montana Listed Priority 2A noxious weed, and twenty-eight infestations of Montana Listed Priority 2B noxious weeds, including spotted knapweed (*Centaurea stoebe*), Canada thistle (*Cirsium arvense*), St. Johnswort (*Hypericum perforatum*), oxeye daisy (*Leucanthemum vulgare*), yellow toadflax (*Linaria vulgaris*), and common tansy (*Tanacetum vulgare*) were identified along the riparian corridor and are listed in Table 3. Cheatgrass (*Bromus tectorum*), a Montana Priority 3 regulated weed species was also identified in several locations across the site. Canada thistle, spotted knapweed, and oxeye daisy comprised the majority of noxious weed infestations observed across the site.

Each noxious weed occurrence 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). The extent of noxious weed coverage has increased at the site, with 23 new infestations mapped since 2014. An estimated 8% of the project area has been colonized by noxious weeds. Weeds were observed on both stream banks upstream and downstream of the Highway 93 Bridge with specific infestation locations provided in Figure 3, Appendix A.

Table 3. Montana State listed noxious weed and regulated species observed in 2016 at the Sweathouse Creek Stream Mitigation Site.

Category*	Scientific Name	Common Name
Priority 2A	<i>Ranunculus acris</i>	Tall Buttercup
Priority 2B	<i>Centaurea stoebe</i>	Spotted Knapweed
	<i>Cirsium arvense</i>	Canada Thistle
	<i>Hypericum perforatum</i>	St. Johnswort
	<i>Leucanthemum vulgare</i>	Oxeye Daisy
	<i>Linaria vulgaris</i>	Yellow Toadflax
	<i>Tanacetum vulgare</i>	Common Tansy
Priority 3 State Regulated	<i>Bromus tectorum</i>	Cheatgrass

*Based on the Montana Dept. of Agriculture's Noxious Weed List, 2015.
New species identified in 2016 are listed in **bold**.

4.2. Erosion Inventory

An erosion inventory conducted along both stream banks revealed no new erosion in 2016. In 2014, erosion was noted along a short segment of the right (south) bank where one of the coir logs separated from the bank and washed downstream. Monitoring of the site during the past two years has indicated no further bank erosion at this location (see Additional Photos 4 and 5 in Appendix C).

No bank erosion has been documented at Photo Point #2, where the upstream-most coir log was installed without keying it into the stream bank. To date this coir log remains intact and secured to the bank.

4.3. Perpendicular Transect Surveys

Two riffle and two pool transects have been surveyed each year since 2013 to document vertical and lateral adjustments to the reconstructed stream channel. Plots of each transect are included in Appendix B. Both pool transects indicate the channel has maintained deeper water habitat in the vicinity of the rootwads installed along the right bank. The channel is capable of scouring against these woody features, which provide cover and depth for use by fish. Many brook trout were observed using these pools as refugia during the monitoring event. Both riffle transects also appear to be maintaining channel width and depth, with only minor adjustments to the bed and bank elevations. Inspection of the surveyed transects indicates no evidence of either aggradation or degradation of the channel since monitoring of this site began in 2013.

4.4. Longitudinal Profile Surveys

A longitudinal profile surveyed down the length of the channel thalweg was repeated in 2016 (see profile in Appendix B). The thalweg elevation has remained relatively consistent throughout the project reach, with minor bed adjustments noticeable over the past three years. A riffle crest beneath the bridge has become lower by approximately 0.4 feet since 2014, which is likely due to settling of materials placed following construction. All other riffle crest elevations have remained consistent throughout the remainder of the project reach. Slight adjustments to bed elevation along the profile, such as those observed at the pools developing between STA 2+50 and 3+00 are most likely due to natural scour and depositional processes at play in a meandering channel, and are not attributed to channel instability within the project reach. The profile indicates the pool features along the right bank have maintained depth while the riffles have maintained a consistent channel slope. The channel planform is straight between STA 3+10 and 4+00, which is resulting in the extension of the riffle feature originally constructed at this location. Overall, the channel appears to be maintaining capacity and slope throughout the length of the project.

5.0 COMPARISON OF RESULTS TO PERFORMANCE STANDARDS

Monitoring of the Sweathouse Creek Stream Mitigation site is intended to document whether the reconstructed segment of the channel is meeting performance standards outlined in the Sweathouse Creek mitigation monitoring plan. The fourth year of monitoring suggests two of the three performance standards are being met five years post-construction. Additional reporting requirements outlined in the monitoring plan including schematics of an as-built topographic survey, repetition of perpendicular transect surveys, and photo documentation of the site are included as appendices in this report.

Table 4. Performance results of Sweathouse Creek 5 years following construction.

Parameter	Success Criteria	Status	Meeting Performance Criteria?
Riparian Coverage	80% total vegetative cover after the 3rd year.	Project area has 97% vegetative cover.	Yes
	50% cover of woody vegetation after the 3rd year.	Project area has 11% woody cover (12% of south bank and 10% of north bank)	No
Stream Bank Stability	Unstable banks identified within the project reach will require corrective action	One eroding streambank was identified in 2014 but did not erode further in 2015 or 2016.	Corrective action does not appear necessary at this bank

5.1. Riparian Vegetation Coverage

Vegetation cover along the Sweathouse Creek Mitigation Site has consistently measured above 95% for the past four monitoring years, and exceeds the performance standard of 80% areal coverage. Vegetation has established well within the riparian zone (defined as within 25' of the stream banks), particularly along the north stream bank. Herbaceous vegetation along the south stream bank has also established well; although mowing has continued up to the edge of the channel by the adjacent landowner.

In 2016, percent cover of woody vegetation within the riparian corridor remained at 11%, the same as 2015, and an increase of 2% since 2014. However, it remains below the performance standard of 50% cover by the end of the third growing season. The willows planted beneath the coir logs along the right bank are in poor condition. Monitoring of the woody vegetation along this bank indicates the young willows are no longer thriving and mortality is increasing. This may be due to continued trimming of the willows by the adjacent landowner. No additional woody vegetation is establishing within the remainder of the 25-foot wide riparian zone along the right bank due to mowing activities. It is unlikely the mitigation site will be able to achieve the performance criteria for woody vegetation composition until the riparian areas along the right bank are replanted with woody shrubs and measures are taken to protect these species from removal. MDT biologists previously installed approximately 150 red-osier dogwood (*Cornus alba*), Woods' rose (*Rosa woodsii*), and willows (*Salix* spp.) within the riparian zone in an attempt to establish woody species composition; however, with the exception of willow stems installed in the stream banks, all woody vegetation installed in the riparian corridor has been removed from the south side of the project reach, presumably by frequent mowing by adjacent landowner.

5.2. Bank Erosion Inventory

The 15-foot section of eroding bank along Sweathouse Creek identified in 2014 did not continue to erode in 2015 or 2016 and is not currently jeopardizing any woody structures installed along the south bank. This moderately eroding bank occurs between two root wads installed to protect the bank from lateral erosion. One of the coir logs placed to protect the upper bank washed out, exposing the upper bank to active flows. Vegetation along this bank has been consistently mowed, and woody vegetation

planted during the project's construction has only sparsely established along the bank toe. It does not appear corrective actions will be necessary to stabilize this bank unless future monitoring efforts indicate accelerated erosion.

6.0 OTHER OBSERVATIONS

A pile of debris was observed on the south bank immediately downstream of the newly constructed bridge. Based on the photograph taken at Photo Point 2.1 in 2015, the landowner may use this area for burning household debris. This pile of debris lies within 25 feet of the highway edge and should be removed to allow for maintenance activities within the road right-of-way.

7.0 LITERATURE CITED

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. July 2015. Accessed September 2016 at <http://agr.mt.gov/agr/Programs/Weeds/PDF/2015WeedList.pdf>.

Appendix A

Project Site Maps

MDT Stream Mitigation Monitoring
Sweathouse Creek
Ravalli County, Montana



Legend

- ★ Photo Points
- Riparian and Perpendicular Transect Endpoints

- Channel Thalweg
- + Major Station (100')
- o Minor Station (25')

- Eroding Banks
- Pool and Riffle Transects
- Riparian Transects

2016 Monitoring Features Sweathouse Creek








Figure 2

Date: 09/27/2016

Sweathouse_features2016



Legend

- | | | | | | |
|---|-----------------------------|---|-----------------------------|---|-------------------------|
|  | <i>Centaurea stoebe</i> |  | <i>Leucanthemum vulgare</i> |  | <i>Linaria vulgaris</i> |
|  | <i>Cirsium arvense</i> |  | <i>Ranunculus acris</i> | | |
|  | <i>Hypericum perforatum</i> |  | <i>Tanacetum vulgare</i> | | |

0 25 50 100 Feet



2016 Monitoring Noxious Weeds Sweathouse Creek

Figure 3

Date: 09/27/2016

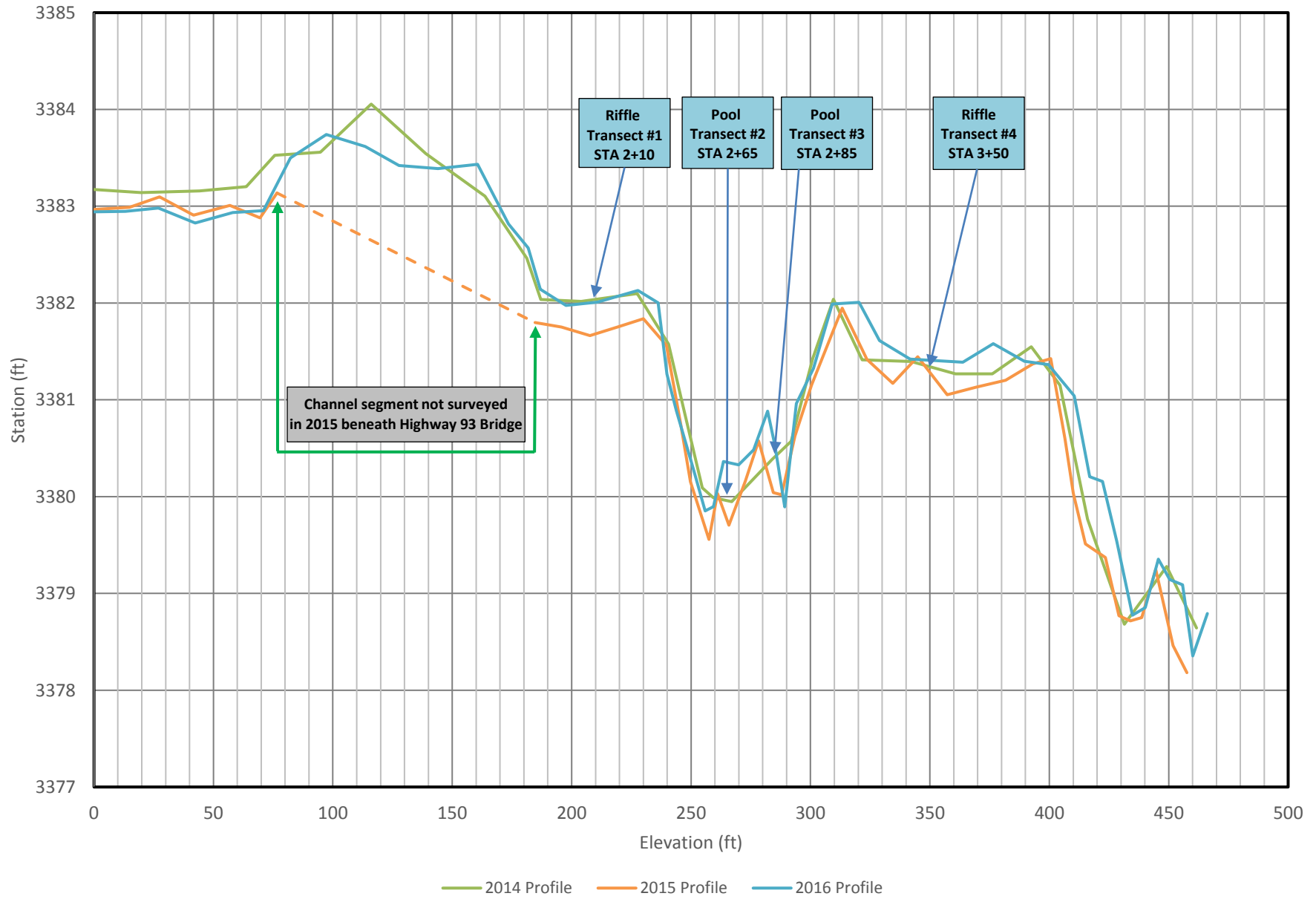
Sweathouse_weeds2016.mxd

Appendix B

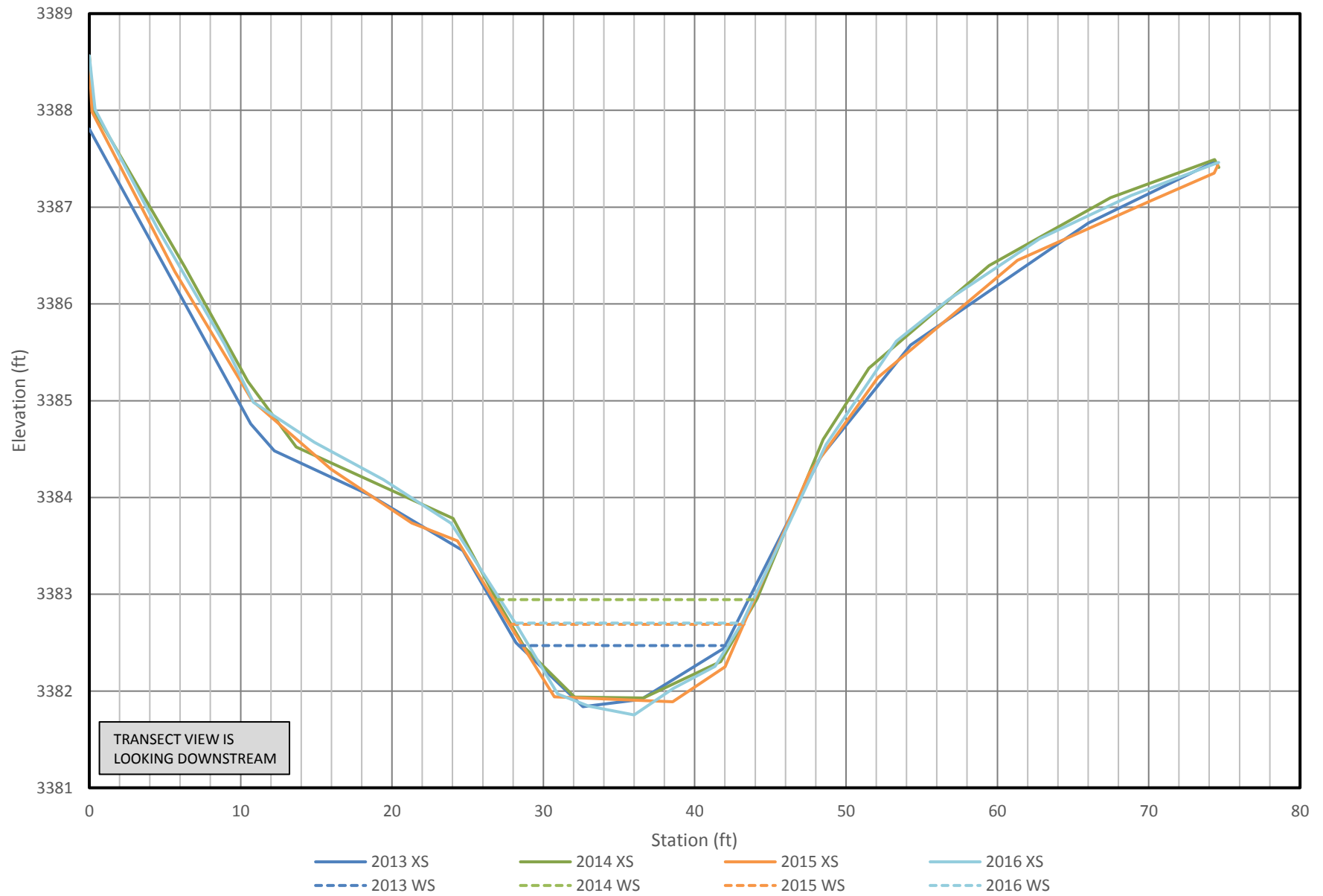
Perpendicular Transect and Longitudinal Profile Plots

MDT Stream Mitigation Monitoring
Sweathouse Creek
Ravalli County, Montana

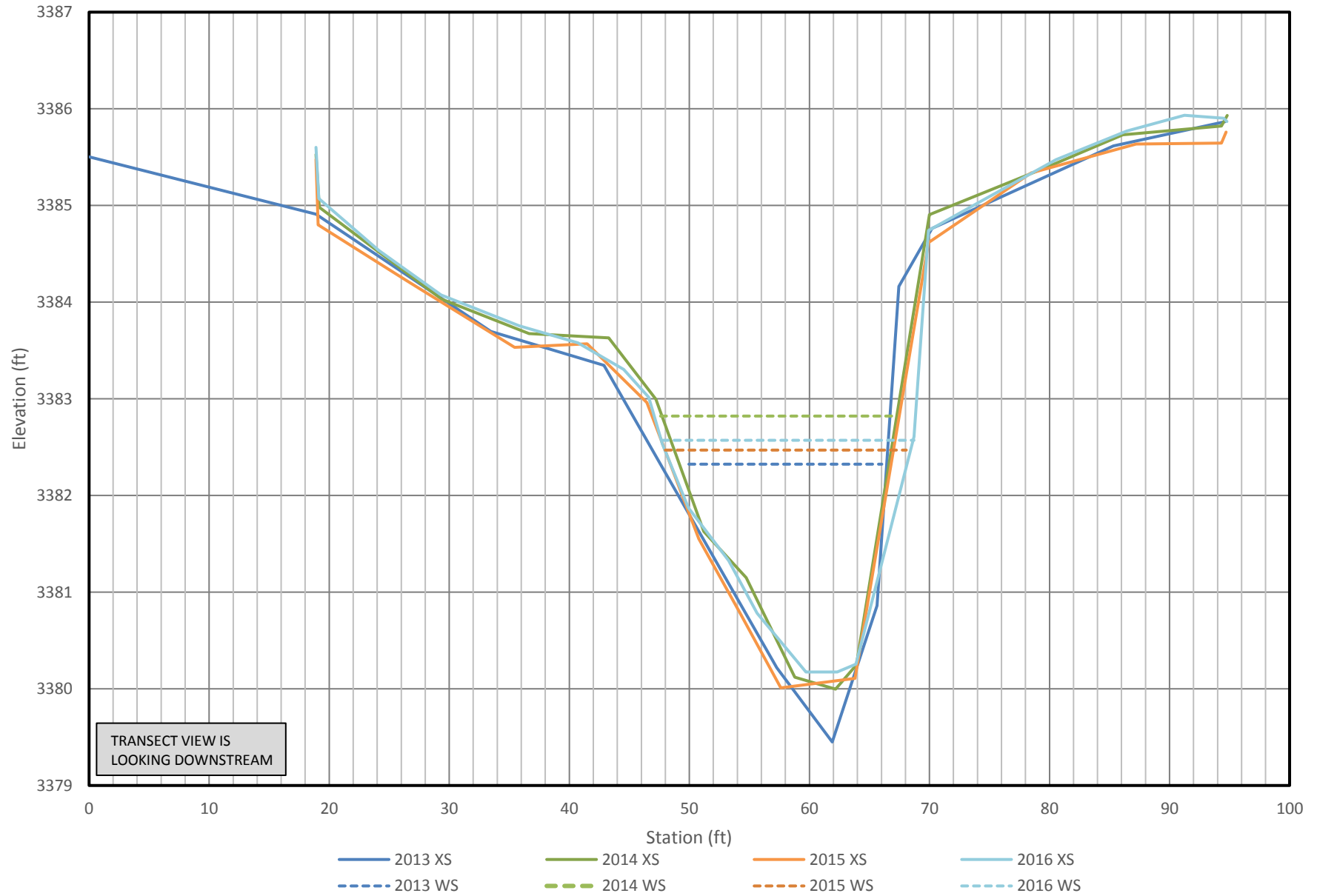
Sweathouse Creek Longitudinal Profiles: 2014 - 2016



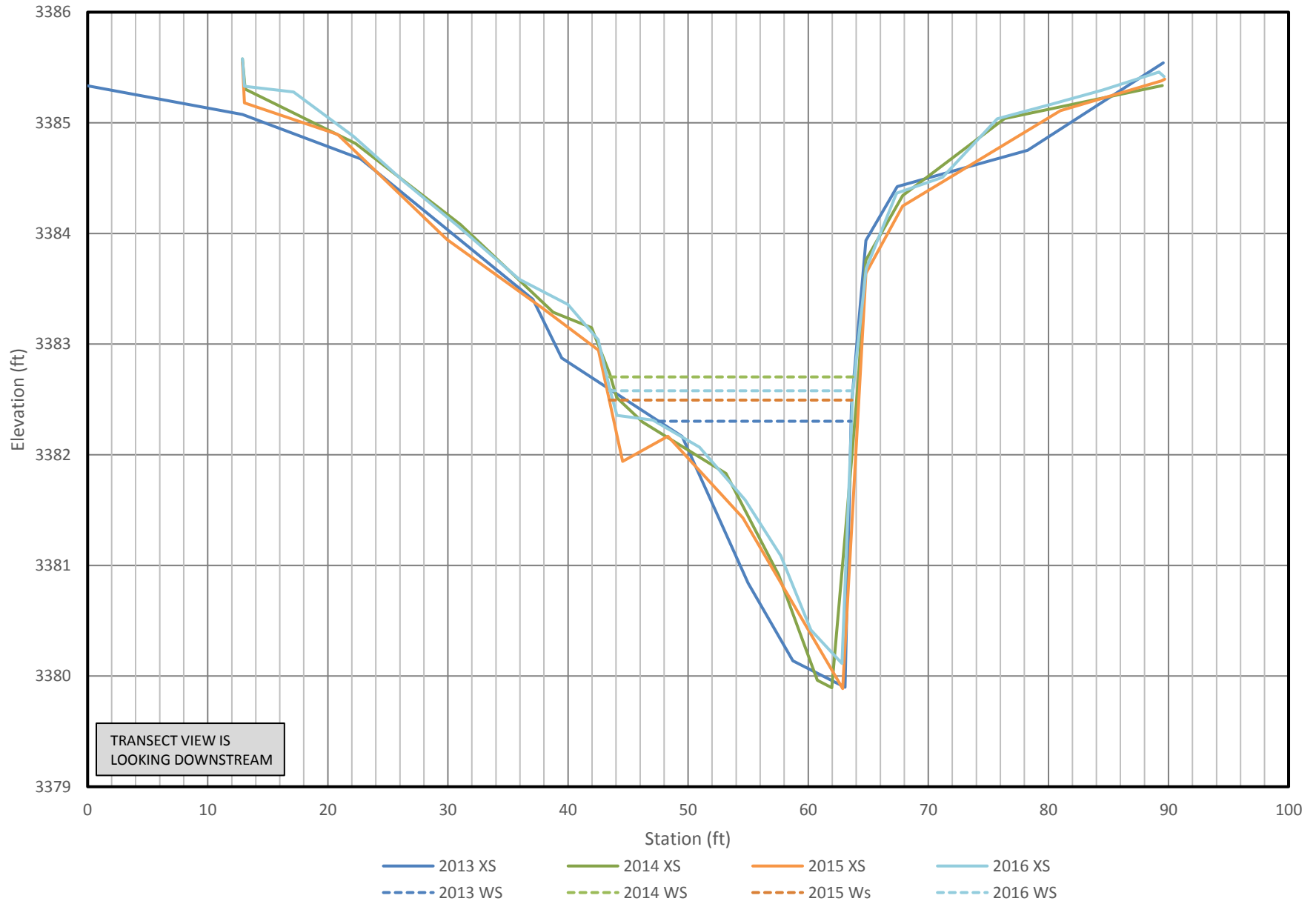
Sweathouse Creek Transect #1 - Riffle



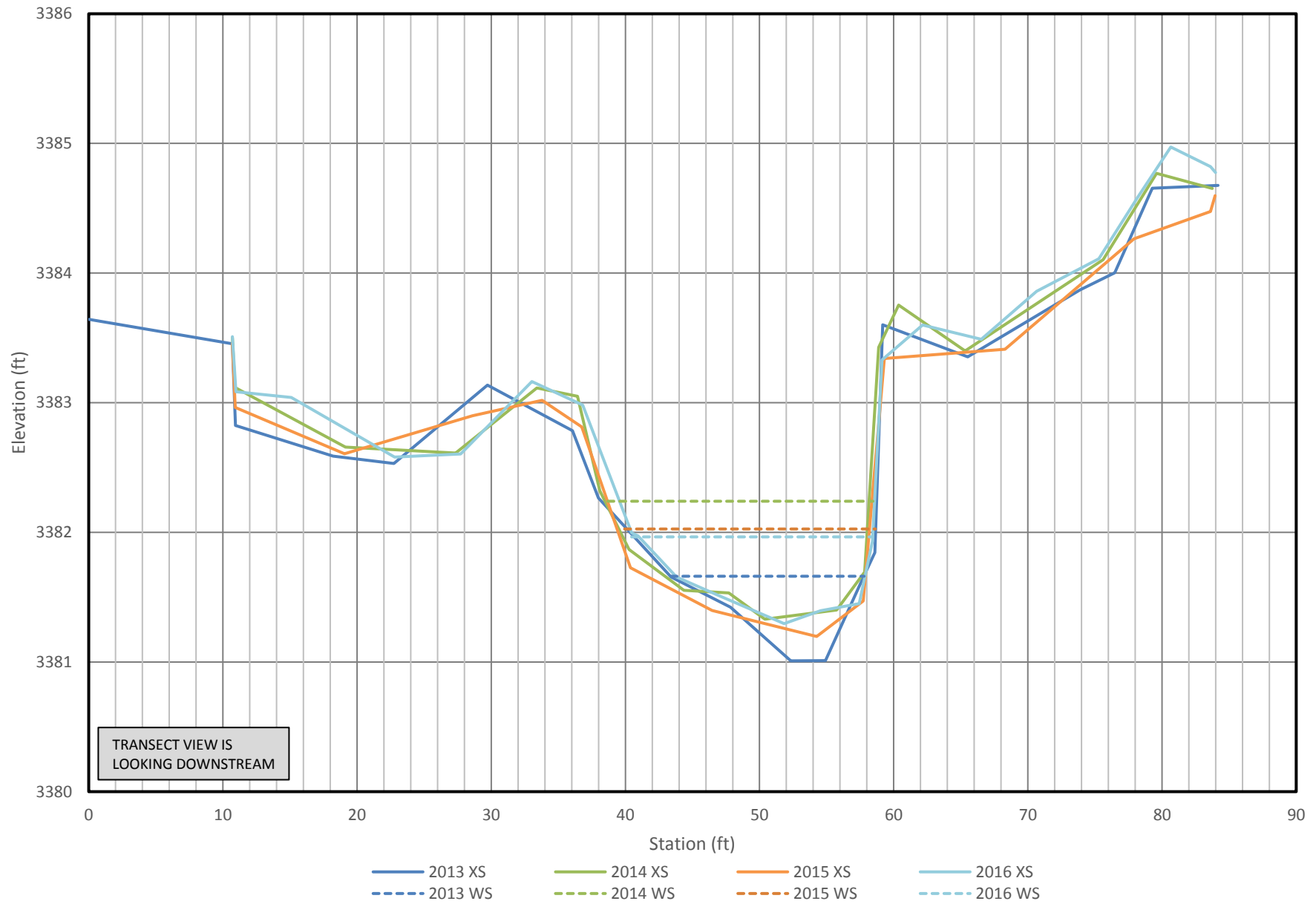
Sweathouse Creek Transect #2 - Pool



Sweathouse Creek Transect #3 - Pool



Sweathouse Creek Transect #4 - Riffle



Appendix C

Project Site Photos

MDT Stream Mitigation Monitoring
Sweathouse Creek
Ravalli County, Montana

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events



Photo Point 1.1—2013

Description: View of north bank from bridge abutment.
Compass: 45 (Northeast)



Photo Point 1.1—2016

Description: View of north bank from bridge abutment.
Compass: 45 (Northeast)



Photo Point 1.2 —2013

Description: View of both banks looking downstream from bridge abutment. **Compass:** 68 (East-Northeast)



Photo Point 1.2 —2016

Description: View of both banks looking downstream from bridge abutment. **Compass:** 68 (East-Northeast)

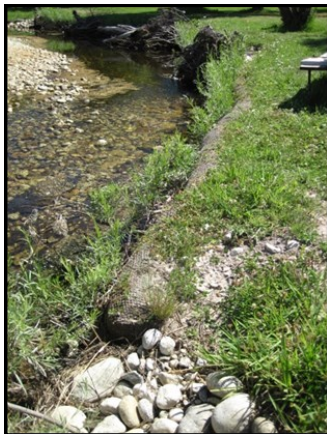


Photo Point 2 —2013

Description: View of un-keyed coir log on south bank
Compass: 90 (East)



Photo Point 2 —2016

Description: View of un-keyed coir log on south bank
Compass: 90 (East)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events



Photo Point 3.1—2013

Description: Looking upstream from downstream end of project reach. **Compass:** 225 (Southwest)



Photo Point 3.1—2016

Description: Looking upstream from downstream end of project reach. **Compass:** 225 (Southwest)



Photo Point 3.2—2013

Description: View of downstream extent of project area. **Compass:** 45 (Northeast)



Photo Point 3.2—2016

Description: View of downstream extent of project area. **Compass:** 45 (Northeast)



Photo Point 3.3—2013

Description: View of the north bank looking across channel. **Compass:** 315 (Northwest)



Photo Point 3.3—2016

Description: View of the north bank looking across channel. **Compass:** 315 (Northwest)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events



Photo Point 4.1—2013

Description: View of both banks looking upstream.
Compass: 45 (Northeast)



Photo Point 4.1—2016

Description: View of both banks looking upstream.
Compass: 45 (Northeast)



Photo Point 4.2—2013

Description: View of north bank and point bar development. **Compass:** 315 (Northwest)



Photo Point 4.2—2016

Description: View of north bank and point bar development. **Compass:** 315 (Northwest)



Photo Point 4.3—2013

Description: View of both banks looking downstream.
Compass: 225 (Southwest)



Photo Point 4.3—2016

Description: View of both banks looking downstream.
Compass: 225 (Southwest)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events



Photo Point 5.1—2013

Description: View from north bank looking upstream underneath bridge. **Compass:** 270 (West)



Photo Point 5.1—2016

Description: View from north bank looking upstream underneath bridge. **Compass:** 270 (West)



Photo Point 5.2—2013

Description: View of south bank.
Compass: 180 (South)



Photo Point 5.2—2016

Description: View of south bank.
Compass: 180 (South)



Photo Point 5.3—2013

Description: View of vegetation on north bank.
Compass: 90 (East)



Photo Point 5.3—2016

Description: View of vegetation on north bank.
Compass: 90 (East)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events



Photo Point 6.1—2013

Description: View of north bank vegetation.
Compass: 225 (Southwest)



Photo Point 6.1—2016

Description: View of north bank vegetation.
Compass: 225 (Southwest)



Photo Point 6.2—2013

Description: View of south bank looking across channel.
Compass: 135 (Southeast)



Photo Point 6.2—2016

Description: View of south bank looking across channel.
Compass: 135 (Southeast)



Photo Point 6.3—2013

Description: View looking across channel from north bank.
Compass: 90 (East)



Photo Point 6.3—2016

Description: View looking across channel from north bank.
Compass: 90 (East)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events



Photo Point 7.1—2013

Description: View of north streambank upstream of bridge. **Compass:** 68 (East-Northeast)



Photo Point 7.1—2016

Description: View of north streambank upstream of bridge. **Compass:** 68 (East-Northeast)



Photo Point 7.2—2013

Description: View looking downstream beneath bridge. **Compass:** 90 (East)



Photo Point 7.2—2016

Description: View looking downstream beneath bridge. **Compass:** 90 (East)



Photo Point 7.3—2013

Description: View of north bank looking across stream channel. **Compass:** 0 (North)



Photo Point 7.3—2016

Description: View of north bank looking across stream channel. **Compass:** 0 (North)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Mitigation Site

DATE: 2013 and 2016 Monitoring Events



Additional Photo 1 - 2013

Description: Root wads along south streambank.
Compass: 45 (Northeast)



Additional Photo 1 - 2016

Description: Root wads along south streambank.
Compass: 45 (Northeast)



Additional Photo 2 - 2013

Description: Point bar formation on north side of channel. **Compass:** 250 (West-Southwest)



Additional Photo 2 - 2016

Description: Point bar formation on north side of channel. **Compass:** 250 (West-Southwest)



Additional Photo 3 - 2013

Description: Log structure along south streambank.
Compass: 110 (East-Southeast)



Additional Photo 3 - 2016

Description: Log structure along south streambank.
Compass: 110 (East-Southeast)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events



Additional Photo 4 - 2013

Description: Eroding Bank EBR1 prior to bank collapse **Compass:** 90 (East)



Additional Photo 4 - 2016

Description: Eroding bank EBR1 along right (south bank). **Compass:** 90 (East)



Additional Photo 5: Eroding Bank EBR1 - 2015

Description: Looking upstream toward Highway 93 bridge from south bank.



Additional Photo 5: Eroding Bank EBR1 - 2016

Description: Looking upstream toward Highway 93 bridge from south bank.



Additional Photo 6 - 2015

Description: Willow cutting growth along north bank **Compass:** 270 (West)



Additional Photo 6 - 2016

Description: Willow cutting growth along north bank **Compass:** 270 (West)

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 1 NORTH LOOKING SOUTH



TRANSECT 1 SOUTH LOOKING NORTH

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 1 NORTH LOOKING UPSTREAM



TRANSECT 1 NORTH LOOKING DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 1 IN CREEK UPSTREAM



TRANSECT 1 IN CREEK DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 1 SOUTH LOOKING UPSTREAM



TRANSECT 1 SOUTH LOOKING DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 2 NORTH LOOKING SOUTHEAST



TRANSECT 2 SOUTH LOOKING NORTHWEST

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 2 NORTH LOOKING UPSTREAM



TRANSECT 2 NORTH LOOKING DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 2 IN CREEK UPSTREAM



TRANSECT 2 IN CREEK DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 2 SOUTH LOOKING UPSTREAM



TRANSECT 2 SOUTH LOOKING DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 3 NORTH LOOKING SOUTHEAST



TRANSECT 3 SOUTH LOOKING NORTHWEST

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 3 NORTH LOOKING UPSTREAM



TRANSECT 3 NORTH LOOKING DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 3 IN CREEK UPSTREAM



TRANSECT 3 IN CREEK DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 3 SOUTH LOOKING UPSTREAM



TRANSECT 3 SOUTH LOOKING DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 4 NORTH LOOKING EAST



TRANSECT 4 SOUTH LOOKING WEST

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 4 NORTH LOOKING UPSTREAM



TRANSECT 4 NORTH LOOKING DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 4 IN CREEK UPSTREAM



TRANSECT 4 IN CREEK DOWNSTREAM

PROJECT NAME: 2016 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-28-16



TRANSECT 4 SOUTH LOOKING UPSTREAM

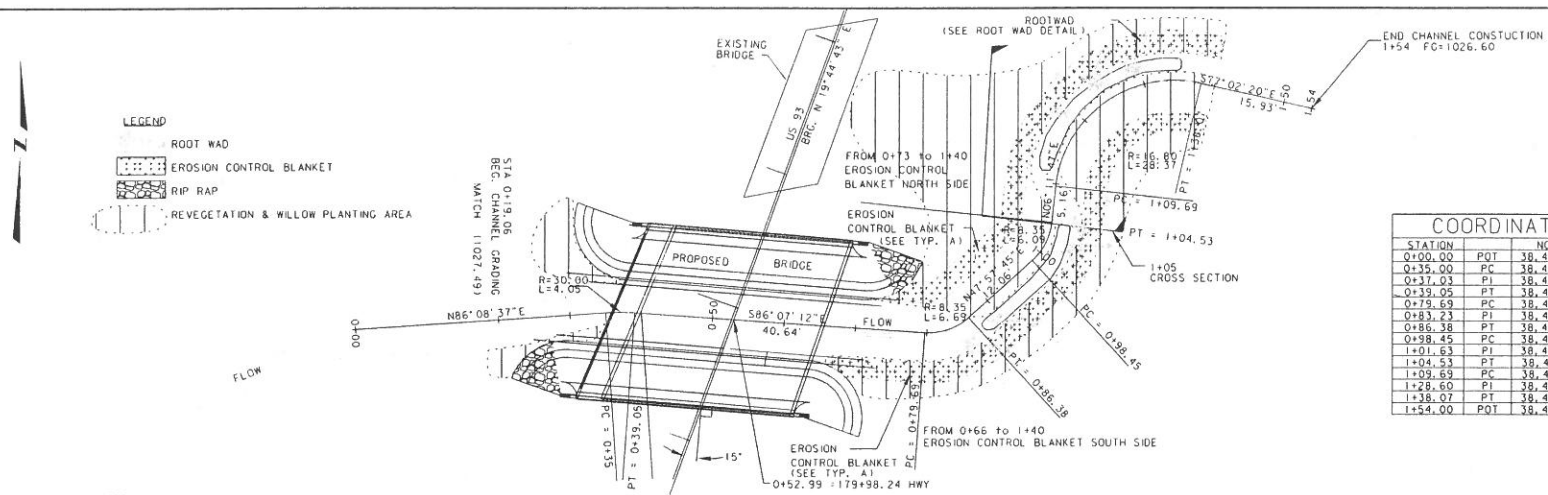


TRANSECT 4 SOUTH LOOKING DOWNSTREAM

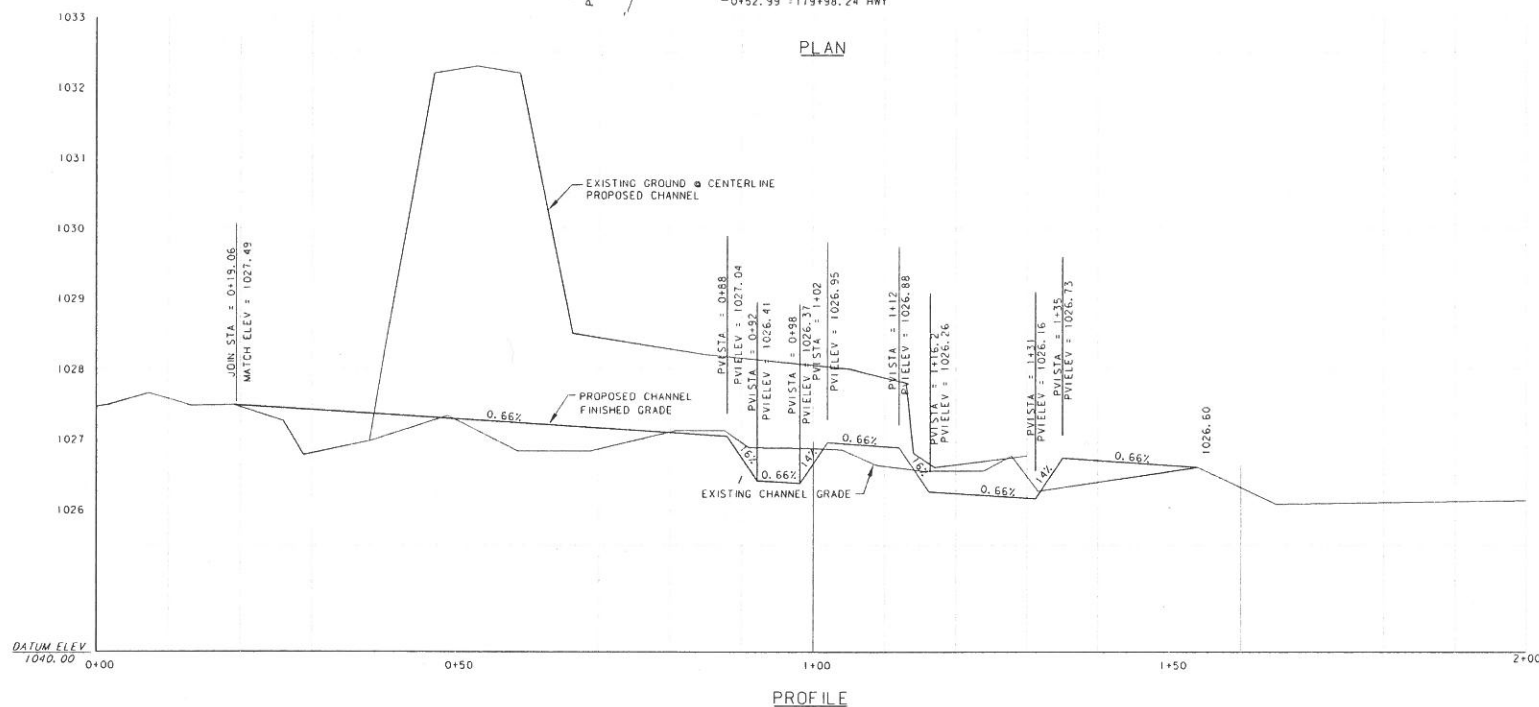
Appendix D

As Built Surveys & Planting Schematics

MDT Stream Mitigation Monitoring
Sweathouse Creek
Ravalli County, Montana

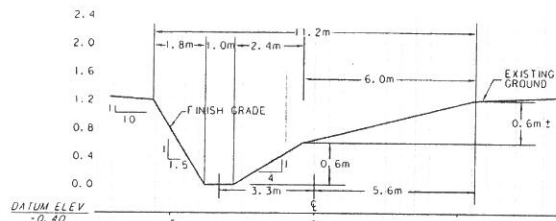


COORDINATE TABLE			
STATION		NORTHING	EASTING
+00.00	PQT	38,404.6787	56,198.687
+03.00	PC	38,407.0326	56,233.608
+07.03	PI	38,407.0690	56,235.436
+09.05	PI	38,407.0318	56,237.658
+07.69	PC	38,404.2817	56,278.204
+083.23	PI	38,404.0424	56,281.734
+086.38	PC	38,406.4110	56,284.361
+09.95	PC	38,414.4878	56,293.319
+09.95	PC	38,418.0110	56,295.855
+04.53	PT	38,424.7881	56,296.029
+09.69	PC	38,424.9181	56,296.586
+12.60	PI	38,443.7182	56,298.627
+13.60	PT	38,439.4768	56,317.056
+14.00	PQT	38,443.7182	56,317.056



SWEATHOUSE CREEK
CHANNEL
RESTORATION
DETAIL
STA. 179+98
SHEET 1 OF 2
NO SCALE

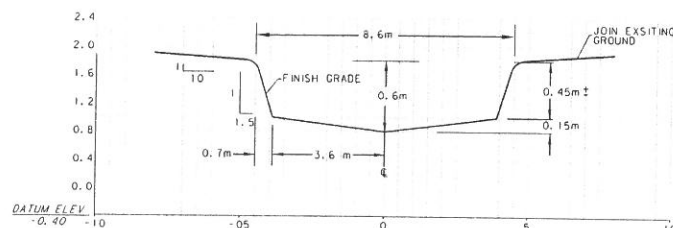
STATE	PROJECT NUMBER	SHEET NO.
MONTANA	NH 7-1(115)59	29
VICTOR URBAN		



TYPICAL POOL LEFT CROSS SECTION

LEFT POOL
1+16.2 TO 1+131

RIGHT POOL
0+92 TO 0+98



TYPICAL RIFFLE CROSS SECTION

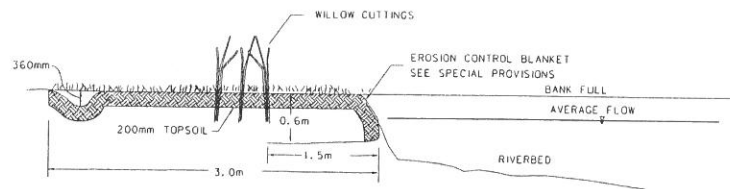
RIFFLE

(INCLUDES TRANSITIONS)

NOTES:

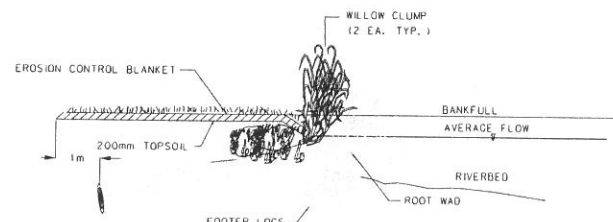
- SEE PLANS FOR POOL LOCATIONS. POOL LEFT (PL) SHOWN, MIRROR ABOUT CENTERLINE (CL) FOR POOL RIGHT LOOKING DOWNSTREAM.
- TRANSITION 4.0m BETWEEN POOL & RIFFLE.
- ROUND SLOPES FOR NATURAL APPEARANCE.

0+19 TO 0+92
1+31 TO 1+53
0+98 TO 1+16.2

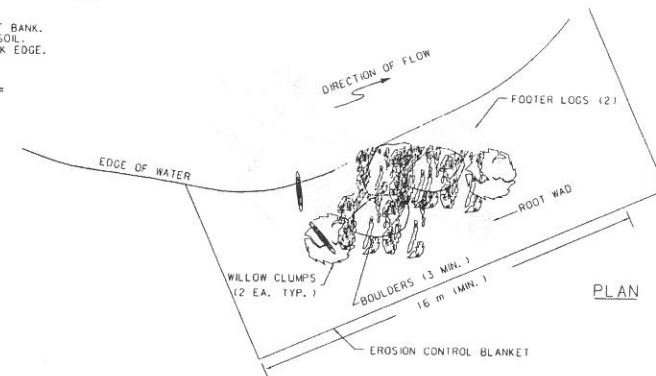


- SUB EXCAVATE BANKS 0.6 METERS.
- LAY LOWER BLANKET MINIMUM 1.5 METERS FROM EDGE OF BANK.
- BACK FILL WITH NATIVE MATERIAL AND 0.2 METERS TOPSOIL.
- WRAP BLANKET AND EXTEND 3.0 METERS MIN. FROM BANK EDGE.

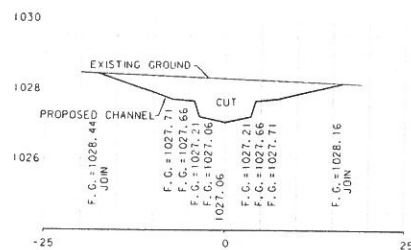
EROSION CONTROL BLANKET TYPICAL
SWEATHOUSE CREEK



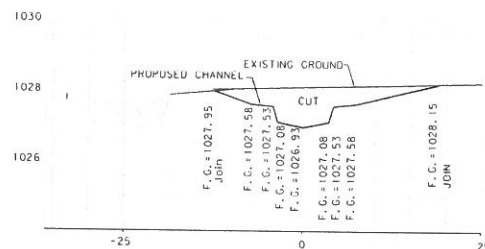
CROSS SECTION



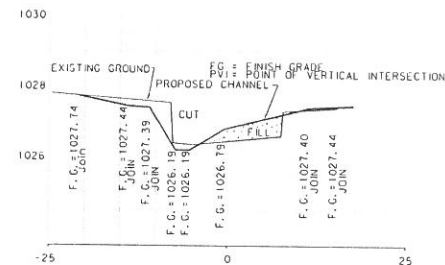
ROOT WAD TYPICAL
SWEATHOUSE CREEK



CROSS SECTION 0+85



CROSS SECTION 1+05



CROSS SECTION 1+25

SWEATHOUSE CREEK
CHANNEL
RESTORATION
DETAILS
STA. 179+98
SHEET 2 OF 2
NO SCALE