MONTANA DEPARTMENT OF TRANSPORTATION
STREAM MITIGATION MONITORING REPORT

Sweathouse Creek
Ravalli County, Montana

Year Project Completed: 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

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

Prepared for:

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December 2017

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Cover Photo: Realigned channel of Sweathouse Creek taken in August, 2017

1.0 INTRODUCTION

The following report presents results of the fifth 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 six 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 fifth year of monitoring in 2017 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 13, 2017 while survey crews visited the site on July 19, 2017. 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. 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 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).

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 3 of 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.

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.

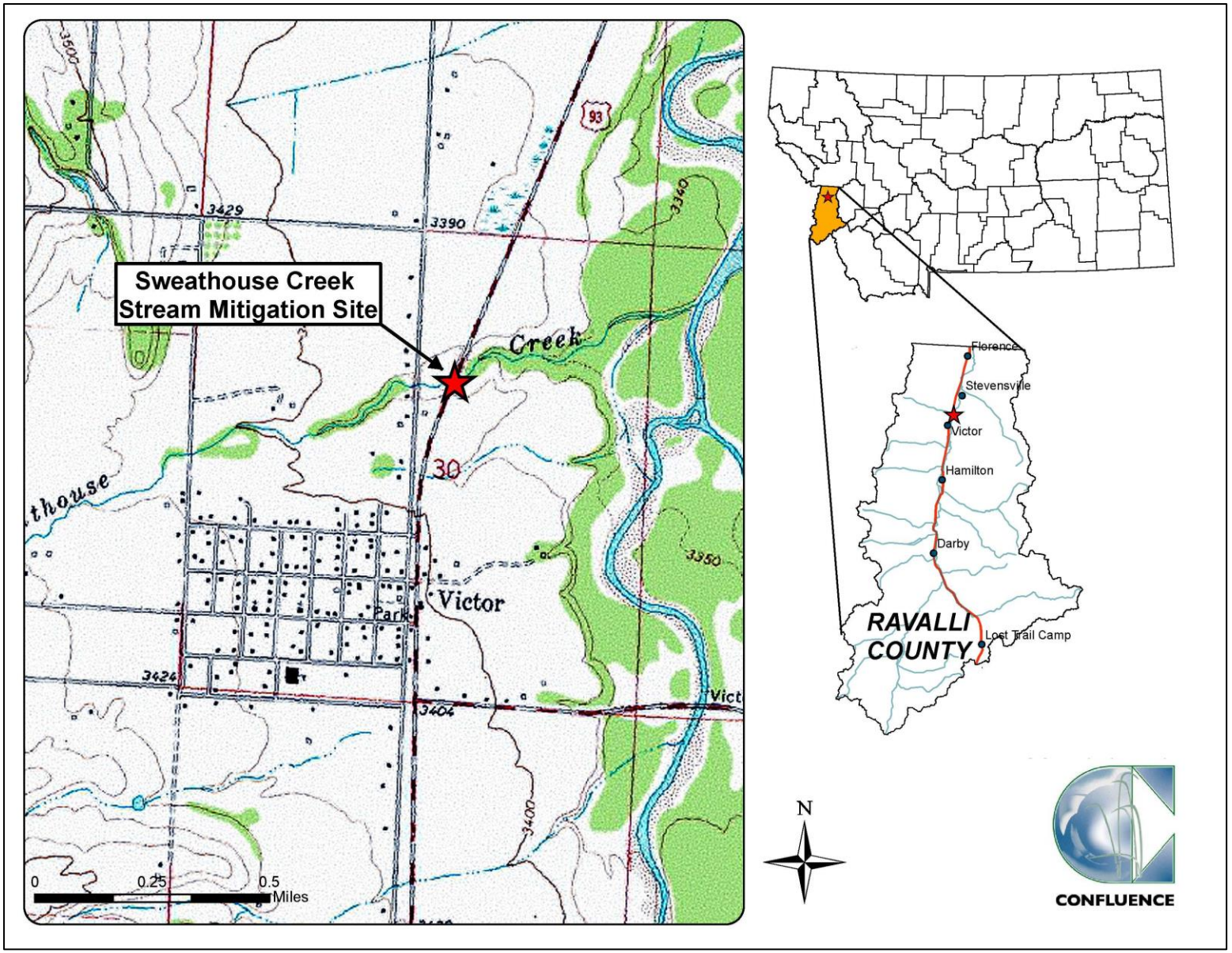


Figure 1. Project location of Sweathouse Creek stream mitigation site.

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 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 increased to 98%, and included 87% cover by herbaceous species and 11% by woody species. The site exhibited a lower percentage of noxious weed cover than observed during the 2016 monitoring event, and was estimated at 6% of the total cover.

Table 2. Percent cover of riparian belt transects at the Sweathouse Creek site 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)	200	97	96	97	97	98	14	10	12	12	11	5	5	5	7	3
Left (north bank)	114	98	98	98	98	98	7	7	10	10	11	3	3	8	10	10
Total	314	97	97	97	97	98	11	9	11	11	11	4	4	6	8	6

Table 3 includes a comprehensive list of plant species observed along the new channel alignment and riparian buffer areas. In 2017, 122 species were observed, representing an increase of 6 species since 2016, 23 species since 2015, 37 species since 2014, and 67 species since the initial monitoring event in 2013. In 2017, 54% of the species observed were hydrophytic based on the 2016 National Wetland Plant List (NWPL) (Lichvar *et al.* 2016).

One infestation of tall buttercup (*Ranunculus acris*), a Montana Listed Priority 2A noxious weed, and twenty-nine 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 4. 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 with cover classes ranging from trace (less than 1 percent) to low (1 to 5 percent). An estimated 6% of the riparian belt transects have been colonized by noxious weeds, which occur primarily outside of the MDT right-of-way, downstream of the Highway 93 Bridge (see Figure 3 in Appendix A).

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

Scientific Name	Common Name	WMVC Indicator Status*
Achillea millefolium	Common Yarrow	FACU
Agastache urticifolia	**Nettle-Leaf Giant-Hyssop**	**FACU**
Agropyron cristatum	Crested Wheatgrass	NL
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
Alopecurus pratensis	Field Meadow-Foxtail	FAC
Alyssum alyssoides	Pale Alyssum	NL
Arctium minus	Lesser Burdock	UPL
Betula pumila	Bog Birch	OBL
Bromus tectorum	Cheatgrass	NL
Calamagrostis canadensis	Buejoint	FACW
Camelina microcarpa	**Little-Pod False Flax**	**FACU**
Carex aquatilis	Leafy Tussock Sedge	OBL
Carex praticola	**Northern Meadow Sedge**	**FACW**
Carex sp.	Sedge	NL
Carex stipata	Stalk-Grain Sedge	OBL
Carex utriculata	Northwest Territory Sedge	OBL
Centaurea stoebe	Spotted Knapweed	NL
Cerastium sp.	Chickweed	NL
Chenopodium album	Lamb's-Quarters	FACU
Cicuta douglasii	Western Water-Hemlock	OBL
Cirsium arvense	Canadian Thistle	FAC
Cirsium vulgare	Bull Thistle	FACU
Cornus alba	Red Osier	FACW
Cystopteris fragilis	Brittle Bladder Fern	FACU
Dactylis glomerata	Orchard Grass	FACU
Dasiphora fruticosa	Golden-Hardhack	FAC
Deschampsia cespitosa	Tufted Hairgrass	FACW
Descurainia sophia	Herb Sophia	NL
Eleocharis palustris	Common Spike-Rush	OBL
Elymus hispidus	Intermediate Wheatgrass	NL
Elymus repens	Creeping Wild Rye	FAC
Epilobium ciliatum	Fringed Willowherb	FACW
Equisetum arvense	Field Horsetail	FAC
Galium aparine	Sticky-Willy	FACU
Geum macrophyllum	Large-Leaf Avens	FAC
Glyceria grandis	American Manna Grass	OBL
Glyceria striata	Fowl Manna Grass	OBL
Holcus lanatus	Common Velvet Grass	FAC
Hordeum jubatum	Fox-Tail Barley	FAC
Hypericum perforatum	Common St. John's-Wort	FACU
Impatiens aurella	Pale-Yellow Touch-Me-Not	FACW
Juncus balticus	Baltic Rush	FACW
Juncus compressus	Round-Fruit Rush	OBL
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**
Lathyrus sylvestris	Flat Pea	NL
Linaria vulgaris	Butter-and-eggs	NL
Lemna minor	Common Duckweed	OBL
Lepidium campestre	Field Pepper-Grass	NL
Lepidium perfoliatum	Clasping Pepperwort	FACU
Leucanthemum vulgare	Ox-Eye Daisy	FACU
Leymus cinereus	Great Basin Lyme Grass	FAC
Lupinus sp.	Lupine	NL
Lycopus asper	Rough Water-Horehound	OBL
Medicago lupulina	Black Medick	FACU
Medicago sativa	Alfalfa	UPL
Melilotus albus	White Sweetclover	NL
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**
Myriophyllum sp.	Water-Milfoil	NL
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
Plantago lanceolata	English Plantain	FACU
Plantago major	Great Plantain	FAC
Poa palustris	Fowl Blue Grass	FAC
Poa pratensis	Kentucky Blue Grass	FAC
Populus angustifolia	Narrow-Leaf Cottonwood	FACW
Populus balsamifera	Balsam Poplar	FAC
Populus tremuloides	Quaking Aspen	FACU
Prunus emarginata	Bitter Cherry	FACU
Ranunculus acris	Tall Buttercup	FAC
Ranunculus aquatilis	White Water-Crowfoot	OBL
Ranunculus sp.	Buttercup	NL
Ribes oxyacanthoides	Canadian Gooseberry	FACW
Rosa woodsii	Woods' Rose	FACU
Rubus idaeus	Common Red Raspberry	FACU
Rubus parviflorus	Western Thimble-Berry	FACU
Rumex acetosa	Garden Sorrel	FAC
Rumex crispus	Curly Dock	FAC
Salix amygdaloides	Peach-Leaf Willow	FACW
Salix babylonica	Chinese Willow	FACW
Salix bebbiana	**Gray Willow**	**FACW**
Salix boothii	Booth's Willow	FACW
Salix drummondiana	Drummond's Willow	FACW
Salix exigua	Narrow-Leaf Willow	FACW
Salix lasiandra	Pacific Willow	FACW
Schoenoplectus acutus	Hard-Stem Club-Rush	OBL
Scirpus microcarpus	Red-Tinge Bulrush	OBL
Scrophularia lanceolata	Lance-Leaf Figwort	FAC
Silene latifolia	Bladder Campion	NL
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 occidentalis	Western Snowberry	FAC
Tanacetum vulgare	Common Tansy	FACU
Taraxacum officinale	Common Dandelion	FACU
Thalictrum occidentale	Western Meadow-Rue	FACU
Thinopyrum ponticum	Tall Wheatgrass	NL
Thlaspi arvense	Field Pennycress	UPL
Tragopogon dubius	Meadow Goat's-beard	NL
Trifolium pratense	Red Clover	FACU
Trifolium repens	White Clover	FAC
Typha latifolia	Broad-Leaf Cat-Tail	OBL
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 Sweathouse Creek Stream Mitigation Site.

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

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

4.2. Erosion Inventory

An erosion inventory conducted along both stream banks revealed no newly eroding banks in 2017. In 2014, erosion at EBR1 was noted along a 15' segment of the right (south) bank where one of the coir logs separated from the bank and washed downstream. The location of this erosion is noted on Figure 2 in Appendix A. This bank has become undercut and laterally migrated an additional 1 foot in the past year as a result of hydraulics in the vicinity of the root wad installed to provide bank protection (see Additional Photos 4 and 5 in Appendix C). All but a couple of willow sprigs installed along this 15-foot bank segment have eroded into the stream. The lack of woody vegetation establishment along the bank, presence of the large root wad, and decomposition of coir materials used to construct the bank factor into the potential that erosion may continue along this short bank segment.

Installation of woody fascines along the toe of the eroding bank would provide temporary protection from erosion; however, the establishment of woody vegetation along the bank will be the most effective treatment to reduce erosion potential. If woody vegetation establishment along the bank is not feasible due to adjacent land use practices, installation of additional rootwads would suffice to prevent further erosion along the bank. The 15-foot segment of bank erosion is equivalent to less than 3% of the 600' bank length within the project reach, not including the stream banks beneath the Highway 93 Bridge. The short length of erosion, relatively slow pace of lateral movement, and lack of infrastructure in jeopardy provide a justifiable basis for not undertaking corrective actions along this 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 outside bend downstream of the bridge. The channel is scouring against these woody features, which provide cover and depth for use by fish. Multiple fish have been

observed using this deeper habitat during each of the five monitoring events. Both riffle transects also appear to be maintaining channel width and depth, with only minor adjustments to the bed and bank elevations observed during the past five years. 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 2017 (see profile in Appendix B). The thalweg elevation has remained relatively consistent throughout the project reach over the past four years, with minor bed adjustments at riffle crests and pool tails. 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 relatively consistent (within 0.3') 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 an overall 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 continues to maintain adequate capacity and slope to effectively convey incoming sediment throughout the relocated channel segment.

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 fifth year of monitoring suggests two of the three performance standards are being met six 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 5. Performance results of Sweathouse Creek 6 years following construction.

Parameter	Success Criteria	Status	Meeting Performance Criteria?
Riparian Coverage	80% total vegetative cover after the 3rd year.	Project area has **98%** total vegetative cover.	Yes
	50% cover of woody vegetation after the 3rd year.	Project area has **11%** woody cover (11% of south bank and 11% of north bank)	No
Stream Bank Stability	Unstable banks identified within the project reach will require corrective action	One 15' eroding streambank has undercut and migrated laterally by 1 foot in the past 3 years.	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 five 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 2017, percent cover of woody vegetation within the riparian corridor remained at 11%, and is 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 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 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 showed no signs of migrating further in 2015 or 2016; however it appears to have undercut and laterally eroded approximately 1 foot southward in the past year. Erosion along this bank is resulting from the hydraulics generated by the adjacent rootwad, lack of woody vegetation establishment along the bank, and degradation of the coir fabric used to originally construct the bank. This erosion is relatively short in length, is not currently threatening any infrastructure and is migrating at a rate of less than 1 foot per year. As a result of these factors, corrective actions do not appear 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 Site Maps

MDT Stream Mitigation Monitoring
Sweathouse Creek
Ravalli County, Montana

CONFLUENCE
consulting incorporated

Legend

- Channel Thalweg
- Major Station (100')
- Minor Station (25')
- Photo Points
- Pool and Riffle Transects
- Riparian Transects
- Eroding Bank

2017 Monitoring Features Sweathouse Creek

Figure 2

Date: 09/18/2017

Sweathouse_features2017

CONFLUENCE
consulting incorporated

Legend

- Centaurea stoebe
- Cirsium arvense
- Hypericum perforatum
- Leucanthemum vulgare
- Ranunculus acris
- Tanacetum vulgare
- Linaria vulgaris

N

0 25 50 100 Feet

2017 Monitoring Noxious Weeds Sweathouse Creek

Figure 3

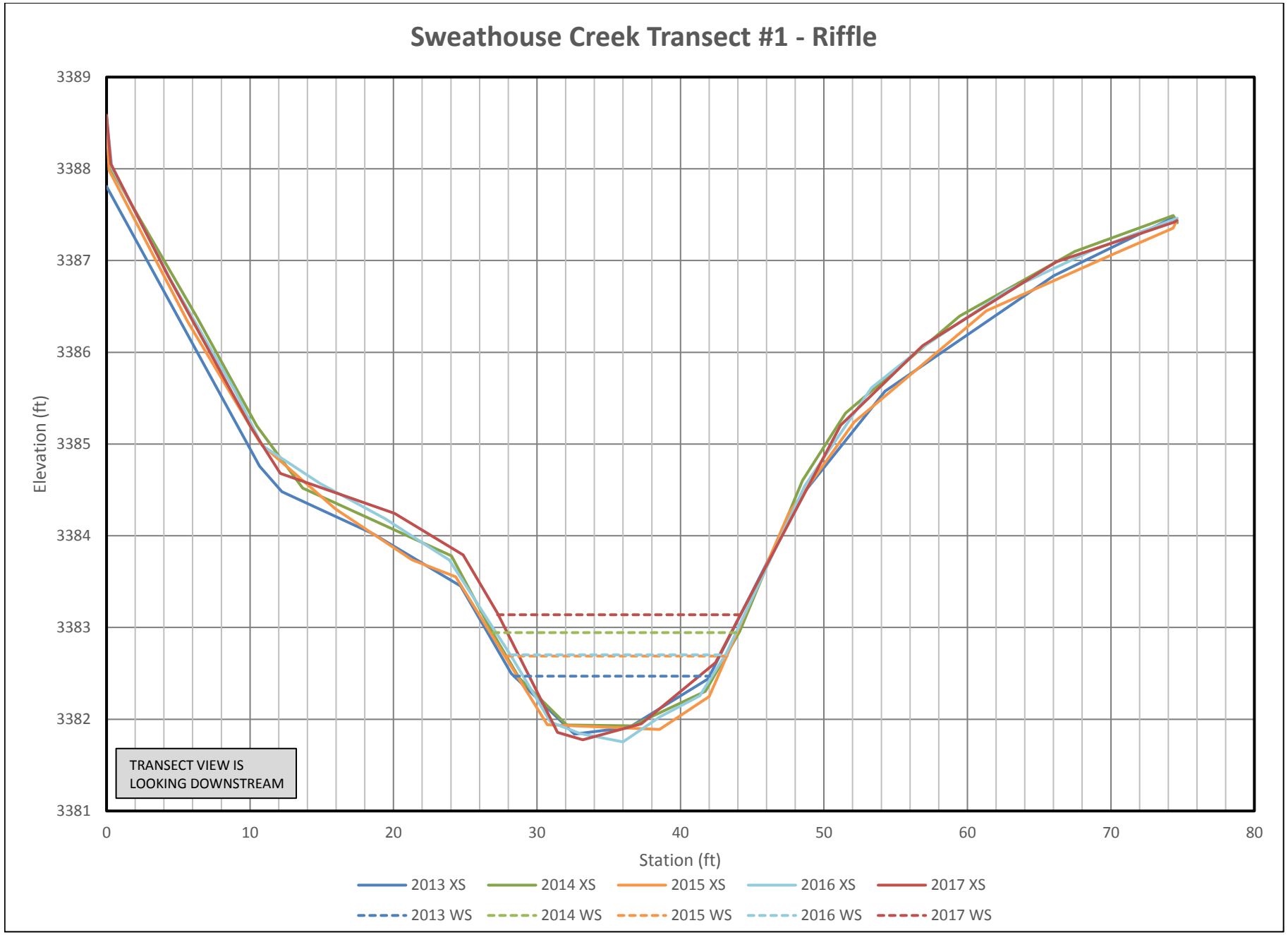
Date: 09/15/2017

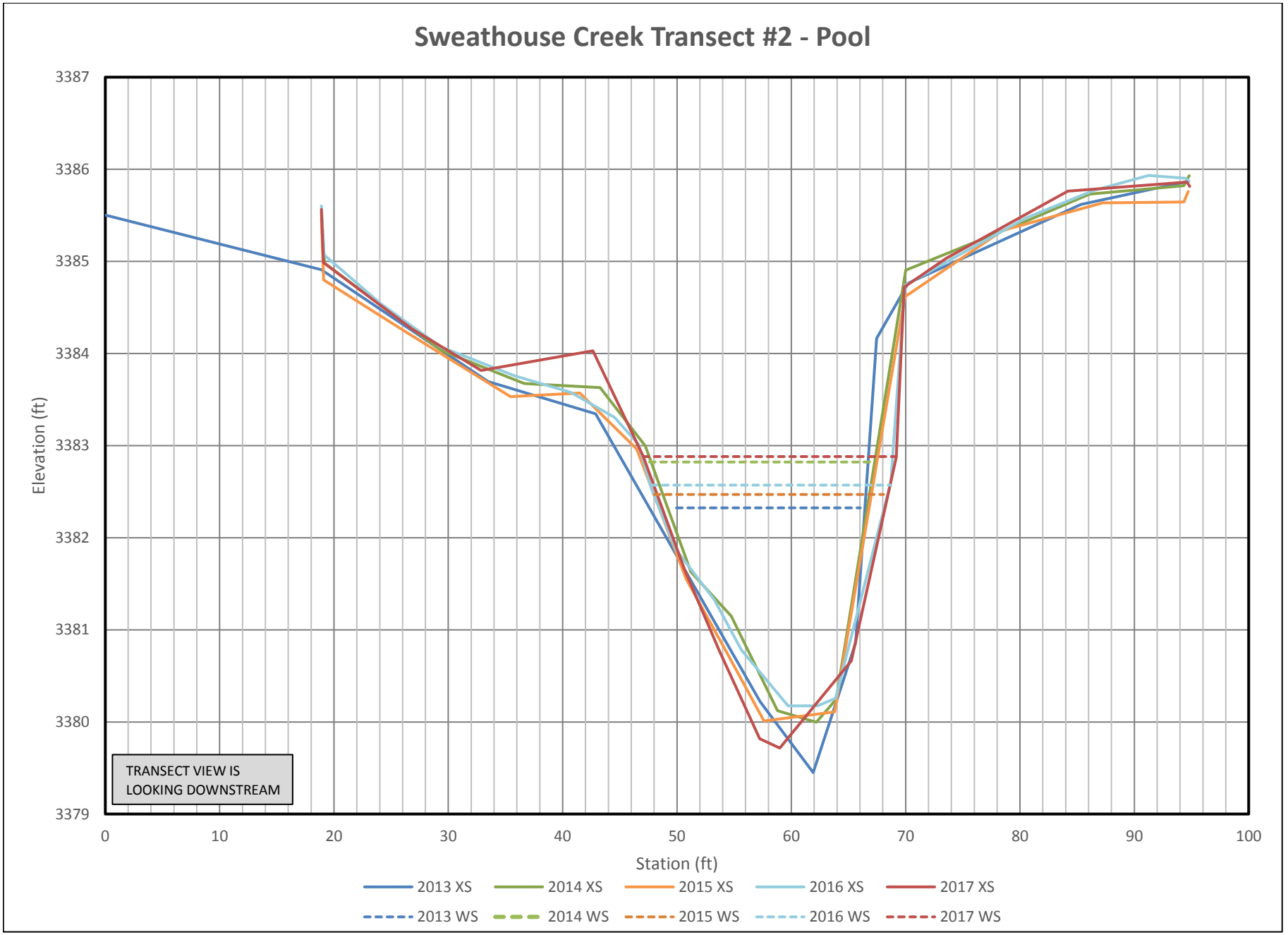
Sweathouse_weeds2017.mxd

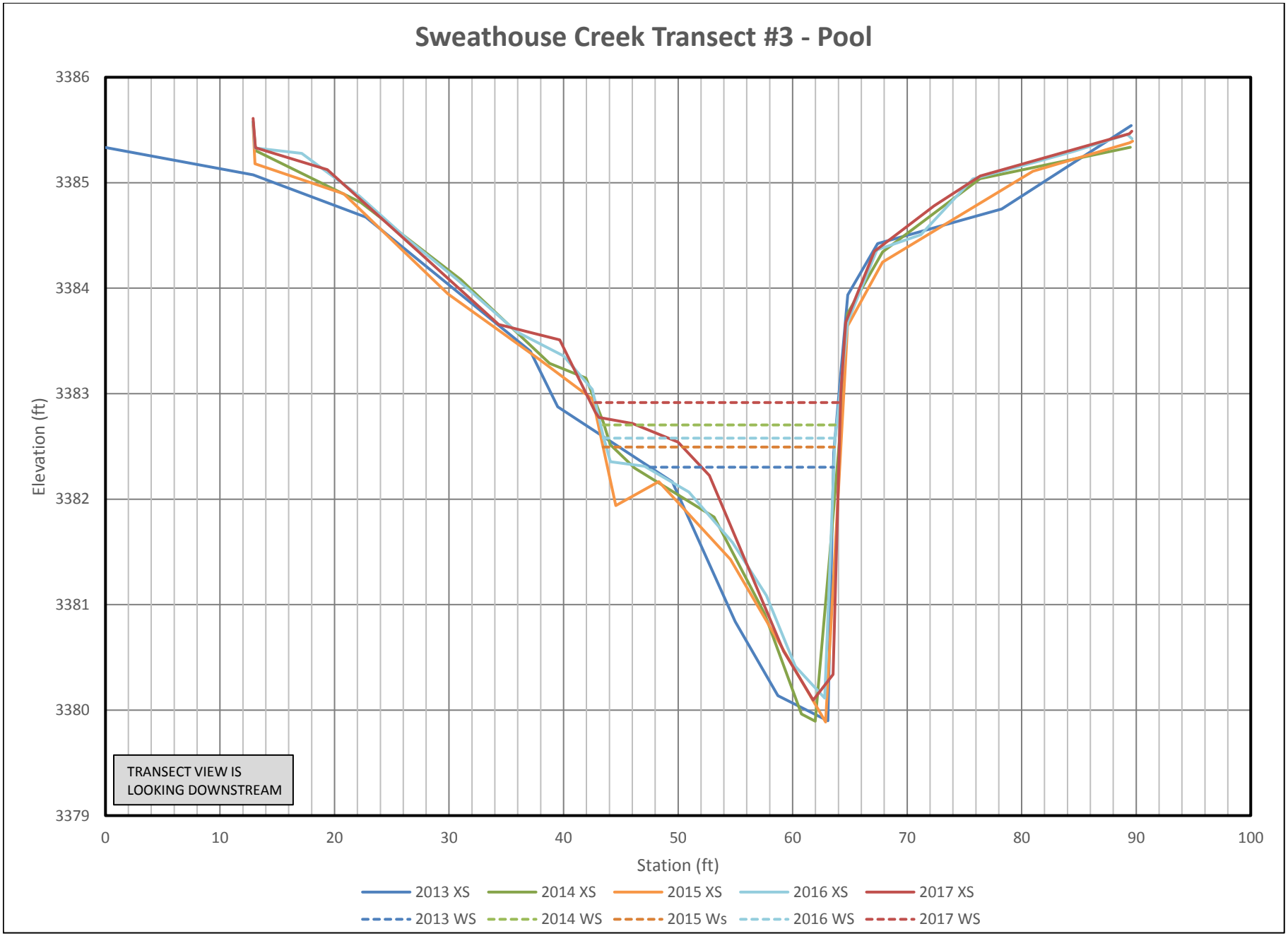
Appendix B

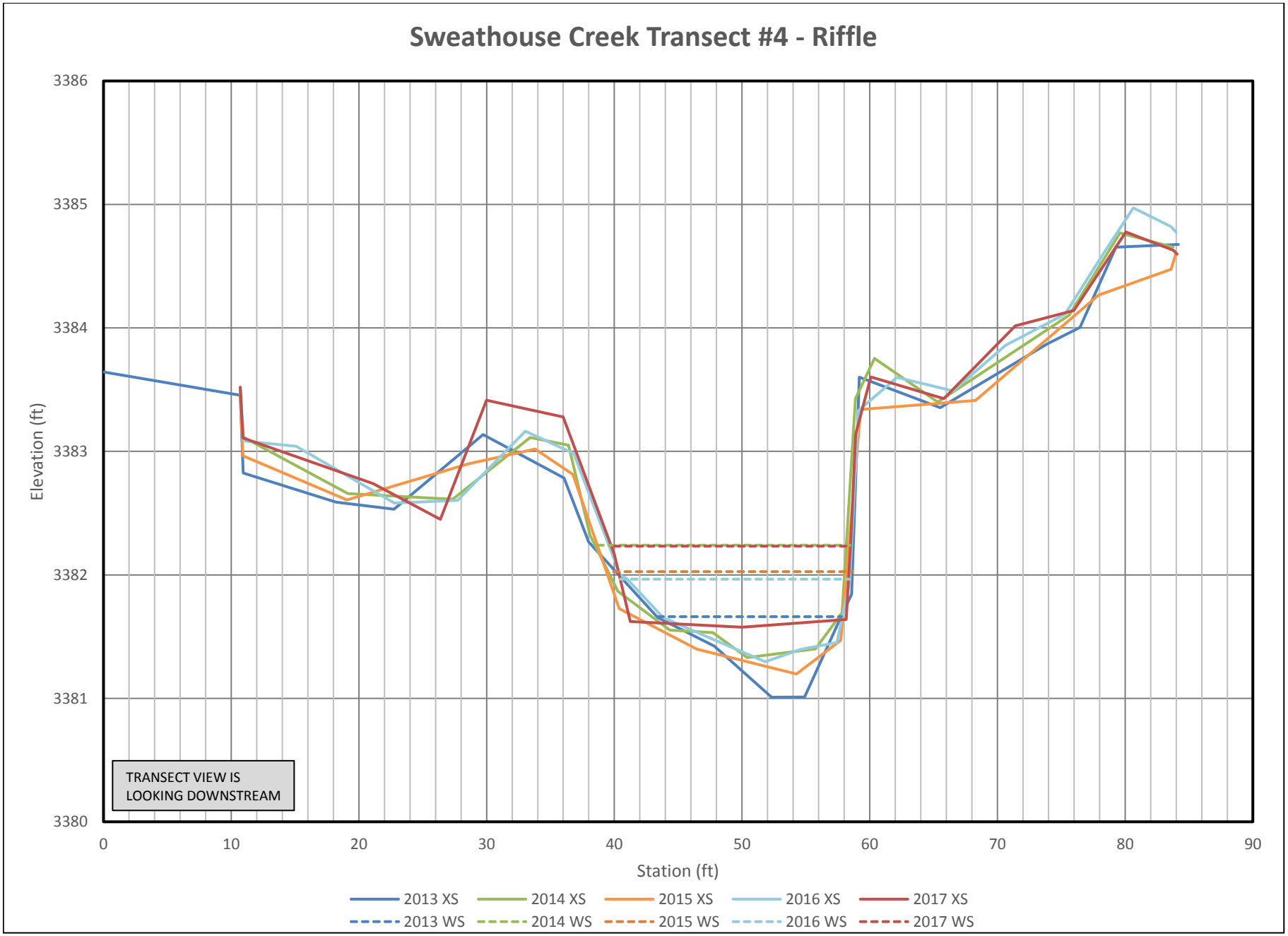
Perpendicular Transect and Longitudinal Profile Plots

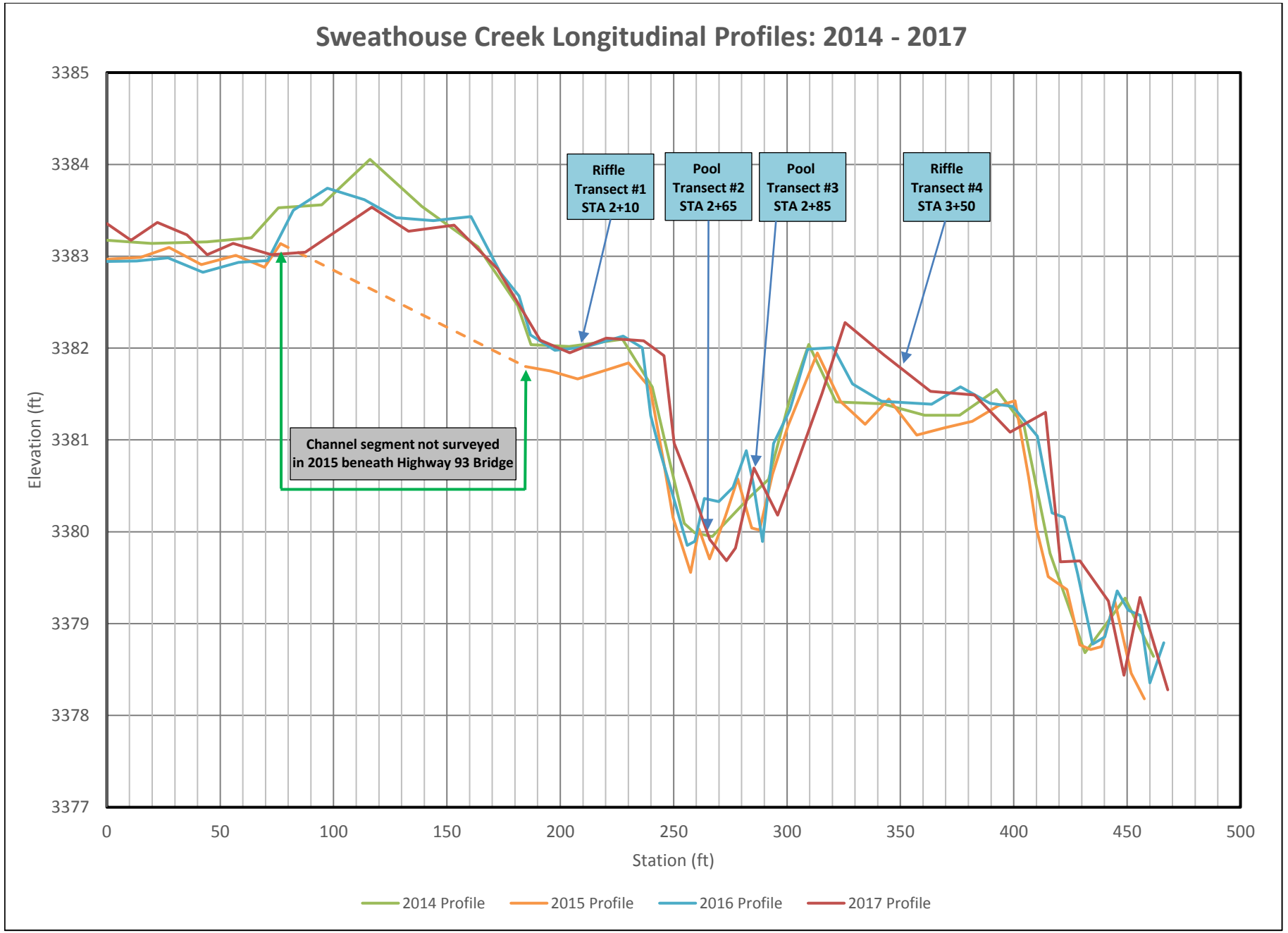
MDT Stream Mitigation Monitoring
Sweathouse Creek
Ravalli County, Montana


Sweathouse Creek Transect #1 - Riffle
Elevation (ft)
3389
3388
3387
3386
3385
3384
3383
3382
3381
0
10
20
30
40
50
60
70
80
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


Sweathouse Creek Transect #2 - Pool
Elevation (ft)
3387
3386
3385
3384
3383
3382
3381
3380
3379
0
10
20
30
40
50
60
70
80
90
100
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


Sweathouse Creek Transect #3 - Pool
Elevation (ft)
3386
3385
3384
3383
3382
3381
3380
3379
0
10
20
30
40
50
60
70
80
90
100
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


Sweathouse Creek Transect #4 - Riffle
Elevation (ft)
3386
3385
3384
3383
3382
3381
3380
0
10
20
30
40
50
60
70
80
90
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


Sweathouse Creek Longitudinal Profiles: 2014 - 2017
Elevation (ft)
3385
3384
3383
3382
3381
3380
3379
3378
3377
0
50
100
150
200
250
300
350
400
450
500
Station (ft)
Riffle Transect #1 STA 2+10
Pool Transect #2 STA 2+65
Pool Transect #3 STA 2+85
Riffle Transect #4 STA 3+50
Channel segment not surveyed in 2015 beneath Highway 93 Bridge
2014 Profile
2015 Profile
2016 Profile
2017 Profile

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 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 1.1: View of north bank from bridge abutment. **Compass**: 45 (Northeast)

2013 **2017**

Photo Point 1.2: View of both banks looking downstream from bridge abutment. **Compass**: 68 (East-Northeast)

2013 **2017**

Photo Point 2: View of un-keyed coir log on south bank. **Compass**: 90 (East)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 3.1: Looking upstream from downstream end of project reach. **Compass**: 225 (Southwest)

2013 **2017**

Photo Point 3.2: View of the north bank looking across channel. **Compass**: 315 (Northwest)

2013 **2017**

Photo Point 3.3: View of downstream extent of project area. **Compass**: 45 (Northeast)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

2013 **2017**

Photo Point 4.1: View of both banks looking upstream. **Compass**: 45 (Northeast)

2013 **2017**

Photo Point 4.2: View of north bank and point bar development. **Compass**: 315 (Northwest)

2013 **2017**

Photo Point 4.3: View of both banks looking downstream. **Compass**: 225 (Southwest)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 5.1: View from north bank looking upstream underneath bridge. **Compass**: 270 (West)

2013 **2017**

Photo Point 5.2: View of south bank. **Compass**: 180 (South)

2013 **2017**

Photo Point 5.3: View of vegetation on north bank. **Compass**: 90 (East)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 6.1: View of north bank vegetation. **Compass**: 225 (Southwest)

2013 **2017**

Photo Point 6.2: View of south bank looking across channel. **Compass**: 135 (Southeast)

2013 **2017**

Photo Point 6.3: View looking across channel from north bank. **Compass**: 90 (East)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Photo Point 7.1: View of north streambank upstream of bridge. **Compass**: 68 (East-Northeast)

2013 **2017**

Photo Point 7.2: View looking downstream beneath bridge. **Compass**: 90 (East)

2013 **2017**

Photo Point 7.3: View of north bank looking across stream channel. **Compass:** 0 (North)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Additional Photo 1: Root wads along south streambank. **Compass:** 45 (Northeast)

2013 **2017**

Additional Photo 2: Point bar formation on north side of channel. **Compass**: 250 (West-Southwest)

2013 **2017**

Additional Photo 3: Log structure along south streambank. **Compass**: 110 (East-Southeast)

PHOTO INFORMATION

PROJECT NAME: Sweathouse Creek Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events

CONFLUENCE

2013 **2017**

Additional Photo 4: Eroding Bank EBR1 prior to bank collapse **Compass**: 90 (East)

2013 **2017**

Additional Photo 5: Looking upstream toward Highway 93 bridge from south bank.

2013 **2017**

Additional Photo 6: Willow cutting growth along north bank **Compass**: 270 (West)

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 1 NORTH LOOKING SOUTH

TRANSECT 1 SOUTH LOOKING NORTH

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 1 NORTH LOOKING UPSTREAM

TRANSECT 1 NORTH LOOKING DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 1 IN CREEK UPSTREAM

TRANSECT 1 IN CREEK DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 1 SOUTH LOOKING UPSTREAM

TRANSECT 1 SOUTH LOOKING DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 2 NORTH LOOKING SOUTHEAST

TRANSECT 2 SOUTH LOOKING NORTHWEST

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 2 NORTH LOOKING UPSTREAM

TRANSECT 2 NORTH LOOKING DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 2 IN CREEK UPSTREAM

TRANSECT 2 IN CREEK DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 2 SOUTH LOOKING UPSTREAM

TRANSECT 2 SOUTH LOOKING DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 3 NORTH LOOKING SOUTHEAST

TRANSECT 3 SOUTH LOOKING NORTHWEST

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 3 NORTH LOOKING UPSTREAM

TRANSECT 3 NORTH LOOKING DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 3 IN CREEK UPSTREAM

TRANSECT 3 IN CREEK DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 3 SOUTH LOOKING UPSTREAM

TRANSECT 3 SOUTH LOOKING DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 4 NORTH LOOKING EAST

TRANSECT 4 SOUTH LOOKING WEST

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 4 NORTH LOOKING UPSTREAM

TRANSECT 4 NORTH LOOKING DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 4 IN CREEK UPSTREAM

TRANSECT 4 IN CREEK DOWNSTREAM

PROJECT NAME: 2017 MDT STREAM MITIGATION—SWEATHOUSE

DATE: 7-19-17

TRANSECT 4 SOUTH LOOKING UPSTREAM

TRANSECT 4 SOUTH LOOKING DOWNSTREAM

Appendix D

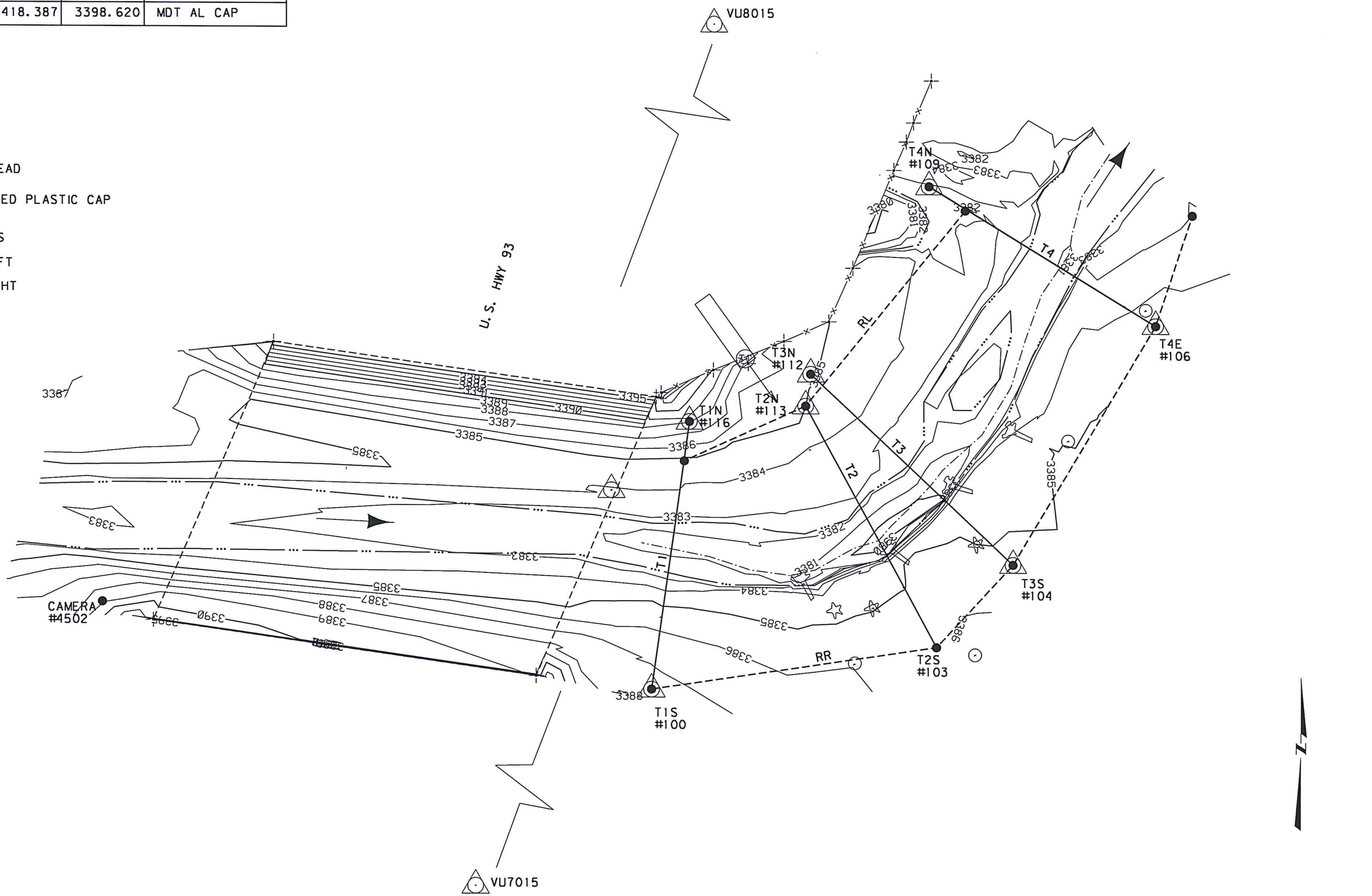
As Built Surveys & Planting Schematics

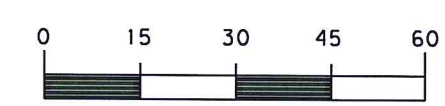
MDT Stream Mitigation Monitoring
Sweathouse Creek
Ravalli County, Montana

CONTROL TABLE				
PNT#	NORTHING	EASTING	ELEV.	DESCRIPTION
VU8015	828172.704	798795.833	3398.807	MDT AL CAP
VU7015	826995.289	798418.387	3398.620	MDT AL CAP

LEGEND

- ROOT BALL
- TREE STUMP
- SPRINKLER HEAD
- IRON PIN W/RED PLASTIC CAP
- T1 TRANSECTIONS
- RL RIPTRANS LEFT
- RR RIPTRANS RIGHT





SURVEYOR NOTES:

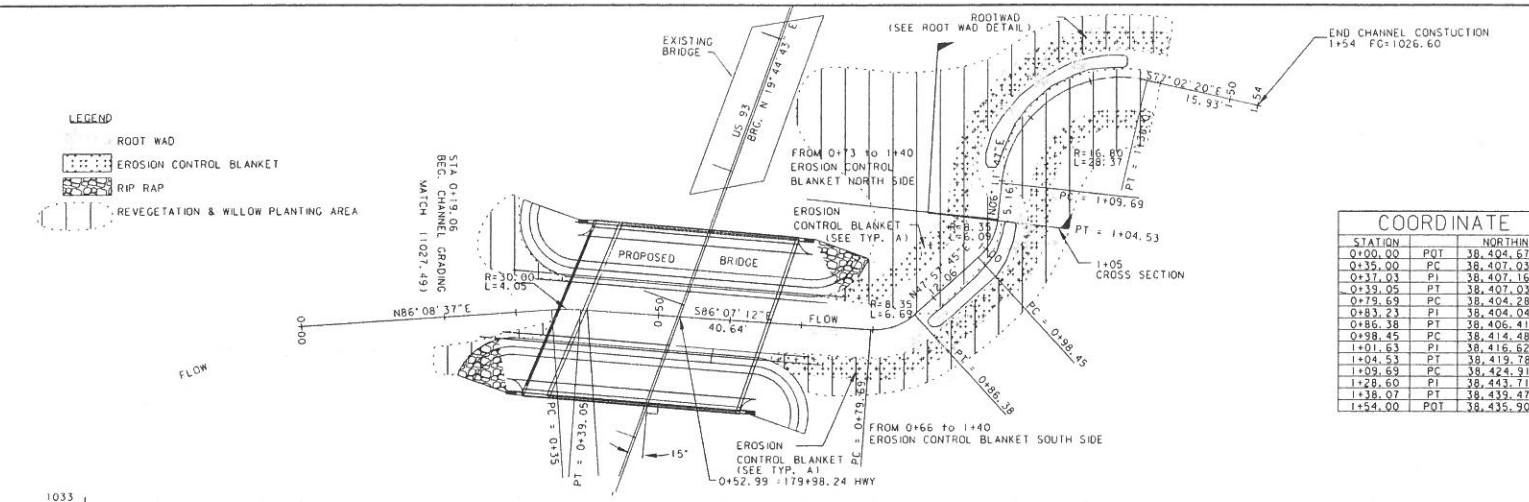
1. THIS SURVEY IS BASED ON FOUND MDT ALUMINUM CAPS STAMPED VU8015 AND VU7015 BUT THEY DO NOT HAVE ESTABLISHED MDT COORDS AND ELEVATIONS. THEREFORE LOCAL CONTROL WAS ESTABLISHED FOR THIS SITE WITH TRIMBLE GPS RTK SURVEY AND THE APPROXIMATE ASSUMED ELEVATION AT MDT ALUM CAP VU8015.
2. THE COORDINATES SHOWN HEREON ARE BASED ON MONTANA STATE PLANE GRID

MDT MONTANA DEPARTMENT OF TRANSPORTATION	...\SWEATHOUSE PLAN .dgn 12/9/2013 11:05:47 AM awiebe	DESIGNED BY ARNE W REVIEWED BY CHECKED BY LARRY R	SWEATHOUSE TOPO

MDT STREAM MITIGATION MONITORING SURVEY

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	NH 7-1(115)59	28

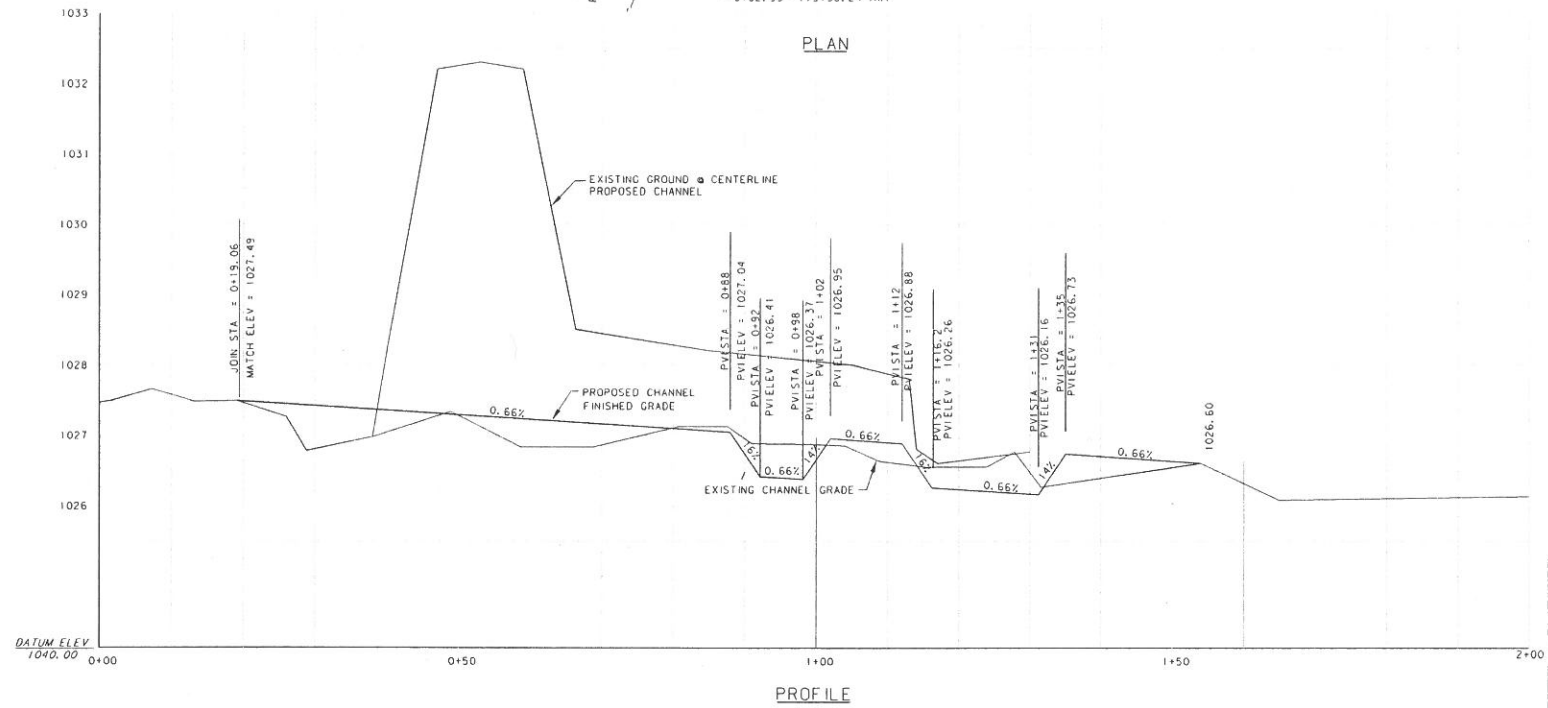
VICTOR URBAN



PLAN

COORDINATE TABLE

STATION		NORTHING	EASTING
0+00.00	POT	38,404.6787	56,198.6875
0+35.00	PC	38,407.0326	56,233.6082
0+37.03	PI	38,407.1690	56,235.6320
0+39.05	PT	38,407.0318	56,237.6558
0+79.69	PC	38,404.2817	56,278.2049
0+83.23	PI	38,404.0424	56,281.7341
0+86.38	PT	38,406.4110	56,284.3612
0+98.45	PC	38,414.4878	56,293.3196
1+01.63	PI	38,416.6210	56,295.6857
1+04.53	PT	38,419.7881	56,296.0296
1+09.69	PC	38,424.9181	56,296.5865
1+28.60	PI	38,443.7182	56,298.6277
1+38.07	PT	38,439.4768	56,317.0564
1+54.00	POT	38,435.9032	56,332.5834



PROFILE

SWEATHOUSE CREEK CHANNEL RESTORATION DETAIL STA. 179+98

SHEET 1 OF 2

NO SCALE

LAND & WATER CONSULTING, INC.

MONTANA CADD

MDT MONTANA DEPARTMENT OF TRANSPORTATION

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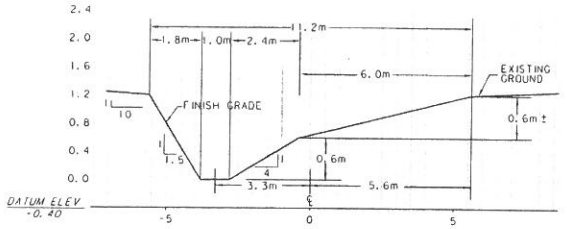
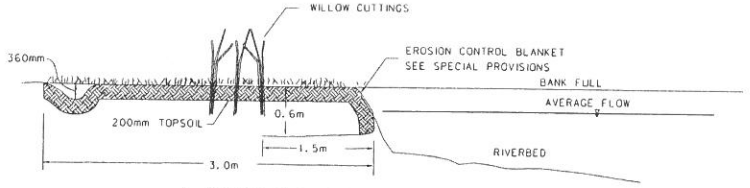
STATE	PROJECT NUMBER	SHEET NO.
MONTANA	NH 7-1(115)59	29

VICTOR URBAN



TYPICAL POOL LEFT CROSS SECTION



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. WRAP BLANKET AND EXTEND 3.0 METERS MIN. FROM BANK EDGE.

EROSION CONTROL BLANKET TYPICAL

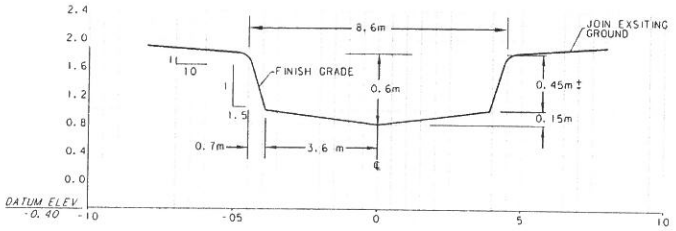
SWEATHOUSE CREEK

LEFT POOL

1+16.2 TO 1+31

RIGHT POOL

0+92 TO 0+98



TYPICAL RIFFLE CROSS SECTION

RIFFLE

(INCLUDES TRANSITIONS)

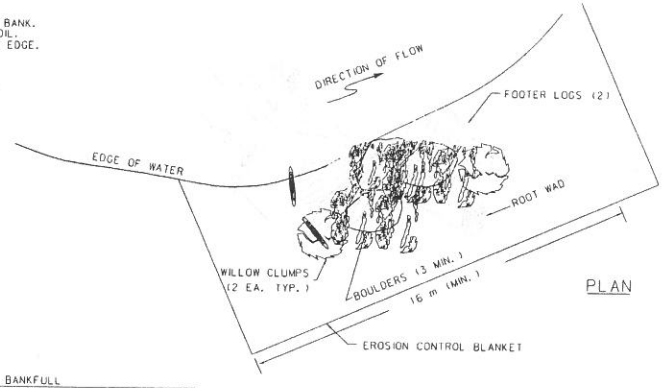
NOTES:

① SEE PLANS FOR POOL LOCATIONS. POOL LEFT (PL) SHOWN, MIRROR ABOUT CENTERLINE (℄) FOR POOL RIGHT LOOKING SOWNSTREAM.

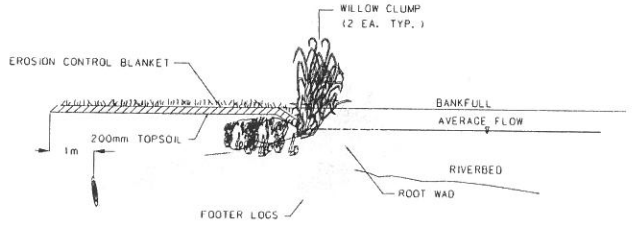
0+19 TO 0+92
1+31 TO 1+53
0+98 TO 1+16.2

② TRANSITION 4.0m BETWEEN POOL & RIFFLE.

③ ROUND SLOPES FOR NATURL APPEARANCE.



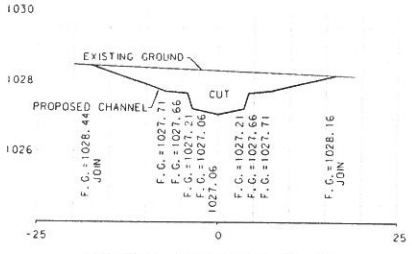
PLAN



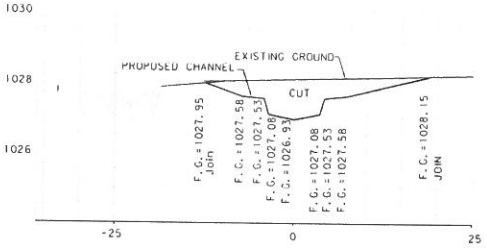
CROSS SECTION

ROOT WAD TYPICAL

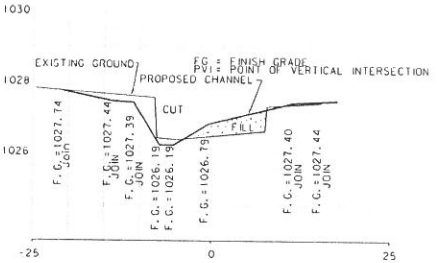
SWEATHOUSE CREEK



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

MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

LAND & WATER CONSULTING, INC.

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