MONTANA DEPARTMENT OF TRANSPORTATION
STREAM MITIGATION MONITORING REPORT

Foy's Bend Fisheries Conservation Area
Flathead County, Montana

Project Completed: 2013
Monitoring Report #4: December 2016

Prepared for:

MONTANA DEPARTMENT OF TRANSPORTATION

Prepared by:

CONFLUENCE consulting incorporated

MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT #4

YEAR 2016

Foy's Bends Fisheries Conservation Area
Flathead County, Montana

MDT Project Number: NH-MT 5-3(50) 109F
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Prepared for:

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

Prepared by:

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

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Cover Photo: Downstream extent of reconstructed bank segment of Flathead River, 2016.

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1.0 INTRODUCTION

The Montana Department of Transportation (MDT), in partnership with Montana Fish, Wildlife and Parks (FWP), has implemented a stream mitigation project at Foy's Bend Fisheries Conservation Area (FCA) near Kalispell, Montana. The goal of the mitigation project is to offset stream and riparian impacts resulting from the Kalispell Bypass and other transportation projects in the Kalispell Region of the Missoula District. Specific project objectives designed to meet this goal include:

- Providing 6,050 linear feet of riparian buffer by establishing 18 fenced exclosures within the Foy's Bend FCA
- Installing woody vegetation plantings within 14 of the 18 fenced exclosures
- Stabilizing 1,350 feet of an eroding bank of the Flathead River utilizing a soil lift and coir fascine.

If successful, the mitigation project will preserve, create, enhance, restore, and maintain permanent, naturally self-sustaining, native habitat. The project is designed to protect the functional values of riparian lands, floodplains, wetlands, and uplands for the benefit of fish and wildlife habitat, water quality, floodwater retention, groundwater recharge, open space, aesthetic values, and environmental education.

The mitigation project will be monitored for a minimum of five years to evaluate compliance toward meeting performance standards. This project was constructed during the spring of 2013; therefore, these results provide documentation of the site's condition during the fourth growing season following the project's completion. The following report provides results from the fourth year of monitoring, and compares these results to the following project performance standards outlined in the post-construction monitoring plan for the site:

<u>Quantitative success criteria:</u>

1. **Riparian Buffer Success** will be achieved when woody and riparian vegetation becomes established, and noxious weeds do not exceed 5% cover within the riparian buffer areas. Any area within the creditable buffer area disturbed by the project construction must have at least 50% areal cover of non-noxious plant species by the end of the monitoring period.
   a) **Vegetation Success** will be achieved when combined areal cover of riparian and stream bank vegetation communities is greater than or equal to 70% and Montana State-listed noxious weeds do not exceed 5% cover, subject to the woody standards listed below.
   b) **Woody Plants** – Planted trees and shrubs will be considered successful where they exhibit 50% survival and areal coverage of 50% or greater after five years.

2. **Bank Restoration Success** will be achieved based upon the rate of erosion encountered during the monitoring period, and will be based upon the evaluated proper functioning condition assessment utilization from the Riparian

Management Guide TR1737-15 "A User's Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas" (Pritchard, D. et al., 1998). The rate of erosion will be determined through the installation of bank pins upon the completion of stream bank work, and will be measured annually for a period of 5-years and/or until vegetation stabilizes along the bank.

a. Rates of success will be determined by the following ratings:

i.) Rate of ≤ 0.5 feet of erosion annually - Functioning*
ii.) Rate of ≤ 1.0 foot of erosion annually - Functioning*
iii.) Rate of ≤ 1.5 feet of erosion annually - Functioning at Risk*
iv.) Rate of ≥ 3 feet of erosion annually - Functioning at Risk or not Functioning**
v.) Rate of > 5 feet or more of erosion annually - Not Functioning**

b. During the 3rd and final monitoring years, ratings for the stream bank will be based upon the Proper Functioning Condition ratings that determine if the area is supporting a healthy and stable bank area adjacent to the stream as derived from the ratings found in Pritchard (1998) for a determination of the following -

i.) **Functioning** - Supporting a healthy and stable bank area adjacent to the river

ii.) **Functioning at Risk** - One or more functions of the stream bank are adjusting to changes in the design within the reach area, and the area may be trending either towards lower or higher functionality, but more monitoring and/or adaptive management may be needed so that it can support a healthy and stable bank area in the future.

iii.) **Not Functioning** - Measurements of the functions indicate that the site is not achieving functional goals and is not supporting a healthy and stable bank reach that may be trending toward further degradation.

*If the rate of bank erosion is greater than 1 to 2 feet per year due to natural erosive actions, adaptive management will take place.

**If the rate of bank erosion is greater than 3 feet or more due to a single force of nature, such as an ice jam or a significant flood event beyond the normal riverine processes, this will be considered a major force event and restoration actions may not occur.

3. **Willow mats** will be monitored annually and considered successful when, after five years, the density of new willow stem growth achieves 50% aerial coverage.

4. **Vegetation along the river bank** will be considered successful when banks are vegetated with a majority of deep-rooting riparian plant species that have root stability indices greater than or equal to 6 (subject to 1.a and 1.b above).

5. **Weed Control** will be based upon annual monitoring of the project area to determine weed species and degree of infestation within the site. Control measures, based upon the monitoring results, will be implemented by MDT in cooperation with FWP to minimize and/or eliminate the intrusion of State Listed noxious weed species within the site. This performance measure will be considered successful when Montana State-listed noxious weeds do not exceed 5% cover within the bank restoration and riparian planting zones.

Results of the fourth year monitoring at the Foy's Bend FCA are included in Section 4. In Section 5, the monitoring results for 2016 are compared to performance standards outlined in the Foy's Bend Monitoring Plan. Section 6 provides management recommendations to maximize the potential for meeting all performance standards at this mitigation site. Additional information including maps of the endpoints of riparian belt transects, stream bank surveys, vegetation communities and locations of noxious weed infestations, repeated survey results along the reconstructed bank segment of the Flathead River, photo documentation of the project site, and a planting schematic from the approved design, is provided as Appendices to this report.

2.0 SITE LOCATION

The Foy's Bend mitigation project occurs on approximately 245 acres of the FWP-owned Foy's Bend FCA property, and is approximately 2 miles southeast of Kalispell. The project is located in Sections 26, 27, 34, and 35, in Township 28 North, Range 21 West, in Flathead County, Montana (Figure 1 and Figure 2).

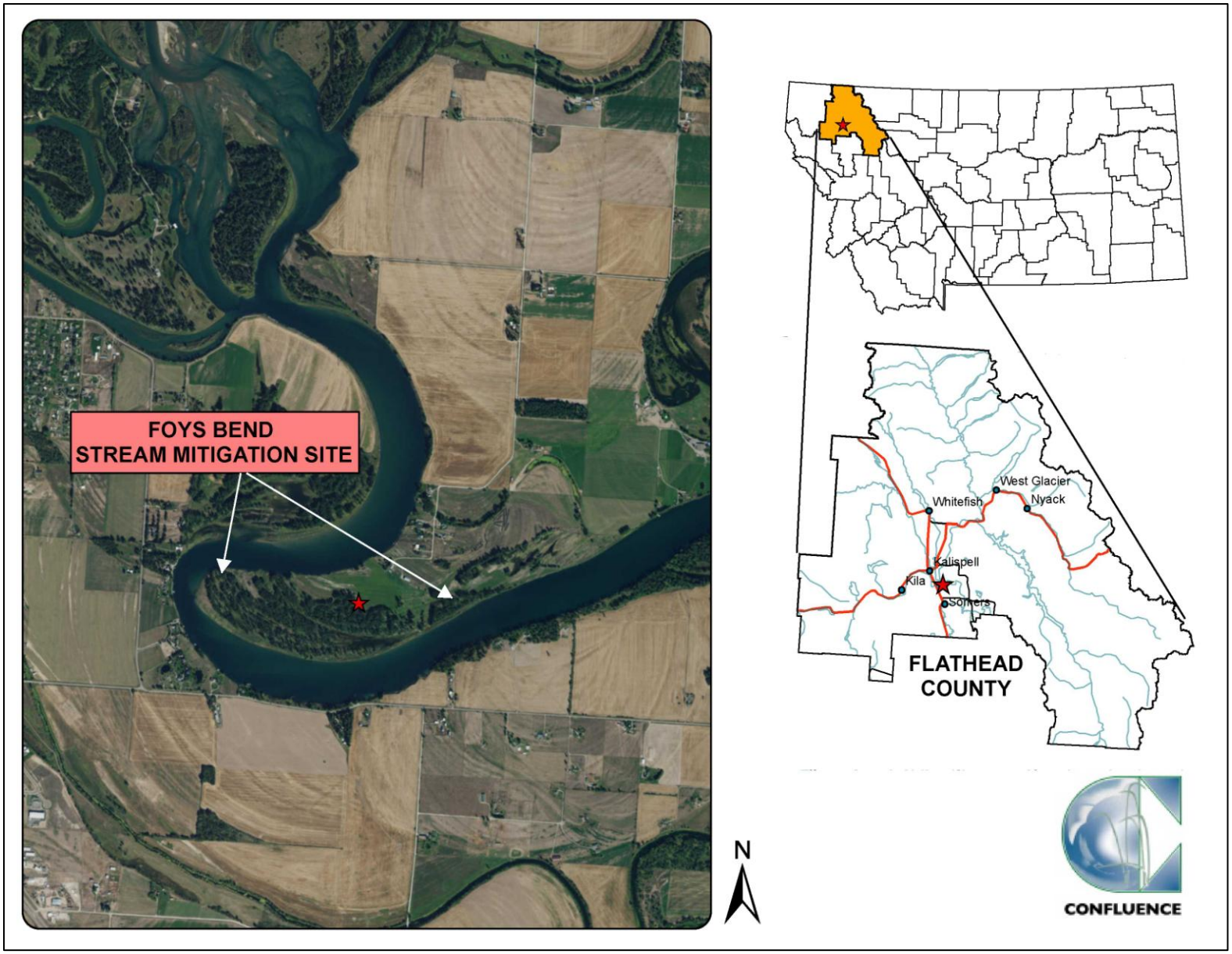

Figure 1. Project location of Foy's Bend Fisheries Conservation Area stream mitigation site.

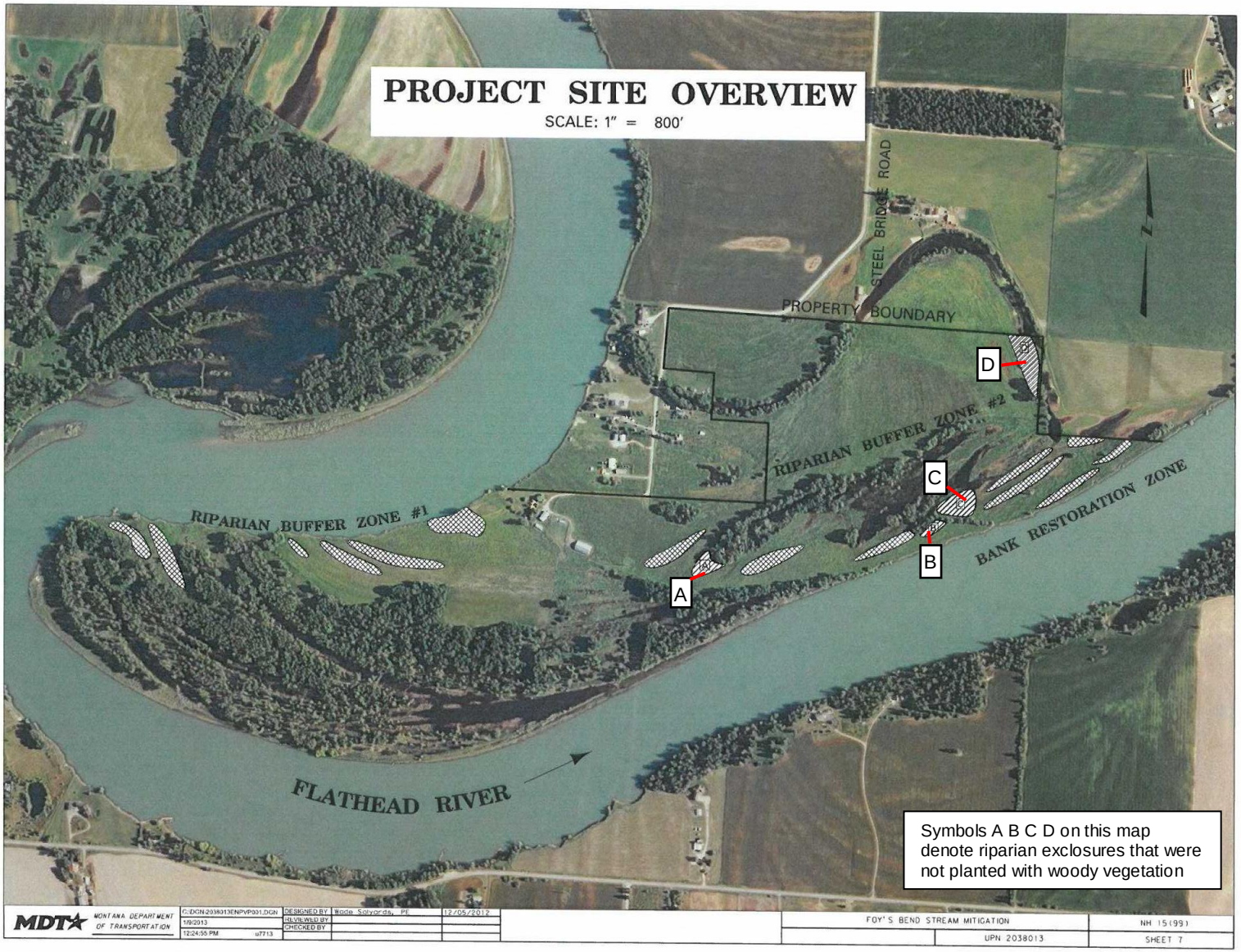

Figure 2. Detail of Foy's Bend Mitigation Site

3.0 MONITORING METHODS

The 2016 monitoring included two site visits to Foy's Bend. A spring site visit was conducted on April 11th and 12th to document conditions of the reconstructed bank segment while Flathead Lake levels remained below full pool. This site visit documented conditions of the reconstructed bank and areas below the bioengineered bank treatment during a time when this portion of the bank remained visible. Survey crews visited the site on April 12th and 13th to establish two new transects further upstream of the reconstructed bank segment and to extend each of the previously established transects further across the river.

Monitoring field crews visited the project site again on August 5th and 6th, 2016, while survey crews visited the site on August 9th. The following data were collected at the Foy's Bend FCA stream mitigation site during the August site visit:

3.1. Vegetation Inventories

Riparian buffer success criteria were monitored annually along four riparian belt transects originally established in 2013, including a 274 foot transect in exclosure #2 (T1), a 425 foot transect in exclosure #6 (T2), a 230 foot transect in exclosure #8 (T3), and a 275 foot transect in exclosure #18 (T4). Monitoring included inventorying vegetation within a 25-foot wide belt centered by the transect alignment. Riparian transects T1 and T2 were conducted in exclosures planted with woody species per the mitigation plan. Riparian transect T3 was conducted in an exclosure that did not contain, nor was planted with woody vegetation prior to mitigation in order to assess volunteer recruitment of woody vegetation growth and establishment. Riparian transect T4 was conducted in an exclosure that had mature woody vegetation present, but was not supplementally planted. In addition to the four riparian transect inventories, dominant vegetation communities, percent cover by noxious weeds, and establishment by volunteer species was documented within all fenced exclosures.

A vegetation inventory was also conducted along one transect (T5) that ran parallel to the restored stream bank. The stream bank transect (T5) extended 1,350 feet and ran parallel to the Flathead River along the length of the reconstructed river bank. Data collection included areal percent cover of total vegetation, woody vegetation, and noxious weeds within a 10 foot wide belt along the entire 1,350-foot length of the reconstructed bank. The vegetation inventory included compiling a list of all plant species and their associated cover classes identified within 10 feet of the active channel. Percent cover of all species observed along the entire length of each bank was estimated and recorded using the classification values listed in Table 1.

Table 1. Classification values and associated percent cover classes used for vegetation inventories.

Classification Value	% Cover
0	<1%
1	1-5%
2	6-10%
3	11-20%
4	21-50%
5	>50%

Stream bank community types were named based on the predominant vegetation species that characterized transect T5. Bank stability indices were then assigned to the stream bank community types (Winward 2000; Pick et al. 2004). The stability ratings are based on vegetation communities rather than individual species; therefore, a vegetation community was assigned to the stream bank based on one or more dominant species. If the community type was defined by one or more dominant species, the more dominant species stability rating was reported.

Areas within the fenced exclosures and along the restored bank were visually inspected to document the presence of noxious weeds. All noxious weed infestations were identified and mapped on aerial photographs, with species, cover class, and infestation extent 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.

All fenced exclosures were visually inspected to document woody vegetation plantings. The inspection included recording the total number of live and dead woody plantings observed along each row of planted shrubs. A qualitative inspection of plantings was conducted to assess whether surviving plants were either thriving or showed signs of stunted growth due to either artificial and/or natural factors. The presence of volunteer woody vegetation within each exclosure was recorded with the species and extent noted.

3.2. Reconstructed River Bank Surveys

Bank restoration success was monitored by surveying a series of perpendicular transects along the reconstructed bank segment. During the April, 2016 site visit, two additional bank transects were established upstream of those previously surveyed. Bank transects #0 and #-0.5 were established 50 and 100 feet upstream of bank transect #0.5, respectively. These transects were established to compare lateral erosion rates along a bank segment that was not stabilized and the 1300-foot long stabilized bank segment just downstream.

During both the April and August 2016 monitoring events, a Trimble R8 GPS with rover and base station units was used to survey the exposed portion of each transect, and a boat-mounted SonarMite Echosounder unit was used to extend the length of each bank transect further across the river. Each transect was extended to document river bank

elevations well below the water surface and help determine whether lateral adjustments are occurring beneath the reconstructed, upper portion of the bank.

Results of all reconstructed bank transect surveys and a profile indicating the elevation of the fascine installed beneath the coir wrapped bank are provided in Appendix B. Perpendicular bank transect #5 should not be confused with vegetation transect #5 (described in Section 3.1), which runs parallel to the reconstructed bank.

3.3. Fencing Inspections

All fencing placed by MDT was inspected for damage or wear. All fencing issues were photographed and locations documented on aerial maps. A list of all fencing maintenance concerns at Foy's Bend was provided to MDT on August 18, 2016. Fence repairs were made by MDT maintenance crews on August 24, 2016.

3.4. Wildlife Documentation

Wildlife use of the project reach was documented by creating a list of all bird, mammal, and herpetile species observed during the site visit. Wildlife species were identified through visual observation, scat, tracks, and observation of nests, burrows, dens, feathers, etc.

3.5. Photo-Documentation

Photos were taken at all permanent photo documentation sites established during the 2013 monitoring event. Survey crews documented the reconstructed bank by taking photographs upstream, downstream, toward the bank, and toward the river at each survey transect. All sites selected for photo documentation were recorded on field maps with headings noted to allow for repetition during subsequent monitoring years.

4.0 RESULTS

4.1. Riparian and Stream Bank Vegetation Inventory

Table 2 presents the vegetation cover results for the four riparian belt transects and single stream bank belt transect from 2013 to 2016. Transect locations are presented on Figures 4, 5, and 6 in Appendix A. Minimal bare ground was observed along three of the four riparian vegetation transects and along the stream bank transect. It should be noted that the total percent cover of vegetation along the riparian transects, in 2015, included the presence of heavily matted litter from multiple grass species. This layer of litter comprised approximately 35-40% of the riparian transects surveyed in 2015. This heavily matted litter was greatly reduced during the August 2016 site visit, thus exposing more bare ground than was observed in previous monitoring years.

Table 2. Percent cover of vegetation transects at the Foy's Bend stream mitigation site from 2013-2016.

Belt Transect	Location	Transect Type	Length (ft.)	Total % Vegetation Cover			
				2013	2014	2015	2016
1	Exclosure 2	Riparian	274	100	100	100	100
2	Exclosure 6	Riparian	425	100	100	97	97
3	Exclosure 8	Riparian	230	100	100	100	97
4	Exclosure 18	Riparian	275	100	100	100	98
5	Stabilized river bank	Streambank	1350	63	85	95	97

For the purposes of determining comprehensive vegetation cover for comparison against the mitigation performance standards, the four riparian belt transects were each considered to be representative of one or more of the 18 riparian exclosure areas, based upon their pre-treatment condition and mitigation activity. Boundaries for the riparian exclosure areas are presented relative to the transect alignments on Figures 4, 5, and 6 in Appendix A.

Transects 1 and 2 were considered representative of the 14 exclosures planted with woody vegetation. A length-based weighted average of vegetation cover for these two transects (98%) was assigned to exclosures 1-7, 9, 10, and 13-17. Transect 3 was considered representative of the three exclosures that were not planted and contained no naturally occurring woody vegetation prior to the mitigation project. The vegetation cover for transect 3 was assigned to riparian exclosures 8, 11, and 12. These three exclosures are intended to promote natural woody vegetation development due to their close proximity to existing stands of aspen and cottonwood. Transect 4 was located in the lone riparian exclosure (#18) that was not planted, but had naturally occurring woody vegetation within it prior to the mitigation project. Therefore, the vegetation cover from transect 4 was considered representative of exclosure 18 only. This exclosure was also unique in that it was established by FWP for MDT prior to the project. Table 3 presents each riparian exclosure, its area in acres, and its areal percent cover of total vegetation. As shown in TablesTable 3 andTable 4, the area-weighted-average of total vegetation cover for all the riparian exclosure areas on the project site is 98%.

Table 3. Exclosure size (acreage) and total percent riparian cover at the Foy's Bend stream mitigation site from 2013-2016.

Exclosure	Planted	Acres	Total % Vegetation Cover			
			2013	2014	2015	2016
1	Yes	0.74	100%	100%	98%	98%
2	Yes	1.06	100%	100%	98%	98%
3	Yes	0.34	100%	100%	98%	98%
4	Yes	0.87	100%	100%	98%	98%
5	Yes	1.20	100%	100%	98%	98%
6	Yes	1.23	100%	100%	98%	98%
7	Yes	0.93	100%	100%	98%	98%
8	No	0.56	100%	100%	100%	97%
9	Yes	1.16	100%	100%	98%	98%
10	Yes	0.67	100%	100%	98%	98%
11	No	0.26	100%	100%	100%	99%
12	No	0.91	100%	100%	100%	98%
13	Yes	0.75	100%	100%	98%	98%
14	Yes	0.89	100%	100%	98%	98%
15	Yes	0.55	100%	100%	98%	98%
16	Yes	0.41	100%	100%	98%	99%
17	Yes	0.34	100%	100%	98%	98%
18	No	1.22	100%	100%	100%	99%
Total		**14.1**	**100%**	**100%**	**98%**	**98%**

The vegetation belt transect along the stream bank (transect 5) was 1,350 feet long, 10 feet wide, and covered approximately 0.3 acres. It was aligned parallel and immediately adjacent to the Flathead River bank on the southern boundary of the project area (Figure 6, Appendix A). As shown in Table 2, total vegetation cover of the stream bank transect was 97%, representing an increase by 2% since 2015, 12% since 2014, and 34% since the initial monitoring event in 2013. Bare ground was primarily observed in areas where vegetation has not established through the coir blanket and in areas where soil has been stripped from the river-side edge of the coir wrapped bank (see Additional Photos 3, 4, and 5 on pages C-5 and C-6 of Appendix C). Table 4 presents a summary of vegetation cover for all riparian exclosure and stream bank transects combined.

Table 4. Area-weighted-average of areal vegetation cover for riparian and stream bank transects at the Foy's Bend stream mitigation site from 2013-2016.

Area Type	Acres	Total % Vegetation Cover			
		2013	2014	2015	2016
Riparian Exclosures	14.1	100%	100%	98%	98%
Streambank	0.3	69%	85%	95%	97%
Total	14.4	99.3%	99.7%	98.3%	98.1%

The vegetation community type for each of the exclosure areas is presented on Figures 7, 8, and 9 in Appendix A. Nine main vegetation community types were identified on site in 2016, and are included in Table 5.

Table 5. Vegetation community types observed at Foys Bend stream mitigation site in 2016.

Community Type	Dominant Species
1	*Phalaris arundinacea/Poa pratensis*
2	*Populus* spp.
4	*Alopecurus arundinaceus/Poa pratensis*
5	*Bromus inermis/Symphoricarpos albus*
6	*Phalaris arundinacea/Symphoricarpos albus*
8	*Bromus inermis/Poa pratensis*
9	*Phalaris arundinacea*
11	*Elymus repens/Poa pratensis*
12	*Poa pratensis/Populus tremuloides*

Vegetation community Type 1 – *Phalaris arundinacea/Poa pratensis* was identified in 17 of the 18 riparian exclosures in 2013 and 2014. In 2016, this community was observed in only two riparian exclosures (6 and 15) due to a shift in species composition and their associated cover classes.

Vegetation community Type 2 – *Populus* spp. was identified in riparian exclosures 1, 6, and 18 from 2013 through 2015. In 2016, this community was observed in riparian exclosures 6, 17, and 18.

Vegetation community Type 4 – *Alopecurus arundinaceus/Poa pratensis* was identified in riparian exclosure 4 from 2013 through 2016. In 2016, this community was also observed in riparian exclosures 5 and 10.

Vegetation community Type 5 – *Bromus inermis/Symphoricarpos albus* was observed in 2015 and 2016 in riparian exclosure 2.

Vegetation community Type 6 – *Phalaris arundinacea/Symphoricarpos albus* was identified in 2015 and 2016 in riparian exclosures 1 and 12.

Vegetation community Type 8 – *Bromus inermis/Poa pratensis* was identified in 2015 and 2016 in riparian exclosures 3 and 18.

Vegetation community Type 9 – *Phalaris arundinacea* was first observed in 2015 in riparian exclosures 13, 14, 16, and 17. In 2016, this community was identified in these same riparian exclosures along with the northeastern portion of riparian exclosure 18.

Vegetation community Type 11 – *Elymus repens/Poa pratensis* was first observed in 2016 in riparian exclosures 7, 8, and 9. Vegetation community Type 7 – *Poa pratensis/Dactylis glomerata* was identified in these exclosures in 2015. The change in community type represents the shift in vegetation cover from a dominance of orchard grass (*Dactylis glomerata*) to creeping wild rye (*Elymus repens*).

Vegetation community Type 12 – *Poa pratensis/Populus tremuloides* was first identified in 2016 in riparian exclosure 11. Vegetation community Type 7 – *Poa pratensis/Dactylis glomerata* was identified in this exclosure in 2015. The change in community type

represents the shift in vegetation cover from a dominance of orchard grass to quaking aspen (*Populus tremuloides*).

Table 6 is a comprehensive list of plant species identified within the riparian exclosures at the Foy's Bend stream mitigation site from 2013 through 2016. In 2016, 122 species were observed, representing an increase by 4 species since 2015, 26 species since 2014, and 60 species since the initial monitoring event in 2013. In 2016, 51% of the species identified on site were hydrophytic based on the 2016 National Wetland Plant List (NWPL) (Lichvar *et al*., 2016).

Table 6. Comprehensive list of plant species identified within riparian exclosures at the Foy's Bend stream mitigation site from 2013- 2016.

Scientific Name	Common Name	WMVC Indicator Status*
Achillea millefolium	Common Yarrow	FACU
Agastache urticifolia	Nettle-Leaf Giant-Hyssop	FACU
Agropyron sp.	Wheatgrass	NL
Agrostis gigantea	Black Bent	FAC
Agrostis stolonifera	Spreading Bent	FAC
Alnus incana	Speckled Alder	FACW
Alopecurus aequalis	Short-Awn Meadow-Foxtail	OBL
Alopecurus arundinaceus	Creeping Meadow-Foxtail	FAC
Alopecurus pratensis	Field Meadow-Foxtail	FAC
Alyssum alyssoides	Pale Alyssum	NL
Apocynum cannabinum	Indian-Hemp	FAC
Arctium lappa	Greater Burdock	NL
Arctium minus	Lesser Burrdock	UPL
Asclepias sp.	Milkweed	NL
Asparagus officinalis	Asparagus	FACU
Asperugo procumbens	German-Madwort	UPL
Aster sp. (white rays)	Aster	NL
Aster sp. (purple rays)	Aster	NL
Brassica juncea	Chinese Mustard	UPL
Bromus inermis	Smooth Brome	UPL
Calamagrostis canadensis	**Bluejoint**	**FACW**
Carduus nutans	Nodding Plumeless-Thistle	UPL
Carex aquatilis	Leafy Tussock Sedge	OBL
Carex bebbii	Bebb's Sedge	OBL
Carex nebrascensis	Nebraska Sedge	OBL
Carex pellita	Woolly Sedge	OBL
Carex sp.	Sedge	NL
Carex stipata	Stalk-Grain Sedge	OBL
Carex utriculata	Northwest Territory Sedge	OBL
Carex vesicaria	Lesser Bladder Sedge	OBL
Carum carvi	Caraway	FACU
Chamerion angustifolium	Fireweed	NL
Chenopodium album	Lamb's-Quarters	FACU
Chenopodium leptophyllum	Narrow-Leaf Goosefoot	FACU
Chenopodium rubrum	Red Goosefoot	FACW
Cirsium arvense	Canadian Thistle	FAC
Cirsium vulgare	Bull Thistle	FACU
Convolvulus arvensis	Field Bindweed	NL
Coreopsis tinctoria	Golden Tickseed	FACU
Cornus alba	Red Osier	FACW
Crataegus douglasii	Black Hawthorn	FAC
Cynoglossum officinale	Gypsy-Flower	FACU
Dactylis glomerata	Orchard Grass	FACU
Descurainia sophia	Herb Sophia	NL
Elaeagnus commutata	American Silver-Berry	FAC
Eleocharis palustris	Common Spike-Rush	OBL
Elymus canadensis	Nodding Wild Rye	FAC
Elymus hispidus	Intermediate Wheatgrass	NL
Elymus repens	Creeping Wild Rye	FAC
Elymus trachycaulus	Slender Wild Rye	FAC
Epilobium ciliatum	Fringed Willowherb	FACW
Equisetum arvense	Field Horsetail	FAC
Equisetum hyemale	Tall Scouring-Rush	FACW
Galium aparine	**Sticky-Willy**	**FACU**
Geum macrophyllum	Large-Leaf Avens	FAC
Glyceria grandis	American Manna Grass	OBL
Heracleum lanatum	Cow-Parsnip	NL
Hordeum jubatum	Fox-Tail Barley	FAC
Juncus balticus	Baltic Rush	FACW
Juncus bufonius	Toad 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
Kochia scoparia	Mexican Kochia	NL
Lactuca serriola	Prickly Lettuce	FACU
Lemna minor	Common Duckweed	OBL
Leucanthemum vulgare	Ox-Eye Daisy	FACU
Linaria vulgaris	Butter-and-eggs	NL
Maianthemum stellatum	Starry False Solomon's-Seal	FAC
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
Nepeta cataria	**Catnip**	**FACU**
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
Polygonum aviculare	Yard Knotweed	FAC
Populus angustifolia	Narrow-Leaf Cottonwood	FACW
Populus balsamifera	Balsam Poplar	FAC
Populus tremuloides	Quaking Aspen	FACU
Potentilla anserina	Silverweed	OBL
Potentilla recta	Sulphur Cinquefoil	NL
Prunus virginiana	Choke Cherry	FACU
Ribes inerme	**White-Stem Gooseberry**	**FAC**
Rosa woodsii	Woods' Rose	FACU
Rumex crispus	Curly Dock	FAC
Rumex fueginus	Tierra del Fuego Dock	FACW
Rumex salicifolius	Willow Dock	FACW
Salix bebbiana	Gray Willow	FACW
Salix exigua	Narrow-Leaf Willow	FACW
Salix sp.	Willow	NL
Schoenoplectus acutus	Hard-Stem Club-Rush	OBL
Scirpus microcarpus	Red-Tinge Bulrush	OBL
Scirpus sp.	Bulrush	NL
Shepherdia argentea	Silver Buffalo-Berry	FACU
Silene vulgaris	Maiden's-tears	NL
Solanum dulcamara	Climbing Nightshade	FAC
Solidago canadensis	Canadian Goldenrod	FACU
Sonchus arvensis	Field Sow-Thistle	FACU
Sporobolus airoides	Alkali-Sacaton	FAC
Symphoricarpos albus	Common Snowberry	FACU
ascendens	Western American-Aster	FACU
Symphyotrichum laeve	Smooth Blue American Aster	FACU
Tanacetum vulgare	Common Tansy	FACU
Taraxacum officinale	Common Dandelion	FACU
Thlaspi arvense	Field Pennycress	UPL
Tragopogon dubius	Meadow Goat's-beard	NL
Trifolium pratense	Red Clover	FACU
Trifolium repens	White Clover	FAC
Typha angustifolia	Narrow-Leaf Cat-Tail	OBL
Typha latifolia	Broad-Leaf Cat-Tail	OBL
Verbascum thapsus	Great Mullein	FACU

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

4.2. Stream Bank Vegetation Composition

In 2016, 54 plant species were observed along vegetation transect #5, running the length of the reconstructed stream bank (Table 7). Reed canary grass (*Phalaris arundinacea*) comprised greater than 50% cover along the stream bank, with lesser cover (21 to 50 percent) provided by spreading bent (*Agrostis stolonifera*). Success criteria outlined in the monitoring plan state the vegetation along the stream banks will be considered successful when banks are vegetated with a majority of deep-rooting riparian plant species with root stability indices ≥6. While spreading bent, with an associated stability index of 3, represented between 21 and 50 percent of the stream bank, reed canary grass, with an associated stability index of 9, dominated the majority (more than 50%) of the vegetation along the reconstructed bank. Reed canary grass, a native, perennial plant species provides increased soil stability and resistance to erosion along the stream bank through a dense rhizomatous root system. Spreading bent, a non-native, perennial plant species, also provides increased soil stability and resistance to erosion along the stream bank through a dense rhizomatous and stoloniferous root system.

Table 7. Vegetation species observed along Transect #5 within the reconstructed bank of the Flathead River in 2016.

Streambank Species	WMVC Indicator Status**	Streambank Species	WMVC Indicator Status**
*Agrostis stolonifera**	FAC	*Lactuca serriola*	FACU
Apocynum cannabinum	FAC	*Leucanthemum vulgare*	FACU
Arctium minus	UPL	*Linaria vulgaris*	NL
Bare Ground	NL	*Medicago lupulina*	FACU
Brassica juncea	UPL	*Mentha arvensis*	FACW
Bromus inermis	UPL	*Phalaris arundinacea**	FACW
Calamagrostis canadensis	FACW	*Plantago major*	FAC
Carex bebbii	OBL	*Poa palustris*	FAC
Carex nebrascensis	OBL	*Poa pratensis*	FAC
Carex pellita	OBL	*Populus angustifolia*	FACW
Carex stipata	OBL	*Populus balsamifera*	FAC
Carex utriculata	OBL	*Populus tremuloides*	FACU
Chenopodium rubrum	FACW	*Prunus virginiana*	FACU
Cirsium arvense	FAC	*Rumex crispus*	FAC
Cirsium vulgare	FACU	*Rumex salicifolius*	FACW
Cornus alba	FACW	*Salix bebbiana*	FACW
Crataegus douglasii	FAC	*Salix exigua*	FACW
Cynoglossum officinale	FACU	*Schoenoplectus acutus*	OBL
Elaeagnus commutata	FAC	*Scirpus microcarpus*	OBL
Eleocharis palustris	OBL	*Shepherdia argentea*	FACU
Elymus repens	FAC	*Solidago canadensis*	FACU
Epilobium ciliatum	FACW	*Sonchus arvensis*	FACU
Equisetum arvense	FAC	*Symphyotrichum ascendens*	FACU
Juncus balticus	FACW	*Taraxacum officinale*	FACU
Juncus bufonius	FACW	*Trifolium pratense*	FACU
Juncus ensifolius	FACW	*Typha angustifolia*	OBL
Juncus tenuis	FAC	*Verbascum thapsus*	FACU

*Indicates the dominant species observed.
**Based on 2016 NWPL (Lichvar *et al*., 2016)

4.3. Willow Mat Inspections

Vegetation transect #5 encompassed areas where willow mats were installed during construction of the restored bank. Willow shoots, including narrow-leaf willow (*Salix exigua*) and gray willow (*Salix bebbiana*), were observed growing within five feet of the high water mark, along the edge of the coir wrapped portion of the bank. While these willows were sprouting from within the coir layer, it was difficult to determine whether they were volunteers or were sprouting from the willow mats. Given their proximity to the edge of the bank and their sprouting through the coir, they are classified as successfully generating from willow mats. Relatively few willow shoots were observed along the bank, with the estimated areal percent cover of these willows at <1%. No additional volunteer woody vegetation was noted along the restored river bank.

4.4. Noxious Weed Inventory

Infestations of Canada thistle (*Cirsium arvense*) and yellow toadflax (*Linaria vulgaris*), both classified as Priority 2B noxious weeds, were considered large enough to include on the noxious weed distribution maps (Figures 7 through 9 in Appendix A). Each mapped noxious weed occurrence was identified in areas less than 0.1 acre in size with cover classes ranging from low (1 to 5 percent) to high (26 to 100 percent). A total of 47 infestations of these two species were found within the riparian exclosures and along the reconstructed river bank.

Three additional Priority 2B noxious weed species, including houndstongue (*Cynoglossum officinale*), oxeye daisy (*Leucanthemum vulgare*), and common tansy (*Tanacetum vulgare*) were observed in isolated, trace amounts. These occurrences were considered too small to include on the infestation maps, but their total combined areas are included in the estimated percent cover of noxious weeds within each exclosure.

This method of mapping weed infestations differed from the 2013 and 2014 monitoring reports, which only mapped and reported infestations that were greater than 5% of the area of each exclosure. Overall areal noxious weed coverage reported in 2013 and 2014 did not include infestations less than 5% of the area of each exclosure; therefore, results for noxious weed coverage for these years may have been under reported.

Table 8 provides a list of all noxious weed species observed within the riparian exclosures and reconstructed stream bank areas within the Foy's Bend mitigation site. Table 9 provides an estimate of percent cover by noxious weeds within each riparian and stream bank exclosure, indicating approximately 9.8% of the mitigation site is currently colonized by noxious weeds, an increase of 1.1% since the 2015 monitoring event. Weed spraying occurred on site in June 2014, July 2015, and again in July 2016 and will continue as part of a joint MDT-FWP weed management program for the site. Weed control efforts were conducted in July 2016 prior to the August 2016 monitoring event and were concentrated in areas of infestation by the five noxious weed species observed on site.

Table 8. Montana State listed noxious weed species observed in 2016 at Foy's Bend.

Category*	Scientific Name	Common Name
Priority 2B	*Cirsium arvense*	Canada Thistle
	Cynoglossum officinale	Houndstongue
	Leucanthemum vulgare	Oxeye Daisy
	Linaria vulgaris	Yellow Toadflax
	Tanacetum vulgare	Common Tansy

*Based on the Montana Department of Agriculture's Noxious Weed List, 2015

Table 9. Percent noxious weed coverage at Foy's Bend in 2016.

Exclosure #	Exclosure Acreage	% Cover of Exclosure by Noxious Weeds 2016	Acreage of Noxious Weeds
1	0.74	12	0.09
2	1.06	2	0.02
3	0.34	3	0.01
4	0.87	3	0.03
5	1.20	2	0.02
6	1.23	25	0.31
7	0.93	4	0.04
8	0.56	8	0.04
9	1.16	35	0.41
10	0.67	33	0.22
11	0.26	4	0.01
12	0.91	4	0.04
13	0.75	1	0.01
14	0.89	4	0.04
15	0.55	4	0.02
16	0.41	8	0.03
17	0.34	2	0.01
18	1.22	4	0.05
Stream Bank	0.30	7	0.02
Total Acreage	**14.39**		**1.41**
Total % Cover of Noxious Weeds at Foys Bend:			**9.78**

4.5. Woody Vegetation Inventory

Planted woody vegetation survival was determined by recording the total number of live and dead plants observed within each riparian exclosure. Table 10 provides the total number of plants observed, and how many of those were either alive or stunted within each riparian exclosure in 2016, as well as planted woody vegetation survival rates observed during the past four monitoring events. In 2016, survival rates in each exclosure ranged from 18% - 53%, while the overall woody planting survival percentage was 31%. Survival rates dropped or remained the same in 10 of the 14 planted areas, while exclosures 2, 3, 4, and 5 exhibited higher survival rates. The increase in survival rates within these four exclosures is attributed to supplemental plantings installed within these areas during the spring of 2016. High mortality rates are likely due in part to vole herbivory, and may have also been influenced by herbicide treatment exposure during weed control efforts.

Table 10. 2016 planted woody vegetation inventory and survival rates for 2013-2016.

Exclosure Number	Planted (Y/N)	Total Plants Inspected (2016)	# of Healthy Plants (2016)	# of Stunted Plants (2016)	% Stunted Plants (2016)	% Survival			
						2013	2014	2015	2016
1	Y	218	17	66	80%	96%	74%	41%	38%
2	Y	443	149	17	10%	70%	60%	18%	37%
3	Y	165	84	4	5%	92%	56%	19%	53%
4	Y	287	43	48	53%	97%	60%	28%	32%
5	Y	271	82	4	5%	97%	56%	19%	32%
6	Y	255	35	28	44%	84%	76%	25%	25%
7	Y	352	19	61	76%	88%	57%	23%	23%
9	Y	227	75	5	6%	92%	75%	47%	35%
10	Y	321	60	75	56%	97%	85%	64%	42%
13	Y	301	22	33	60%	93%	69%	41%	18%
14	Y	308	60	9	13%	95%	76%	37%	22%
15	Y	181	32	6	16%	97%	69%	22%	21%
16	Y	91	13	7	35%	96%	61%	30%	22%
17	Y	146	11	25	69%	99%	65%	43%	25%
	Total	**3566**	**702**	**388**	**36%**	**91%**	**68%**	**32%**	**31%**

In 2016, percent cover by planted woody vegetation was documented for the first time within each of the 14 planted exclosures. This data is summarized in Table 11 and indicates approximately 5.4% cover by woody plantings within all the planted exclosures combined.

Table 11. Percent cover by woody plantings at Foy's Bend in 2016.

Exclosure	Planted (Y/N)	Acres	% Cover of Exclosure by Woody Plantings	Acreage of Woody Plantings
			2016	2016
1	Y	0.74	3	0.02
2	Y	1.06	5	0.05
3	Y	0.34	5	0.02
4	Y	0.87	3	0.03
5	Y	1.20	7	0.08
6	Y	1.23	9	0.11
7	Y	0.93	4	0.04
9	Y	1.16	7	0.08
10	Y	0.67	7	0.05
13	Y	0.75	6	0.05
14	Y	0.89	3	0.03
15	Y	0.55	2	0.01
16	Y	0.41	2	0.01
17	Y	0.34	9	0.03
Total Acreage		**11.14**		**0.60**

Total % Cover of Woody Plantings at Foys Bend:	**5.38%**

Table 12 provides a summary of percent cover by volunteer woody vegetation growth within each of the 18 exclosures from 2014 through 2016, as well as the total percent cover of woody volunteer species within all 18 exclosures in 2016. Between 2015 and 2016, percent cover of volunteer woody species increased in eight of the exclosures, decreased in two of the exclosures, and remained constant in eight of the exclosures.

This data indicates approximately 13.1% cover by woody volunteers within all 18 exclosures combined in 2016.

Table 12. Observed volunteer plant species establishment within exclosures at Foy's Bend in 2014-2016.

Exclosure Number	Planted (Y/N)	% Cover by Volunteers			Elaeagnus commutata	Populus angustifolia	Populus tremuloides	Prunus virginiana	Rosa woodsii	Salix bebbiana	Symphoricarpos albus
		2014	2015	2016							
1	Y	30%	40%	42%					X		X
2	Y	10%	50%	50%		X			X		X
3	Y	5%	3%	3%			X				
4	Y	0%	0%	0%							
5	Y	0%	0%	1%	X						
6	Y	20%	10%	11%			X				X
7	Y	1%	5%	5%			X				
8	N	1%	1%	0%							
9	Y	5%	1%	1%			X				
10	Y	25%	20%	18%	X		X				
11	N	15%	30%	30%			X				X
12	N	20%	25%	25%			X			X	X
13	Y	0%	0%	0%							
14	Y	0%	0%	2%							X
15	Y	1%	0%	1%				X			X
16	Y	1%	0%	3%							X
17	Y	5%	5%	6%			X				X
18	N	5%	23%	25%		X	X	X			X

Total Acreage of Exclosures	Acreage of Woody Volunteers in 2016	Total % Cover of Woody Volunteers within Exclosures at Foys Bend in 2016
14.09	1.84	13.09%

4.6. Stream Bank Performance

For the purposes of describing the reconstructed bank segment, it has been divided into three reaches based on conditions observed and surveys conducted during the monitoring site visits (Figure 3). The following sections describe monitoring data documented within each of the three reaches as well as immediately upstream of the reconstructed bank. Supporting data includes plotted survey transect data (Appendix B) and photo documentation of the river bank (Appendix C). Perpendicular bank transects plotted at each of the locations shown in Figure 3 also includes the elevation at the top of the fascine during the most recent survey event.

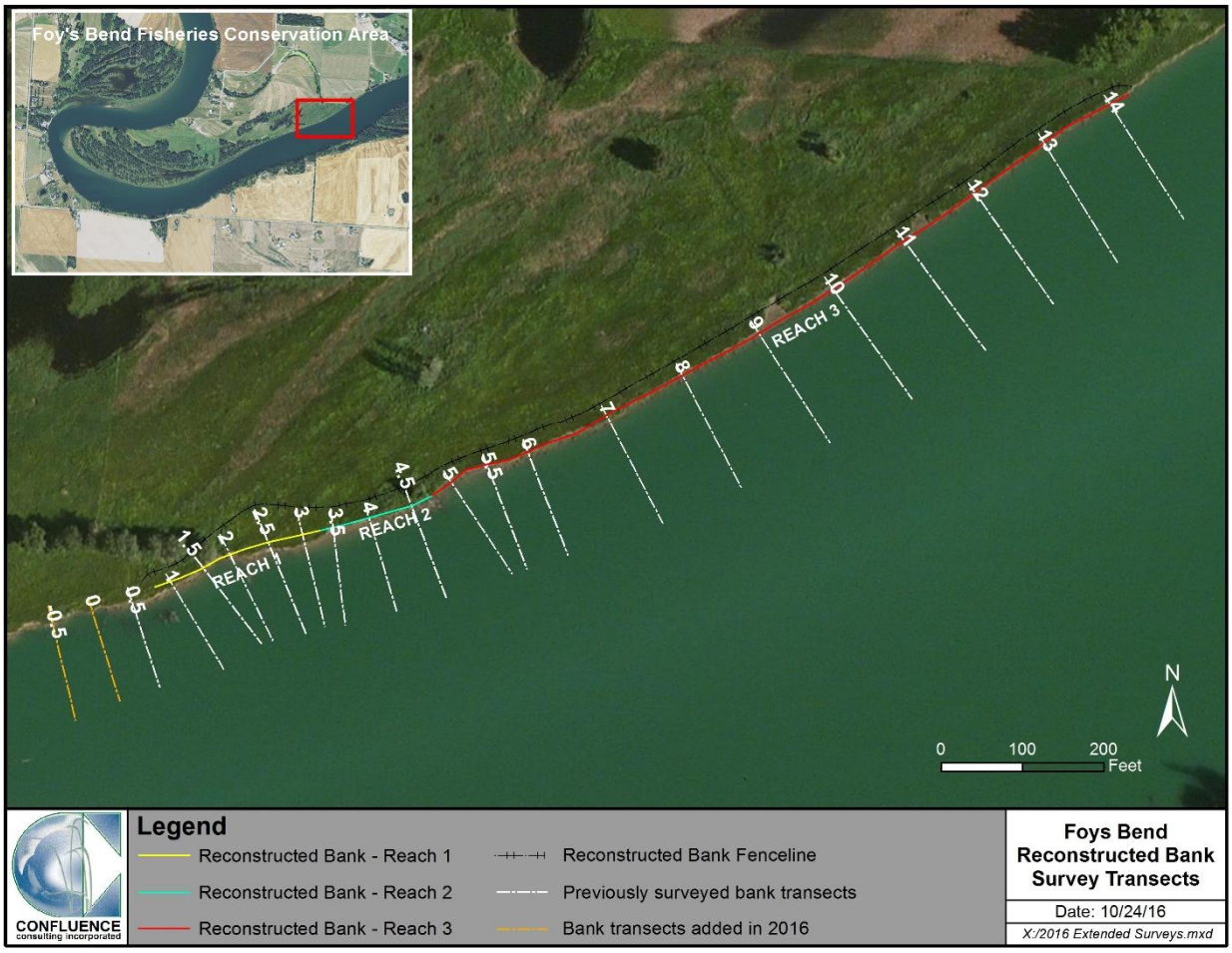

Figure 3. Reach breaks and surveyed transects along Foy's Bend reconstructed bank segment.

4.6.1. Upstream of Reconstructed Bank Segment

Monitoring of the bank upstream of the stabilization project involved photo-documentation and surveying of three perpendicular bank transects (Transects -0.5, 0 and 1.5). The following points summarize conditions immediately upstream of the reconstructed bank segment:

- Photo Point 5.1 and Additional Photos 1 and 2 in Appendix C reveal the top of the river bank has continued to erode northward. The top of the bank at transect -0.5, located 130 feet upstream of the reconstructed bank, revealed a retreat by two feet between April and August 2016. Survey transect 0.5, located 20 feet upstream of the reconstructed bank, eroded three feet northward near the top of the bank.
- Extended bank survey results at transects -0.5, 0, and 0.5 indicate the bank below the low water surface has not eroded northward; rather, it shows evidence of deposition. The source of this deposition may be material that has calved off the top of the bank and has sloughed down the bank or from natural deposition following the spring 2016 runoff event

- No vegetation exists along the lower bank due to the frequency of soil erosion in this area. The upper bank is characterized primarily by reed canary grass, comprising greater than 50% cover along the upper stream bank, with lesser cover (21 to 50%) provided by spreading bent. While both species offer increased soil stability and resistance to erosion along the stream bank, spreading bent, with a root stability index of 3, provides less stability to the river bank than reed canary grass, with a root stability index of 9.
- Given the upper bank retreat observed over the past three years, erosion along this bank is considered severe. The erosion occurring along this bank segment has yet to affect the reconstructed bank area other than calving of the bank where fence posts were installed at the upstream extent of the restored stream bank exclosure. Continued erosion of the river bank upstream of the stabilized reach is threatening to extend into the MDT project area.
- Other than a short segment of the bank that has been riprapped, active bank erosion extends approximately 775 feet upstream of the reconstructed bank segment.

4.6.2. Reconstructed Bank Segment – Reach 1

Reach 1 includes the upper (western) 235 feet of the reconstructed bank, which begins near the southwestern extent of the protective fencing. Perpendicular bank transects 1-3 lie within Reach 1. The following points describe bank conditions documented within Reach 1:

- The upper, re-sloped portion of the reconstructed bank above the bioengineered treatment appears stable with no indication of lateral erosion between bank transects 1 through 3 (see Photo Point 5.2 on page C-3 of Appendix C). This rate of erosion is well below the rate considered “functional” in the performance standards and is less than that observed at transects #-0.5 to #0.5 just upstream.
- Vegetation along the upper bank is dominated by reed canary grass and a diversity of sedges, grasses and forbs, with additional cover provided by a variety of planted shrubs. Willow shoots have sprouted along the outer (river-side) face of the revegetated soil lift from within the coir fabric. It is unclear if these willows, which include narrow-leaf willow and gray willow, are volunteers or have grown from the willow mattresses installed during bank reconstruction.
- Soil placed along the outer (river-side) edge of the coir lift has been stripped from within the lift throughout length of Reach 1. Soil loss stopped at the upper limit of a clearly defined debris line formed by wave action. Soil loss was estimated at 6” vertically based on the design thickness of the soil lift (see Additional Photos 3, 4, and 5 on page C-5 of Appendix C).
- The woody fascine below the soil lift is lower than the design elevation (and assumed construction elevation) by up to 1.3 feet within Reach 1 (@ transect #1), but did not drop further in the past year. The lowering of the fascine may be a result of compaction or decomposition of the fascine and/or slope failure beneath the fascine (see profile of fascine surveyed in August, 2015 on page 21

of Appendix B and Additional photo 5 on page C-5 of Appendix C). Slope failure below the fascines is likely the main contributing factor to the drop in fascine elevation.

- The maximum bank retreat documented at the edge of the reconstructed bank within Reach 1 is approximately 1.75 feet since 2013 (@ transect #1); representing a yearly erosion rate of <1 foot per year. The lateral bank movement documented in Reach 1 is attributed to soil loss and slumping of the fascine and soil lift rather than from active lateral erosion during high flows.
- Surveys of the bank below the bioengineered treatment indicate lateral erosion by up to three feet in some areas (Transects 2 and 2.5). Continued lateral bank movements along the lower bank threaten the stability of the upper, resloped and revegetated bank areas due to the potential for erosion to undercut beneath the willow fascines and coir soil lifts.
- Deposition has also been noted below the bioengineered bank treatment, indicating undercutting of the stabilized bank is not necessarily occurring along the entire length of the stabilized bank.
- Extended transect surveys performed in April and August, 2016 indicated the lower portion of the bank has extended outward by as much as ten feet. This material was likely deposited during spring high flows in the Flathead River as opposed to material fracturing off the top of the bank and depositing further down the bank slope.

4.6.3. Reconstructed Bank Segment – Reach 2

Reach 2 includes 135 feet of the reconstructed bank downstream of Reach 1. Monitoring of this reach includes photo documentation and surveys at perpendicular bank transects 3.5, 4, and 4.5. The following points describe bank conditions documented within Reach 2:

- The upper, re-sloped portion of the reconstructed bank above the soil lift remains stable with no indication of lateral erosion (see Photo Points 6.1 and 6.2 on pages C-3 and C-4 of Appendix C).
- Vegetation along the upper bank is dominated by reed canary grass and a diversity of sedges, grasses and forbs, with additional cover provided by a variety of planted shrubs. A few willow shoots have sprouted along the outer (river-side) face of the revegetated soil lift, which have been attributed to the willow mats installed during construction of the project.
- Soil placed along the outer (river-side) edge of the coir lift has been stripped from the lift throughout length of Reach 2. Soil loss stopped at the upper limit of a clearly defined debris line formed by wave action during high water. Soil loss was estimated at 6” based on the design thickness of the soil lift (see Photo Point 6.1 on page C-4 and Additional Photo 6 on Page C-6 in Appendix C).

- Visual observations during April 2014 noted significant soil loss below the bioengineered bank treatment, which had undermined approximately 50 feet of the fascine placed below the soil lift.
- Visual observations in March 2015 noted additional soil loss from beneath the bioengineered bank treatment as evidenced by the coir fascine and soil lift slumping into the river at low water (see fascine profile in Appendix B and Additional Photos 9 and 10 on page C-6 of Appendix C).
- Visual observations in April 2016 noted continued soil loss from beneath the bank treatments and slumping of the woody fascines and coir fabric along the lower bank. These conditions were particularly evident between Transects 3.5 and 4 (see Additional Photo 7 on page C-6 of Appendix C).
- Undercutting of the stabilized bank has caused a 20-foot segment of woody fascine to separate from the bank near transect #4. Additional fracturing of the woody fascine from beneath the bank is expected as the lower bank continues to recede northward (see Additional Photo 8 on page C-6 of Appendix C).
- The elevation of the woody fascine in Reach 2 has continued to drop over the past year, and is now 0.75 to 3.1 feet below the design elevation (see profile of fascine surveyed in August, 2015 on page B-21 of Appendix B).
- The rate of bank retreat at the elevation of the fascine within Reach 2 varies from 0.75 to 1 foot per year over the past three years; however, this retreat is attributed to soil loss and slumping of the fascine and soil lift rather than from lateral erosion of the reconstructed bank during high spring flows.
- The slope of the river bank between the April (ordinary low) and August (ordinary high) water surface elevations is steeper than both the bioengineered bank treatment and the bank toe extending below the April water surface elevations. As a result, the bank segment between the ordinary low and high water surface elevations is prone to additional erosion and soil loss.
- Extended transect surveys performed in April and August, 2016 indicated the bank below the low water elevation has extended outward by two to three feet. This outward movement of the lower bank is most likely from deposition of sediments following the last high water event on the Flathead River.

4.6.4. Reconstructed Bank Segment – Reach 3

Reach 3 includes the downstream 1,000 feet of the reconstructed bank. Monitoring of this reach includes photo documentation and surveys at perpendicular bank transects 5-14. The following points describe bank conditions documented within Reach 3:

- The upper, re-sloped portion of the reconstructed bank above the soil lift appears stable with no documentation of lateral erosion (See Photo Point 7 on page C-4 of Appendix C).
- Vegetation along the upper bank is dominated by reed canarygrass and a diversity of sedges, grasses and forbs, with additional cover provided by a variety

of planted shrubs. A few willow shoots have sprouted along the outer (river-side) face of the revegetated soil lift.

- Similar to observations in Reach 1 and 2, soil has been stripped from the leading edge of the coir lift throughout the length of Reach 3. Soil loss stopped at the upper limit of a clearly defined debris line formed by wave action during high water. Soil loss was estimated at 6" based on the design thickness of the soil lift (See Photo Point 6.2 on page C-4 of Appendix C). It does not appear water extends above this line during the summer months and vegetation has established well within the coir fabric to prevent any additional stripping and soil loss.
- The elevation of the woody fascine in Reach 3 is consistently 0.25 to 1 foot lower than the design elevation. Changes in the elevation of the fascine in 2016 are likely within the error limits of the survey (see profile of fascine surveyed in August, 2015 on page B-21 of Appendix B).
- Surveys indicate the bank immediately below the bioengineered treatment has slowly, but consistently steepened and retreated northward at Transects 7, 8, 10, 11, 12, 13, and 14 over the past two to three years. Continual migration of the bank between the high summer and low winter water surface elevations is threatening to undermine the woody fascines and resloped bank segment along Reach 3 (see Additional Photo 9 and 10 on page C-6 of Appendix C).
- Extended bank transects performed in April and August, 2016 indicate a relatively large deposit of material extending outward from the bank. This deposit is apparent in transects 7-14 and generally extends from the winter, low water elevation outward approximately 50 feet. It is unclear what circumstances led to this depositional feature.

4.6.5. Erosional Processes Observed along the Reconstructed Bank

Over the course of the monitoring phase of the project, the following types of erosion have been observed, and are contributing to soil losses beneath the bioengineered bank treatment:

- Internal Erosion: Piping losses of soil were observed in numerous locations during the April, 2014 monitoring site visit beneath the restored bank area. Piping was evidenced by large voids and tunnels (pipes) within the bank soils. These pipes were oriented generally perpendicular to the slope but were somewhat serpentine.

  Piping was observed in the restoration area at a greater frequency than in the unaltered, eroding bank upstream. This may have been caused by subtle differences in the soils along the treatment section, but more likely was the result of the upper treated bank being more stable and preventing collapse and covering up the pipes.

  Internal erosion losses likely occurred during drawdown of the river in the fall. However, it is uncertain whether pipes formed in the fall would last until spring.

Alternatively, pipes may have formed during snow melt and flow of meltwater through the fine sandy bank soils from nearby meander scars.

- Rill Erosion: Rills were observed beneath the coir wrapped bank and fascines running perpendicular to the bank slope during the spring 2014 monitoring event, indicating recent erosion by surface runoff. This likely occurred during snow melt and rain events. Rills were also observed during the spring, 2015 event, although were less pronounced.
- Wave Erosion: Waves were actively eroding the bank slope below the fascines and coir wrapped bank where the water surface met the fine grained bank. A small vertical scarp was observed at the erosional face. Height of the scarp ranged from a two inches to two feet. Wave erosion was observed whenever wind speed increased above approximately 10 knots for more than a few minutes. Wind-caused wave erosion is expected to be significant during prolonged southwesterly winds, as the fetch is approximately 1 mile in length. Bank erosion was also observed when wakes from passing boats reached the shore. Three boats were observed traveling in the middle of the river that each caused collapse of the vertical erosion scarp during the site visit.
- Mass Wasting: Mass slope failure was not observed but may have been obscured by high water. Mass failures were observed by Karin Boyd in this area while conducting a channel migration study of the Flathead River (AGI and DTM 2010).

Based on these observations, it is believed the most significant cause of bank erosion is wave action combined with river transport of eroded sediment and the change in water elevation associated with operation of Sélíš Ksanka Qlispé (formerly Kerr Dam). While not directly observed, ice formation and bank scour during low water stages may also be occurring in the vicinity of the restored bank. The general erosional process is described by:

i. Wave action (wind and boat) cutting vertical scarp at the river water surface and depositing eroded material on the bank below the water line
ii. River current transporting materials removed by the erosion scarp
iii. Water level changes, leading to formation of new scarps at different elevations along the bank slope
iv. Loss of sediments through river transport which prevent the formation of a stable slope

Monitoring of the bioengineered bank treatment along the Flathead River indicates stability of the bank is limited to the re-sloped and revegetated areas of the bank above the soil lift. The bank beneath the treatment shows signs of instability and migration between the low and high water surface elevations. Bank instability due to slope failure beneath the fascines has been documented in Reach 2, and is likely to occur in Reaches 1 and 3 over the next several years as the erosive material beneath the reconstructed banks is removed by various erosional processes.

4.6.6. Fascine Inspections

Observations of the woody fascines installed beneath the coir soil lifts during the 2016 monitoring events revealed the following:

- Nearly all of the fascines installed remain intact; however, undercutting and erosion of the bank beneath the fascines along Reach 2 of the bank has caused the fascines to slump and drape into the river (see Additional Photos 6 and 7 on page C-6 of Appendix C).
- Erosion beneath the reconstructed bank near transect #4.5 has caused a 20-foot segment of the fascine to separate from the bank (see Additional Photo 8 on page C-6 of Appendix C).
- Lower bank failure and slumping fascines is most evident near the upstream extent of the reconstructed bank (Transects 1, 1.5, and 2) and within Reach 2 of the reconstructed bank (Transects 3.5, 4, and 4.5).
- While intact, most of the woody fascines in Reach 3 are lower than the design elevation by 0.5 to 1.0 foot.
- All of the fascines are completely submerged during high water and nearly all of the willow cuttings installed between the fascines and the coir wrapped soil lift have perished as a result of being submerged throughout the growing season.

4.7. Fencing Inspections

Fencing issues at 21 locations were documented during the August, 2016 monitoring event, and included broken zip ties and torn fence segments. Two whitetail deer were observed inside the fenced exclosures. Photographs were taken and GPS points recorded at each fence failure location. Documentation of each fencing issue was provided to MDT immediately following the monitoring event. MDT maintenance crews repaired all fencing issues within one week of the inspection results.

4.8. Wildlife Documentation

Wildlife use documented at the Foy's Bend mitigation area from 2013 through 2016 includes 37 bird and four mammal species (Table 13). Seven newly observed bird species were identified during the 2016 site visit.

Table 13. Wildlife observations at the Foy's Bend stream mitigation site from 2013-2016.

Common Name	Scientific Name	Common Name	Scientific Name
Birds		**Birds**	
American crow	*Corvus brachyrhynchos*	Northern flicker	*Colaptes auratus*
American robin	*Turdus migratorius*	Osprey	*Pandion haliaetus*
Bald eagle	*Haliaeetus leucocephalus*	Red-tailed hawk	*Buteo jamaicensis*
Belted kingfisher	*Megaceryle alcyon*	Ring-necked pheasant	*Phasianus colchicus*
Black-billed magpie	*Pica hudsonia*	**Sandhill crane**	***Grus canadensis***
Black-capped chickadee	*Poecile atricapillus*	Song sparrow	*Melospiza melodia*
Brown-headed cowbird	***Molothrus ater***	Sparrow sp.	*Passer* sp.
Canada goose	*Branta canadensis*	Spotted sandpiper	*Actitis macularius*
Cedar waxwing	**Bombycilla cedrorum**	Swainson's hawk	*Buteo swainsoni*
Common merganser	*Mergus merganser*	Swallow sp.	*Tachycineta* sp.
Common raven	*Corvus corax*	Tree swallow	*Tachycineta bicolor*
Dark-eyed junco	*Junco hyemalis*	Western kingbird	*Tyrannus verticalis*
Eastern kingbird	**Tyrannus tyrannus**	Western meadowlark	*Sturnella neglecta*
Falcon sp.	*Falco* sp.	**Wild turkey**	***Meleagris gallopavo***
Great blue heron	*Ardea herodias*	Woodpecker sp.	*Pickidae* family
Great horned owl	*Bubo virginianus*	**Yellow warbler**	***Setophaga petechia***
Gull sp.	*Laridae* family	**Mammals**	
House wren	*Troglodytes aedon*	Beaver (chews)	*Castor canadensis*
Mallard	*Anas platyrhynchos*	Coyote (scat)	*Canis latrans*
Marsh wren	*Cistothorus palustris*	White-tailed deer	*Odocoileus virginianus*
Mourning dove	*Zenaida macroura*	Vole sp.	*Arvicolinae* sp.

*New species observed in 2016 are **bolded.**

4.9. Photo-Documentation

Photo documentation of the site was repeated at several photo points established during the 2013 monitoring event and at several other locations to document vegetation establishment and stream bank conditions within the project site (Appendix C). All sites selected for photo-documentation were recorded on field maps with headings noted to allow for repetition during subsequent monitoring years. Photos were also repeated at each bank pin in the upstream and downstream direction, toward the bank, and toward the river to document conditions along the reconstructed river bank.

5.0 COMPARISON OF RESULTS TO PERFORMANCE STANDARDS

Monitoring of the Foy's Bend mitigation site is intended to document whether the reconstructed river bank and riparian enhancement plots are meeting performance standards outlined in the post-construction monitoring plan for the site (Table 14). The fourth year of monitoring suggests four of the ten performance standards are currently being met.

5.1. Riparian Buffer Success

Vegetation monitoring of the riparian corridor and stream bank indicated 88% of disturbed areas have successfully revegetated with non-noxious species following reconstruction of the river bank and installation of the riparian exclosures. Non-noxious vegetation cover was determined by subtracting the percent cover of noxious weeds

(9.8%) from the site's total vegetation cover (98%). Performance criteria specify at least 50% of the disturbed areas within the creditable buffer area must be vegetated with non-noxious weed species; therefore, this criterion is currently being met.

Monitoring of noxious weeds revealed seven of the 18 exclosures exhibit noxious weed cover that exceeds the 5% threshold. Exclosures 9 and 10 were particularly infested, with approximately 35% and 33% areal coverage of noxious weeds, respectively. While the recent herbicide application in July 2016 has helped reduce some noxious weed infestations, many infestations remain and continued control efforts are necessary to achieve the performance target. Overall, 9.8% of the revegetated areas exhibit noxious weeds, which exceeds the success criteria of 5% established in the monitoring plan.

5.1.1. Vegetation Success

Total combined areal vegetation cover of the riparian exclosures and the reconstructed river bank is currently 98% (98% of the exclosures and 97% of the river bank). Cover of noxious weed species site-wide is currently 9.8%. The performance criterion for this category specifies the combined areal cover of riparian and stream bank vegetation is ≥70% and noxious weeds do not exceed 5% cover. While the combined areal cover of riparian and stream bank vegetation (98%) is currently meeting this performance criteria, noxious weed cover (9.8%) within riparian exclosures exceeds the 5% threshold established in the monitoring plan.

5.1.2. Woody Plants

Woody vegetation plantings indicated a survival rate of 31% following the fourth growing season, representing a substantial drop since 2014. The drop below the success threshold of 50% survival four years following woody vegetation installation indicates this criterion will not be met five years following project completion. The primary factor limiting survival is attributed to vole herbivory.

In 2016, planted woody vegetation covered approximately 5.4% of the 14 planted exclosures, which is far below the success criterion of 50% areal coverage after five years established in the monitoring plan. Volunteer species were observed in 15 of the 18 exclosures and ranged in percent coverage from 1% to 50% of the fenced area. A few volunteer willows were observed along the stream bank, although their percent cover is limited due to their young age.

Table 14. Comparison of results to performance criteria for the Foy's Bend mitigation site, 2016.

Parameter	Performance Standard	Status	Site Meeting Performance Criteria?
1. Riparian Buffer Success	Areas within creditable riparian buffer disturbed during construction must have 50% or greater areal cover of non-noxious weed species by the end of the monitoring period	All 18 riparian exclosures exhibit >50**%** cover of non-noxious weed species. Overall, the riparian exclosures exhibit **88%** cover by non-noxious species	YES
	Vegetation Success: Combined areal cover of riparian and stream bank vegetation communities is at least 70%	Combined areal cover of riparian and stream bank vegetation is **98.1%**	YES
	Vegetation Success: Noxious weeds do not exceed 5% cover within the riparian buffer areas.	**9.8%** cover of noxious weeds observed within riparian exclosures	NO
	Woody Plants: Planted trees and shrubs must exhibit 50% survival after 5 years	Woody vegetation surveys indicate **31%** survival during fourth growing season	NO
	Woody Plants: Planted trees and shrubs must exhibit 50% aerial coverage after 5 years	**5.4%** cover of woody plantings observed within planted riparian exclosures	NO
2. Bank Restoration Success	i.) Rate of ≤ 0.5 feet of erosion annually - Functioning* ii.) Rate of ≤ 1.0 foot of erosion annually - Functioning* iii.) Rate of ≤ 1.5 feet of erosion annually - Functioning at Risk* iv.) Rate of ≥ 3 feet of erosion annually - Functioning at Risk or not Functioning** v.) Rate of > 5 feet or more of erosion annually - Not Functioning**	Bioengineered upper bank segment has eroded **≤ 1 foot annually**[1] **= Functioning**	YES[1]
	Pritchard (1998) Proper Functioning Condition Rating = Functional	PFC rating from 2015 monitoring was **Functional - at risk with upward trend**	NO
3. Willow Mats	Density of new willow stem growth achieves 50% aerial coverage after five years	Density of new willow growth along reconstructed bank segment is <**1%**	NO
4. Vegetation along river bank	Majority of plants on the river bank must have root stability indices of at least 6	Dominant vegetation along the majority of the stream bank is reed canary grass (*Phalaris arundinacea*), with a root stability index of 9.	YES
5. Weed Control	Montana State-listed noxious weeds do not exceed 5% cover within the bank restoration and riparian planting zones.	**9.8%** cover of noxious weeds observed within riparian exclosures	NO

1. Performance criteria does not account for bank instability beneath bioengineered treatment
* If the rate of bank erosion is greater than 1 to 2 feet per year due to natural erosive actions, adaptive management will take place
** If the rate of bank erosion is greater than 3 feet or more due to a single force of nature, such as an ice jam or a significant flood event beyond the normal riverine processes, this will be considered a force majeure event and restoration actions may not occur.

5.2. Bank Restoration Success

Determination of bank restoration success requires a) monitoring erosion rates over multiple years to determine the functional performance of the bank segment, and b) conducting a Functional Assessment of the reconstructed bank using lotic inventory assessment protocols (Pritchard, D. et al., 1998). Monitoring of the 22 established bank profiles indicated stabilization of the upper, re-sloped and revegetated area of the bioengineered bank is functioning as designed based on erosion rates at or less than one foot per year. The most rapid lateral migration along the reconstructed bank length is occurring around transect 4.5, where the bank has retreated two feet in the past two years (1 foot/year). Erosion along this segment of the bank is primarily due to wave action combined with river transport of eroded sediment and the change in water elevation associated with downriver dam operations. While the lateral erosion rate is most severe at bank transect 4.5, other portions of the restored bank show signs of instability below the fascines and coir wrapped soil lifts. These areas were not disturbed or modified during construction of the restored bank.

Sections of the bank between the summer high and winter low water surface elevations of the Flathead River are continuing to slowly erode due to multiple mechanisms, and are acting to undermine the upper bank. Although the performance criteria for bank stability is currently being met, evidence continues to indicate the bank is at risk of failure from instability caused by fluctuating lake levels, wave action created by boats and wind, river currents, and potentially mass wasting beneath the bioengineered treatments installed along the upper bank. These processes have resulted in active undercutting and fascine slumping along approximately 300 feet (22%) of the 1,370-foot long reconstructed bank. These erosional processes appear to be affecting much of the remaining sections of reconstructed bank as well, albeit at a slower pace.

In addition to the erosional processes occurring beneath the stabilized bank, active lateral bank erosion has been documented immediately upstream of the reconstructed bank. Lateral erosion upstream of the stabilized bank is anticipated to continue, which will jeopardize the long term stability of the treated bank if its northward movement advances.

A functional assessment of the reconstructed bank was not performed in 2016, as the Foy's Bend monitoring plan only requires implementing this method during the third and final years of monitoring. A rating of "functional at-risk with upward trend" was assigned to this mitigation area in 2015 based on existing conditions and river processes at that time. Primary factors supporting this classification included:

- Hydrology of the Flathead River in the vicinity of the Foy's Bend FCA is profoundly affected by operation of 1) the Séliš Ksanka Qlispé Dam, which prolongs the period during which Flathead Lake remains at full pool and backwaters the Flathead River; and 2) Hungry Horse Dam, which reduces the frequency and magnitude of flood discharges in the Flathead River through the project reach.

- The modified hydrology resulting from Séliš Ksanka Qlʼispé (formerly Kerr Dam) has resulted in widespread bank instability, which is evident along approximately half of the Flathead River bank within the Foy's Bend FCA.
- Re-sloped and revegetated areas along the reconstructed river bank are capable of maintaining stability along the upper bank; however the bioengineered treatment is not capable of stabilizing the lower bank between the high and low water surface elevations.
- Woody vegetation installed within the fenced exclosures will expand the extent and improve the function of riparian habitats within the Foy's Bend FCA in areas that have been historically managed for agricultural purposes.
- Although the woody vegetation installed within the riparian exclosures is currently young, it will eventually provide improved riparian function and a source of coarse woody material to the floodplain.
- Although the hydrologic factors at play along the Flathead River are negatively affecting the function of riparian and wetland habitats and overall channel stability, it is unlikely these conditions will worsen over time.
- Management of former agricultural areas within the Foy's Bend FCA is anticipated to improve riparian and wetland function over time.

Lotic inventory assessment protocols will be used to document the ability of this site to properly function during subsequent monitoring efforts.

5.3. Willow Mats

Observations of the willow cuttings installed immediately above the fascine along the length of the reconstructed bank indicate this planting technique was unsuccessful in establishing a dense stand of willows along the river bank / shoreline. A few volunteer willows have established by shooting up through the coir soil lift. The mortality of the willows installed along the fascine is likely a result of the cuttings being submerged throughout the duration of the growing season. Overall, less than 1% of the reconstructed bank segment exhibits willow growth from planted and volunteer establishment.

5.4. Vegetation along Stream bank

Reed canary grass comprised greater than 50% cover along the stream bank in 2016. While spreading bent, with an associated stability index of 3, accounted for 21 to 50% cover along the bank, reed canary grass was the dominant vegetation community observed, with an associated stability rating of 9 (Winward 2000; Pick et al. 2004). Therefore, stream bank vegetation is successfully meeting the associated performance criteria.

5.5. Weed Control

Weed control efforts occurred in 2014 through 2016 in an attempt to reduce infestations of noxious weeds found within the riparian exclosures. While the recent herbicide

application in July 2016 has helped reduce some noxious weed infestations, many infestations remain and additional control efforts are necessary to achieve the 5% cover performance standard. It should be noted that an additional supplemental weed control effort occurred in late August 2016 to treat Canada thistle infestations by both MDT and MFWP within and around all exclosures.

6.0 MANAGEMENT AND DESIGN RECOMMENDATIONS

The following are recommendations that may be considered by MDT for use in designing and implementing future stream and riparian mitigation projects. With the exception of noxious weed management, these recommendations should not be considered required actions to ensure successful mitigation at the Foy's Bend project site.

6.1. Coir Bank Reconstruction Materials

Designs for the reconstructed river bank included placing a layer of coir fabric along the toe of the bank slope to temporarily protect the re-sloped bank while planted vegetation established. The coir fabric has been effective at withstanding erosion along the bank; however, the large gaps between the coir strands allowed the fine soils to escape during high flows. Portions of the fabric layer are sagging as a result of these fine materials being stripped from within the coir.

Fine soils placed within protective coir may be secured if a second, finer layer of coir fabric is placed between the outer coir layer and the soil. This second layer is often used in bioengineered stream banks to prevent fine soil loss when the bank is submerged. The recommended fabric to achieve this goal is North American Green, product #125-BN. This product includes a fine coir mesh and biodegradable reinforcement twine.

6.2. Woody Plantings

Survival rate and areal coverage of woody plantings are at levels that do not meet success criteria four years following installation. As a result, additional plantings are necessary to achieve the target for woody vegetation establishment. The planting plan should incorporate techniques that 1) reduce mortality from herbivory, or 2) integrate an expected mortality rate that will result in achieving the percent cover criterion for woody vegetation within the riparian exclosures. For example, if monitoring data indicate a mortality rate of 75% over five years, but the surviving plants provide 25% areal cover of woody vegetation, planting rates should be doubled to achieve the intended 50% cover by woody vegetation.

6.3. Woody vegetation along reconstructed bank

Willows installed along the reconstructed bank did not survive due to their inundation throughout the growing season. Achieving the success criteria established for willow cover along the reconstructed bank will require installing additional willows. While willow cuttings may facilitate the achievement of this performance criterion over time, it would likely take less time if mature willows were transplanted along the river bank. The

latter technique would not only take less time, but also provide a greater percent cover of willows along the bank.

7.0 LITERATURE CITED

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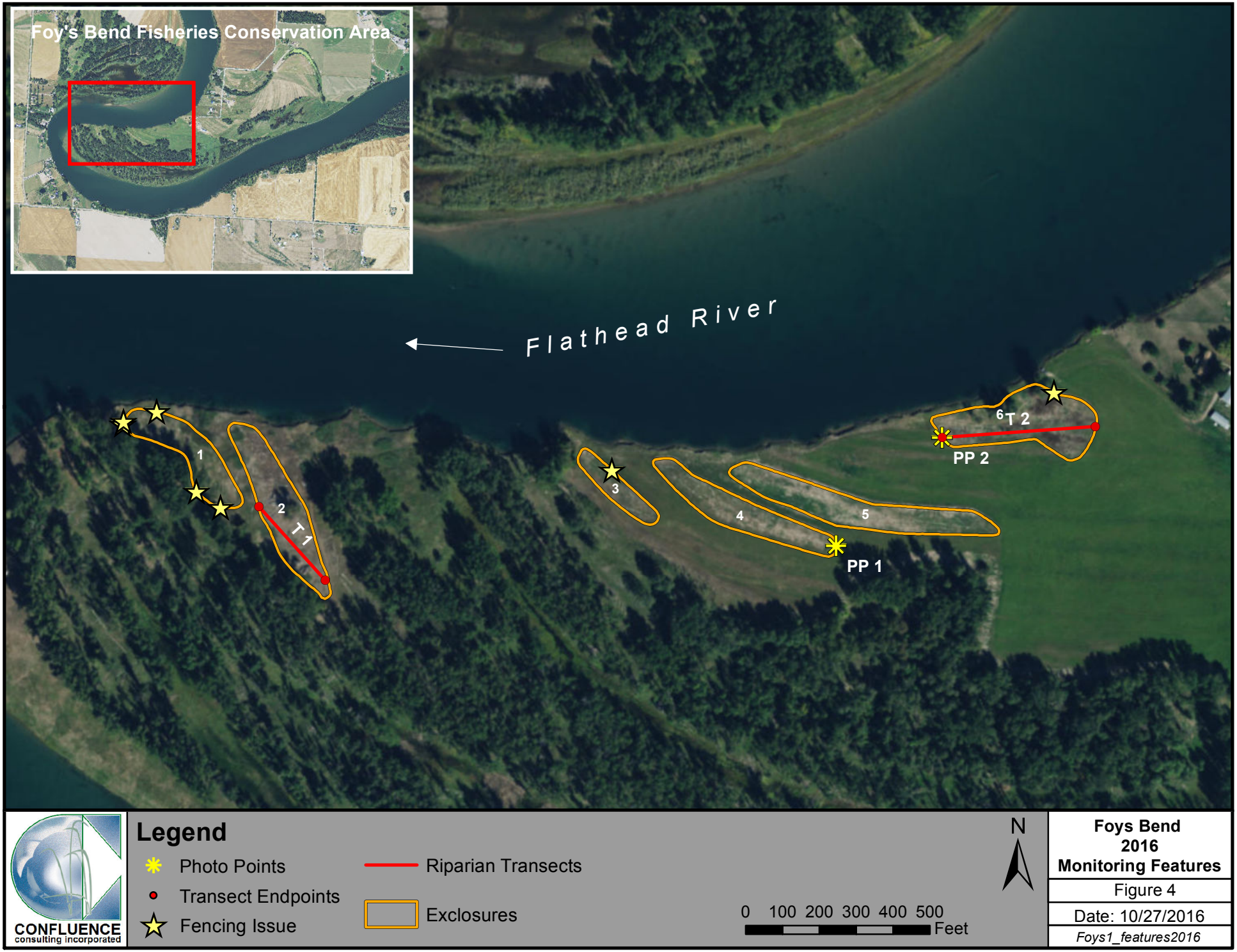
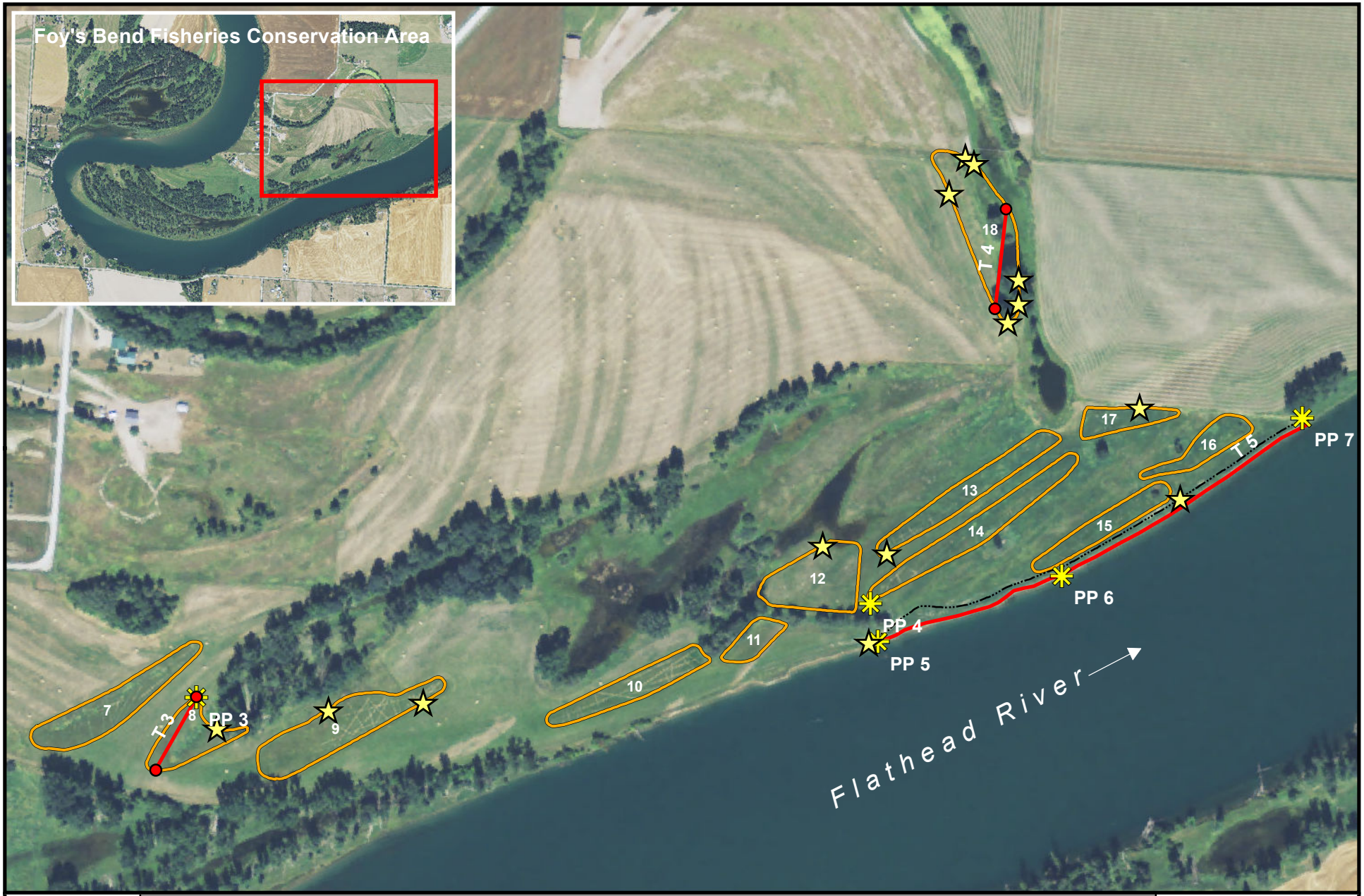
Appendix A

Project Area Maps

MDT Stream Mitigation Monitoring
Foy's Bend Fisheries Conservation Area
Flathead County, Montana


Foy's Bend Fisheries Conservation Area
Flathead River
1
2
T 1
3
4
5
PP 1
6
T 2
PP 2
Legend
Photo Points
Transect Endpoints
Fencing Issue
Riparian Transects
Exclosures
0 100 200 300 400 500
Feet
N
CONFLUENCE
consulting incorporated
Foys Bend
2016
Monitoring Features
Figure 4
Date: 10/27/2016
Foys1_features2016



Legend

- Photo Points
- Transect Endpoints
- Fencing Issue
- Riparian Transect
- Reconstructed Bank Fence
- Exclosures

0 300 600 Feet

N

CONFLUENCE consulting incorporated

Foys Bend 2016 Monitoring Features

Figure 5

Date: 10/27/2016

Foys2_features2016

CONFLUENCE
consulting incorporated

Legend

- Photo Points
- Exclosures
- Fencing Issue
- Vegetation Transect #5 along reconstructed bank
- Perpendicular Bank Profiles
- Reconstructed Bank Fenceline

N

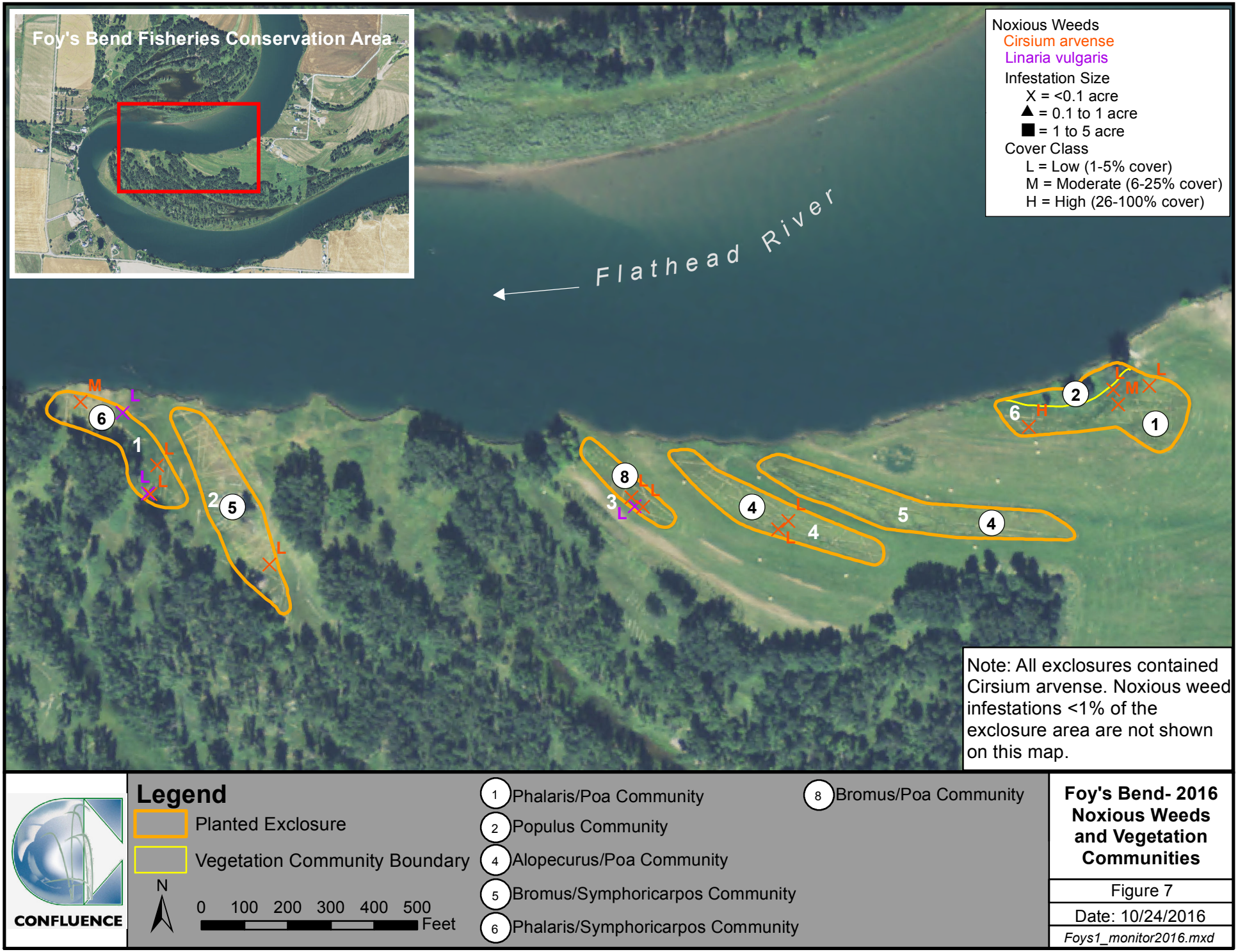
0 100 200 300 Feet

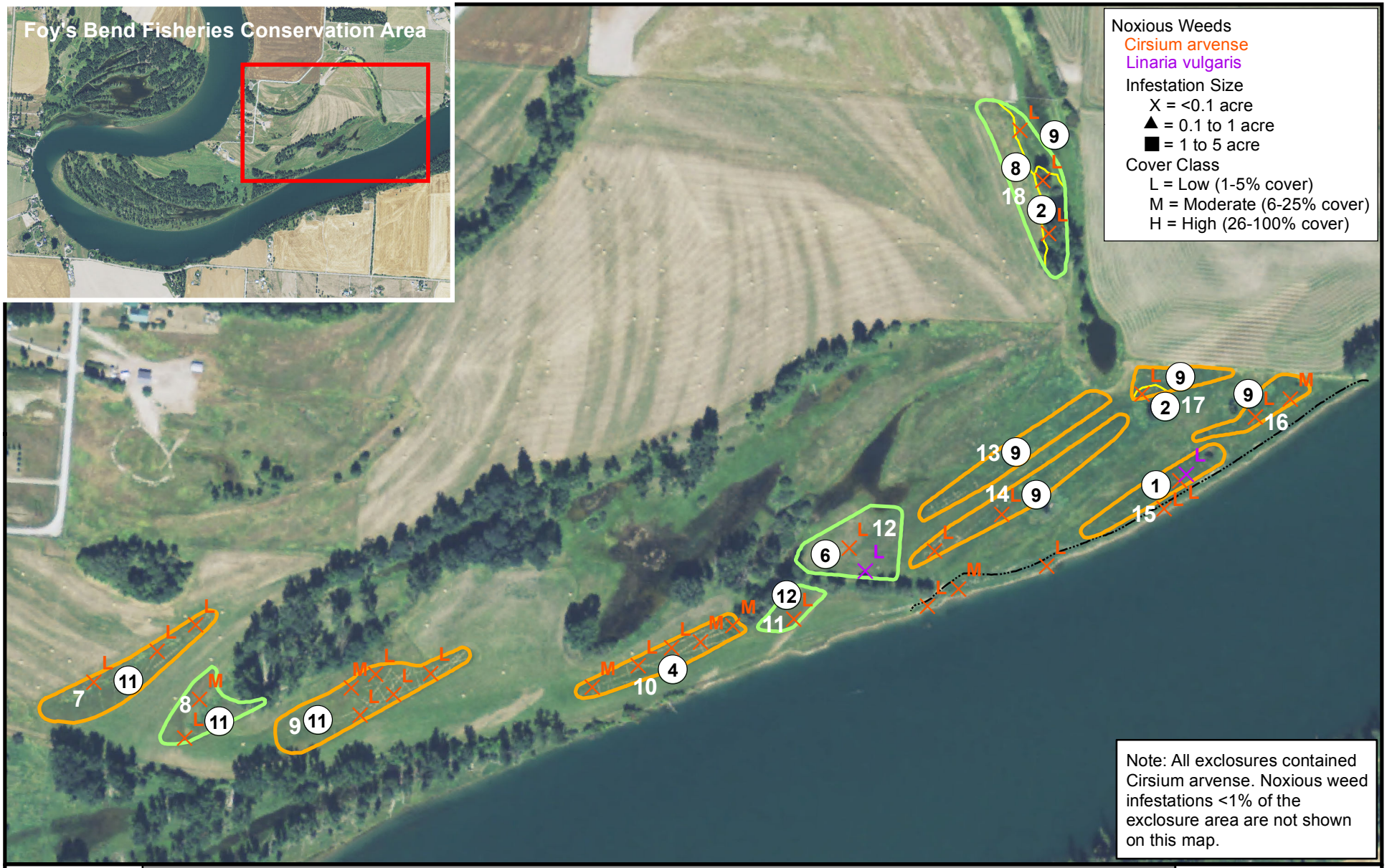
Foys Bend 2016 Monitoring Features

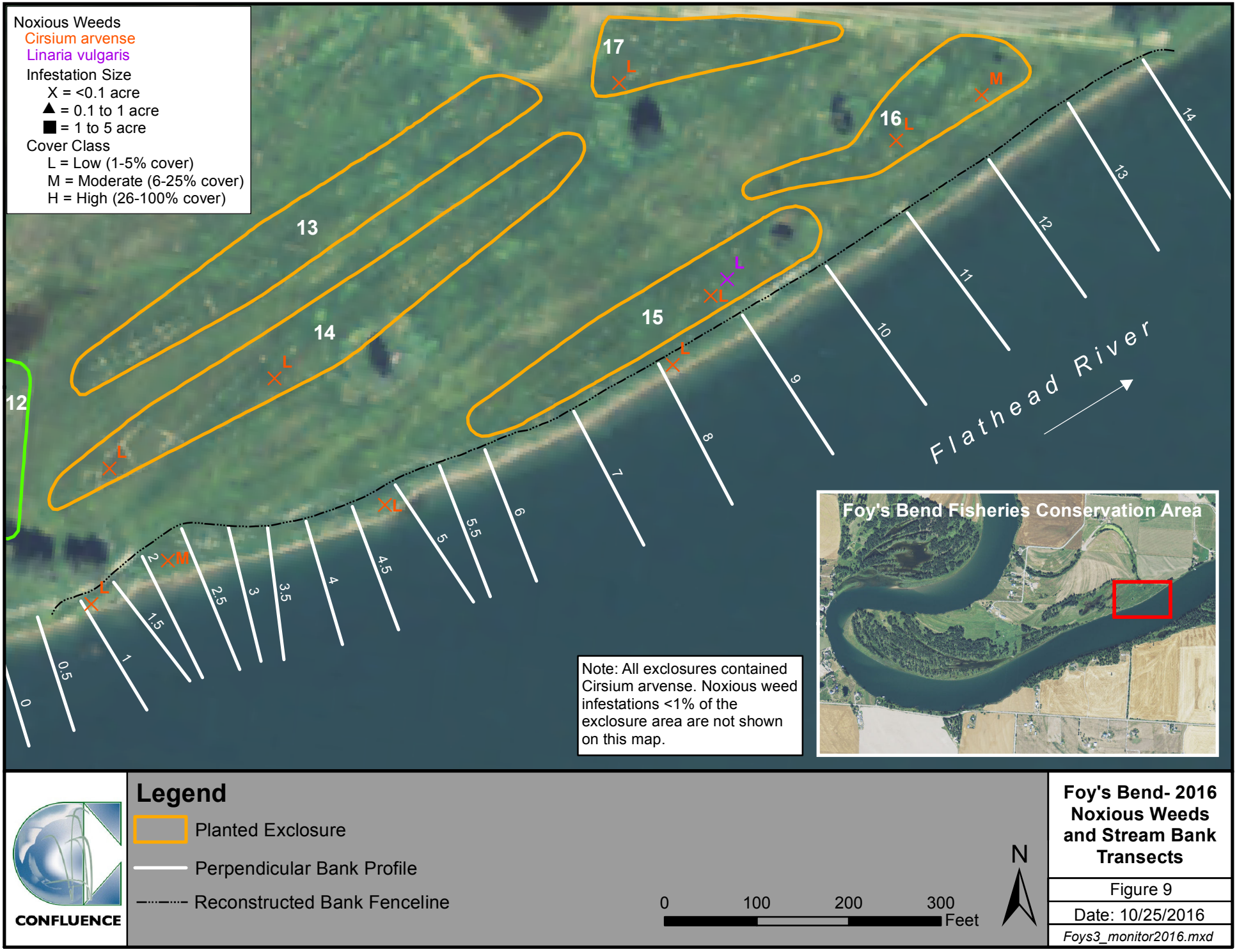
Figure 6

Date: 10/27/2016

Foys3_features2016


Foy's Bend Fisheries Conservation Area
Noxious Weeds
Cirsium arvense
Linaria vulgaris
Infestation Size
X = <0.1 acre
▲ = 0.1 to 1 acre
■ = 1 to 5 acre
Cover Class
L = Low (1-5% cover)
M = Moderate (6-25% cover)
H = High (26-100% cover)
Flathead River
Note: All exclosures contained Cirsium arvense. Noxious weed infestations <1% of the exclosure area are not shown on this map.
Legend
Planted Exclosure
Vegetation Community Boundary
N
0 100 200 300 400 500 Feet
1 Phalaris/Poa Community
2 Populus Community
4 Alopecurus/Poa Community
5 Bromus/Symphoricarpos Community
6 Phalaris/Symphoricarpos Community
8 Bromus/Poa Community
CONFLUENCE
Foy's Bend- 2016 Noxious Weeds and Vegetation Communities
Figure 7
Date: 10/24/2016
Foys1_monitor2016.mxd


Foy's Bend Fisheries Conservation Area
Noxious Weeds
Cirsium arvense
Linaria vulgaris
Infestation Size
X = <0.1 acre
▲ = 0.1 to 1 acre
■ = 1 to 5 acre
Cover Class
L = Low (1-5% cover)
M = Moderate (6-25% cover)
H = High (26-100% cover)
Note: All exclosures contained Cirsium arvense. Noxious weed infestations <1% of the exclosure area are not shown on this map.
Legend
Planted Exclosure
Unplanted Exclosure
Vegetation Community Boundary
Reconstructed Bank Fenceline
1 Phalaris/Poa Community
2 Populus Community
4 Alopecurus/Poa Community
6 Phalaris/Symphoricarpos Community
8 Bromus/Poa Community
9 Phalaris Community
11 Elymus/Poa Community
12 Poa/Populus Community
0 100 200 300 400 500 Feet
N
CONFLUENCE
Foy's Bend- 2016 Noxious Weeds and Vegetation Communities
Figure 8
Date: 10/25/2016
Foys2_monitor2016.mxd



CONFLUENCE

Legend

- Planted Exclosure
- Perpendicular Bank Profile
- Reconstructed Bank Fenceline

0 100 200 300 Feet

N

Foy's Bend- 2016 Noxious Weeds and Stream Bank Transects

Figure 9

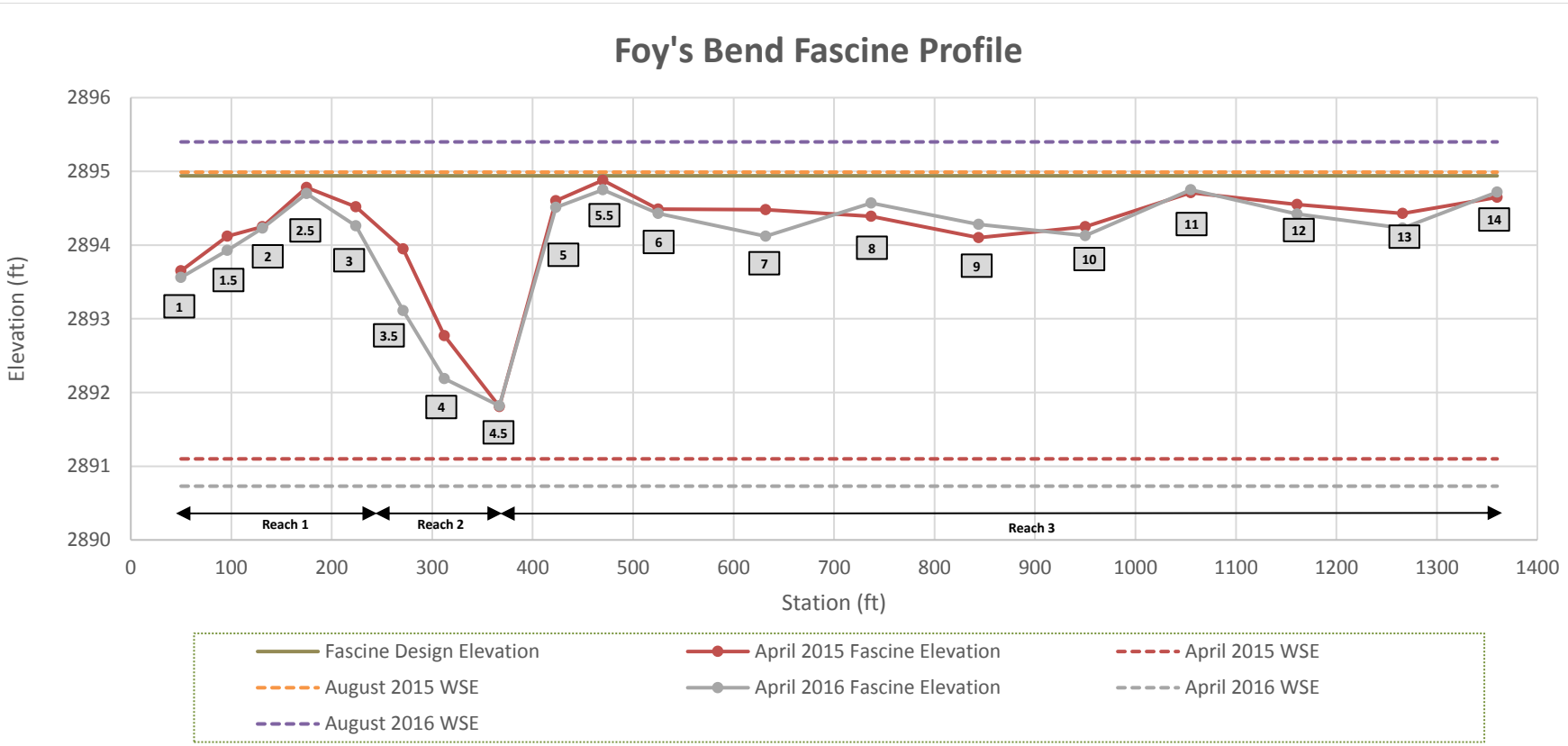
Date: 10/25/2016

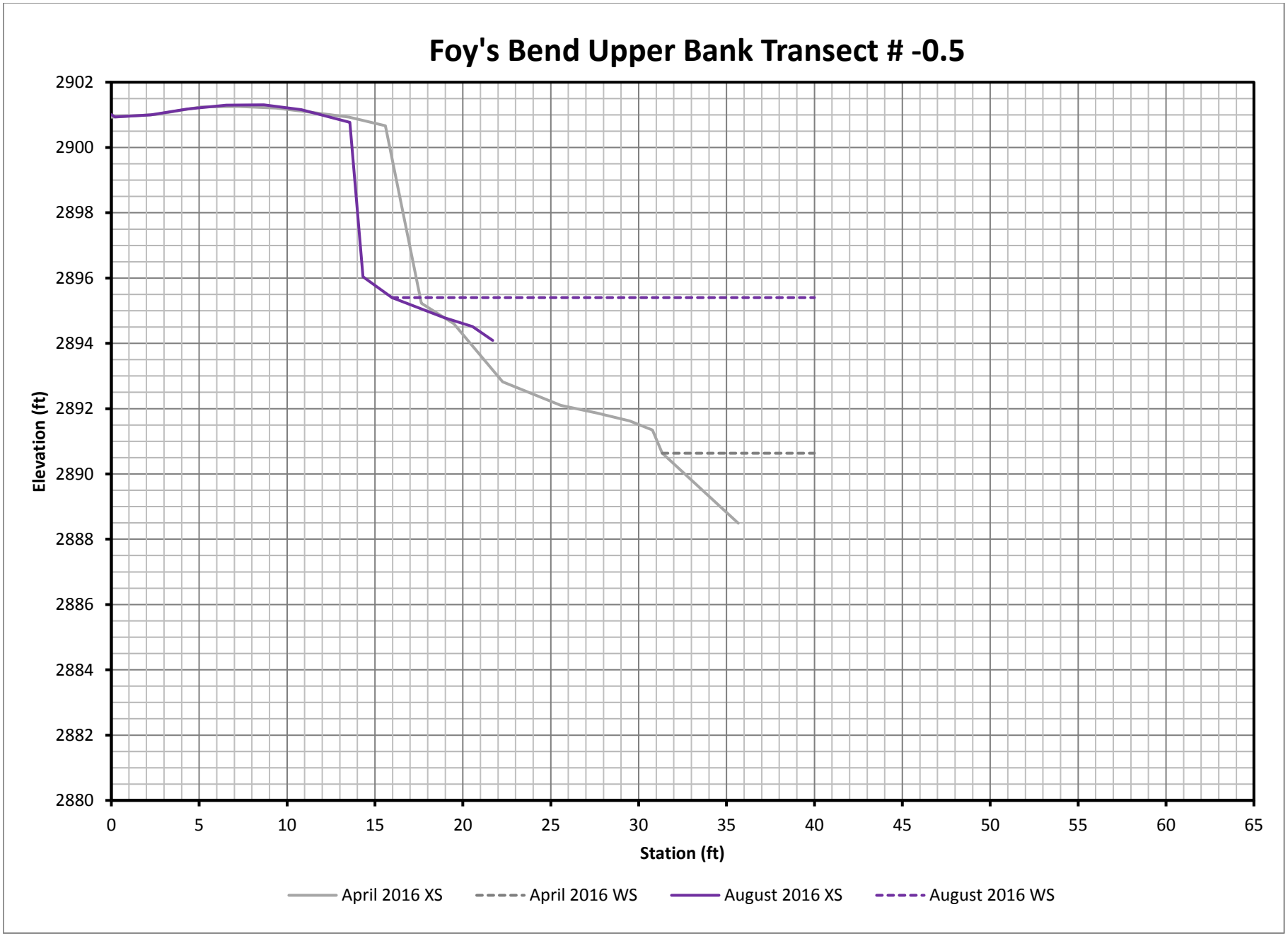
Foys3_monitor2016.mxd

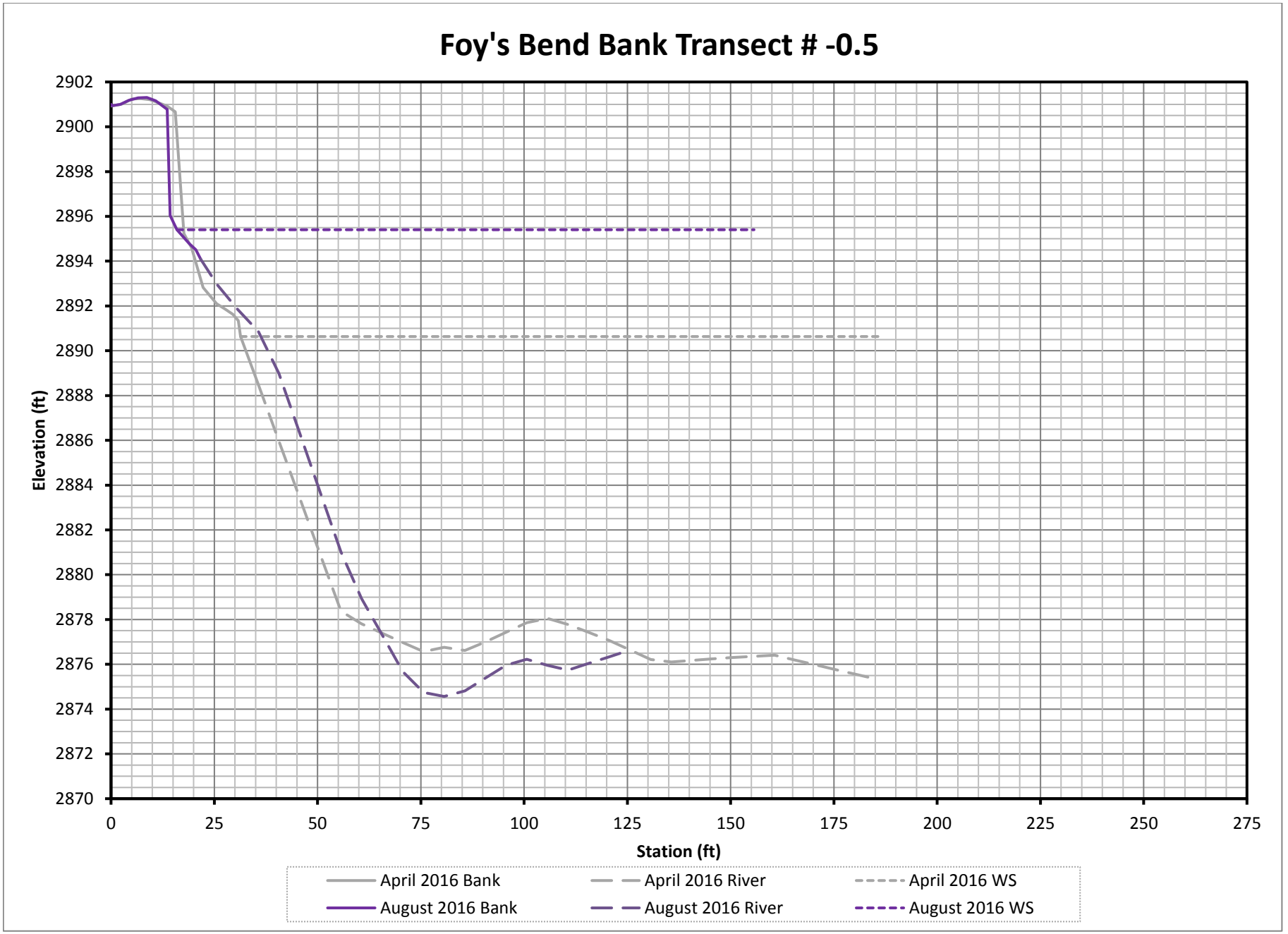
Appendix B

Reconstructed Bank Transect Plots

MDT Stream Mitigation Monitoring
Foy's Bend Fisheries Conservation Area
Flathead County, Montana


Foy's Bend Fascine Profile
Elevation (ft)
2896
2895
2894
2893
2892
2891
2890
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
Station (ft)
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
7
8
9
10
11
12
13
14
Reach 1
Reach 2
Reach 3
Fascine Design Elevation
April 2015 Fascine Elevation
April 2015 WSE
August 2015 WSE
April 2016 Fascine Elevation
April 2016 WSE
August 2016 WSE


Foy's Bend Upper Bank Transect # -0.5
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
0
5
10
15
20
25
30
35
40
45
50
55
60
65
Station (ft)
April 2016 XS
April 2016 WS
August 2016 XS
August 2016 WS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Elevation (ft)
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2900
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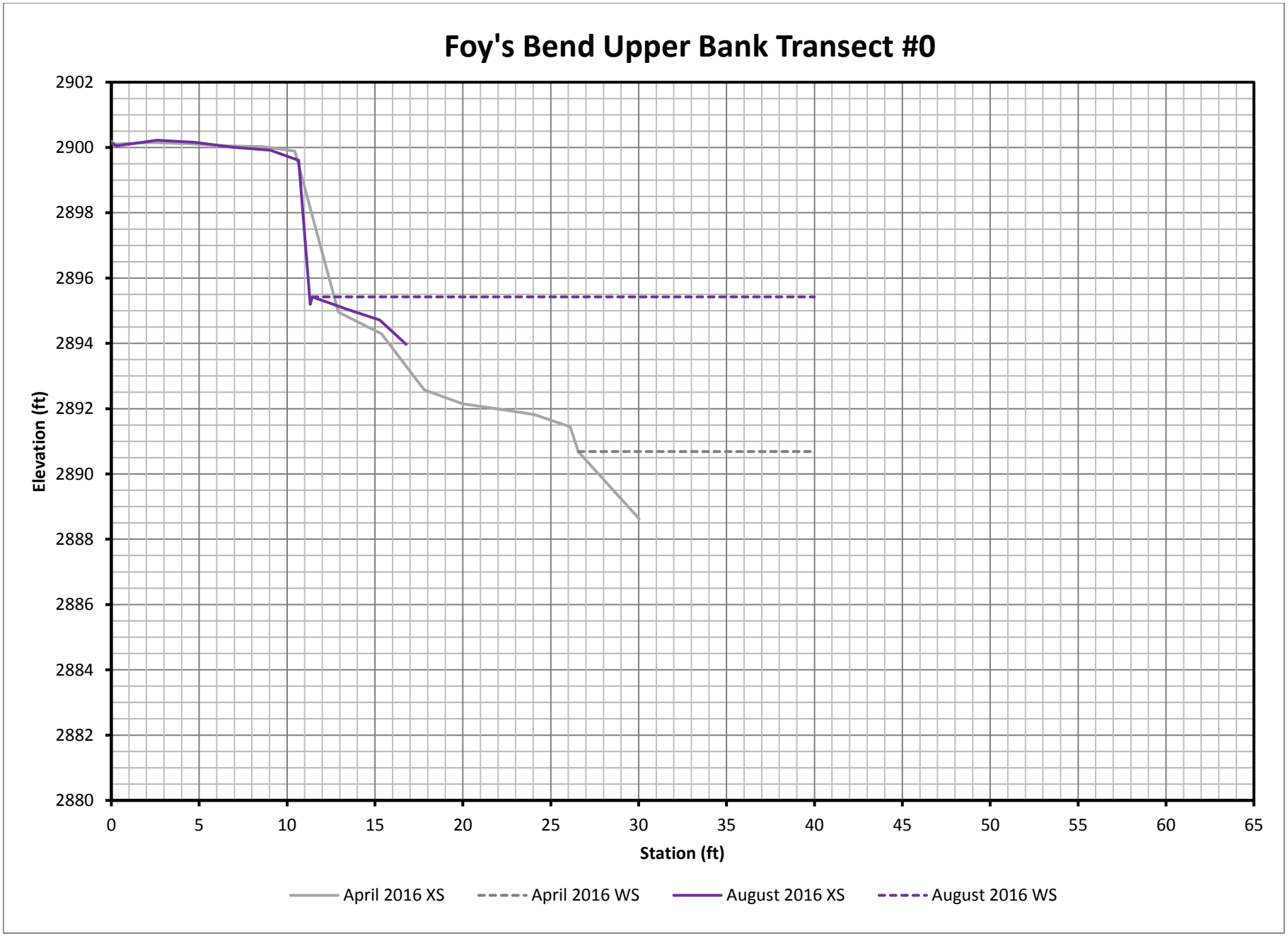
2896
2894
2892
2890
2888
2886
2884
2882
2880
2878
2876
2874
2872
2870
0
25
50
75
100
125
150
175
200
225
250
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #0
Elevation (ft)
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2900
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2894
2892
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2888
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2882
2880
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5
10
15
20
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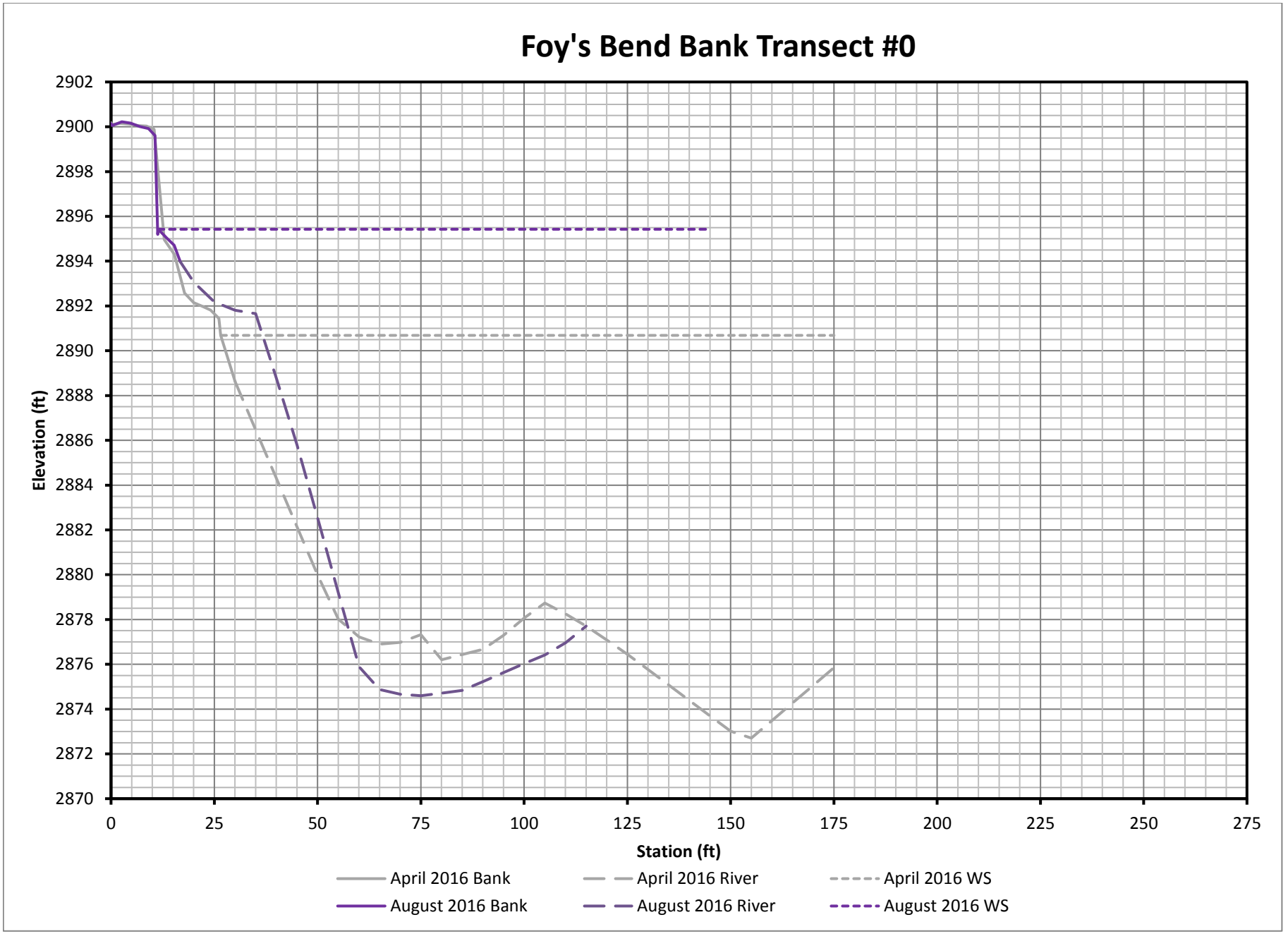
30
35
40
45
50
55
60
65
Station (ft)
April 2016 XS
April 2016 WS
August 2016 XS
August 2016 WS


Foy's Bend Bank Transect #0
Elevation (ft)
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2900
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2894
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2888
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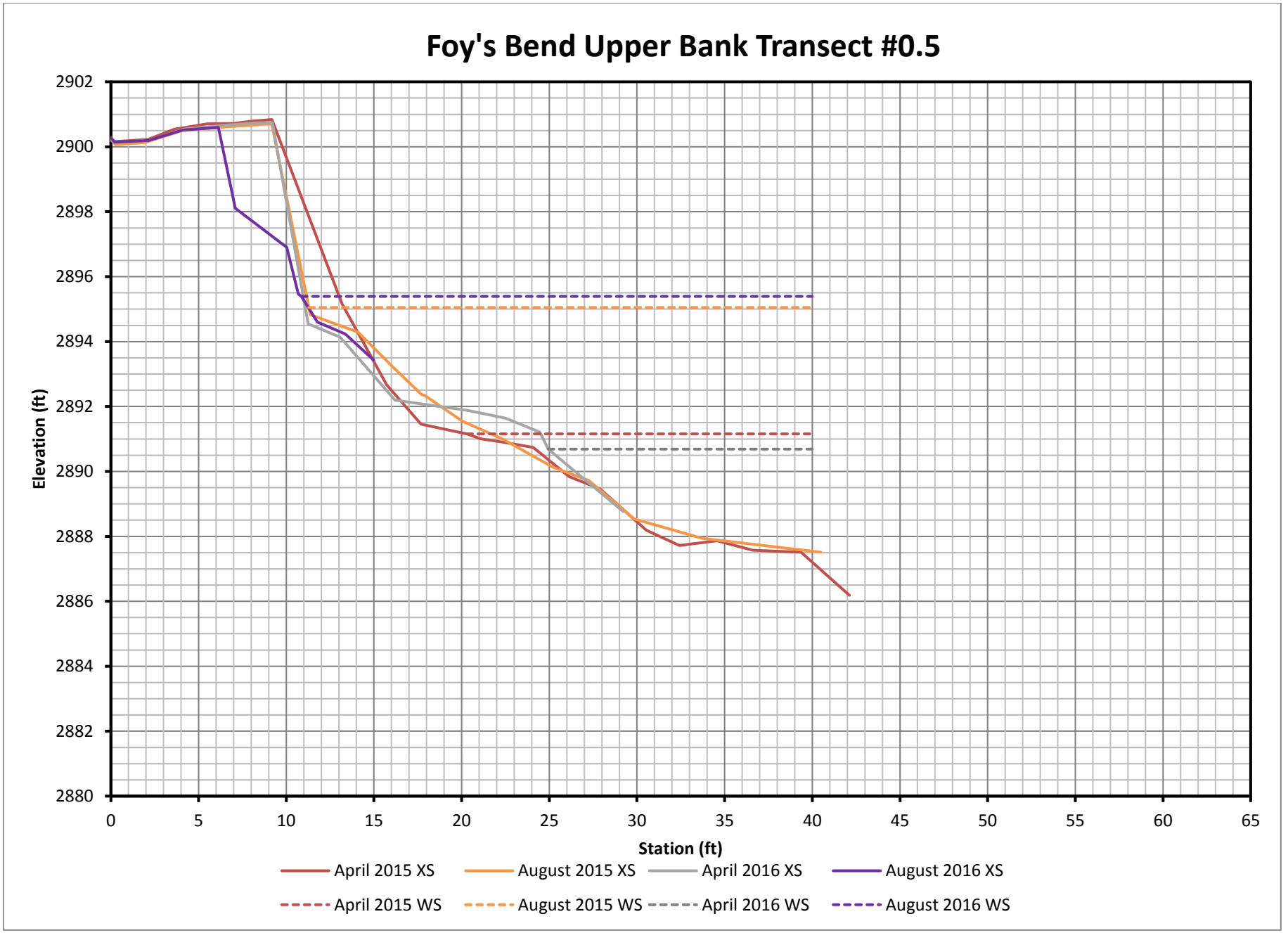
2882
2880
2878
2876
2874
2872
2870
0
25
50
75
100
125
150
175
200
225
250
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #0.5
Elevation (ft)
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2894
2892
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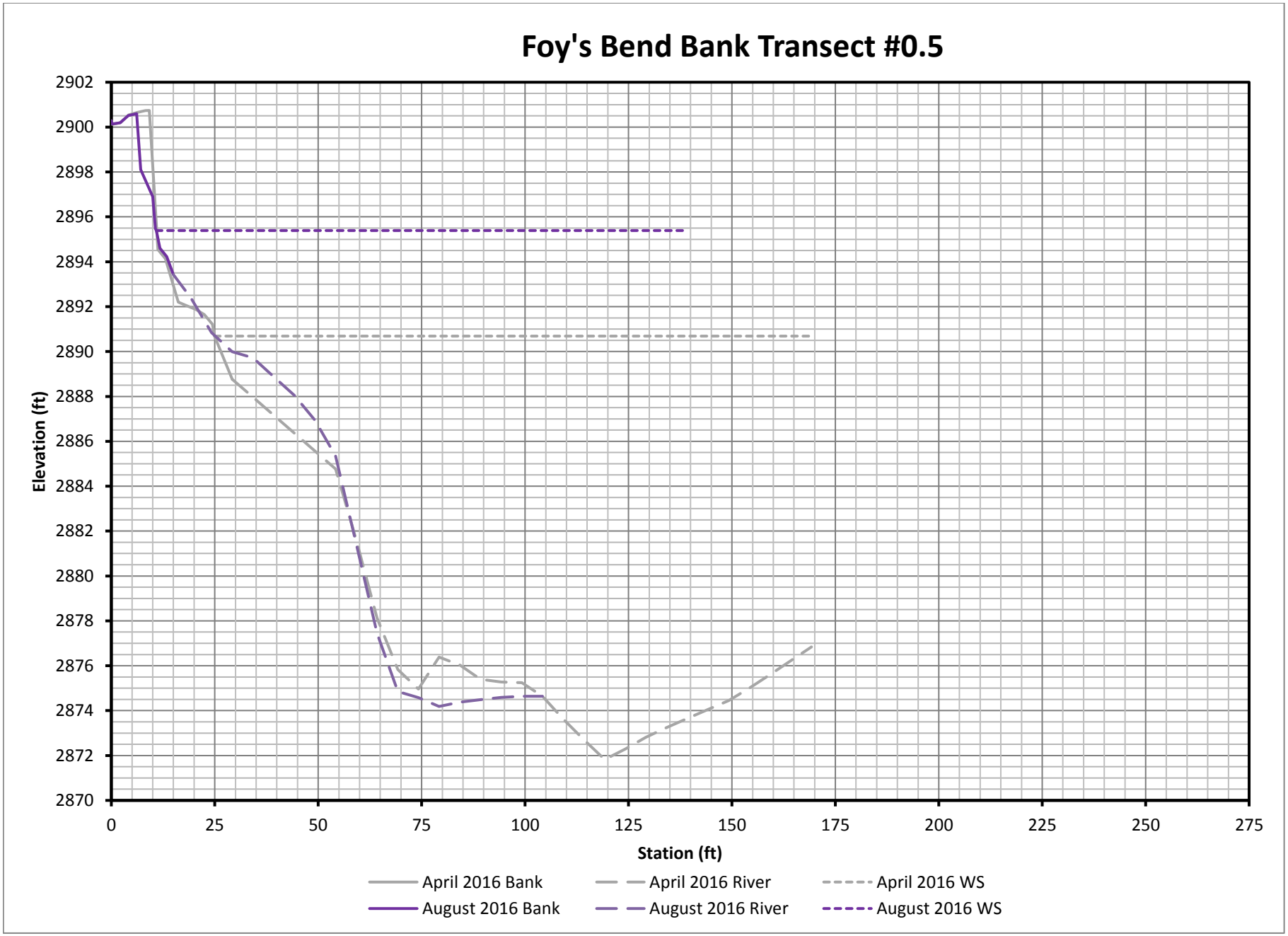
2888
2886
2884
2882
2880
0
5
10
15
20
25
30
35
40
45
50
55
60
65
Station (ft)
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #0.5
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
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2882
2880
2878
2876
2874
2872
2870
0
25
50
75
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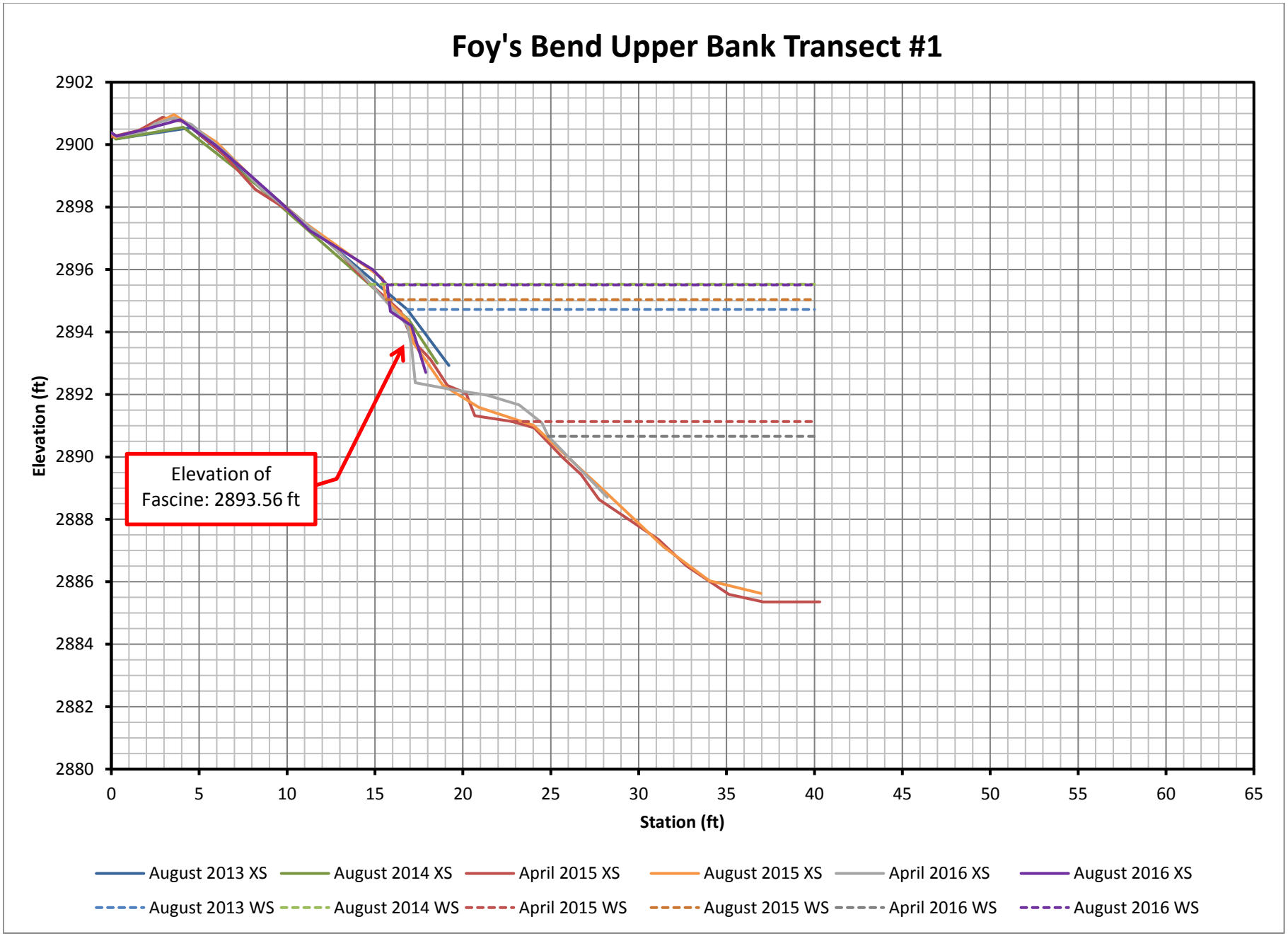
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #1
Elevation (ft)
2902
2900
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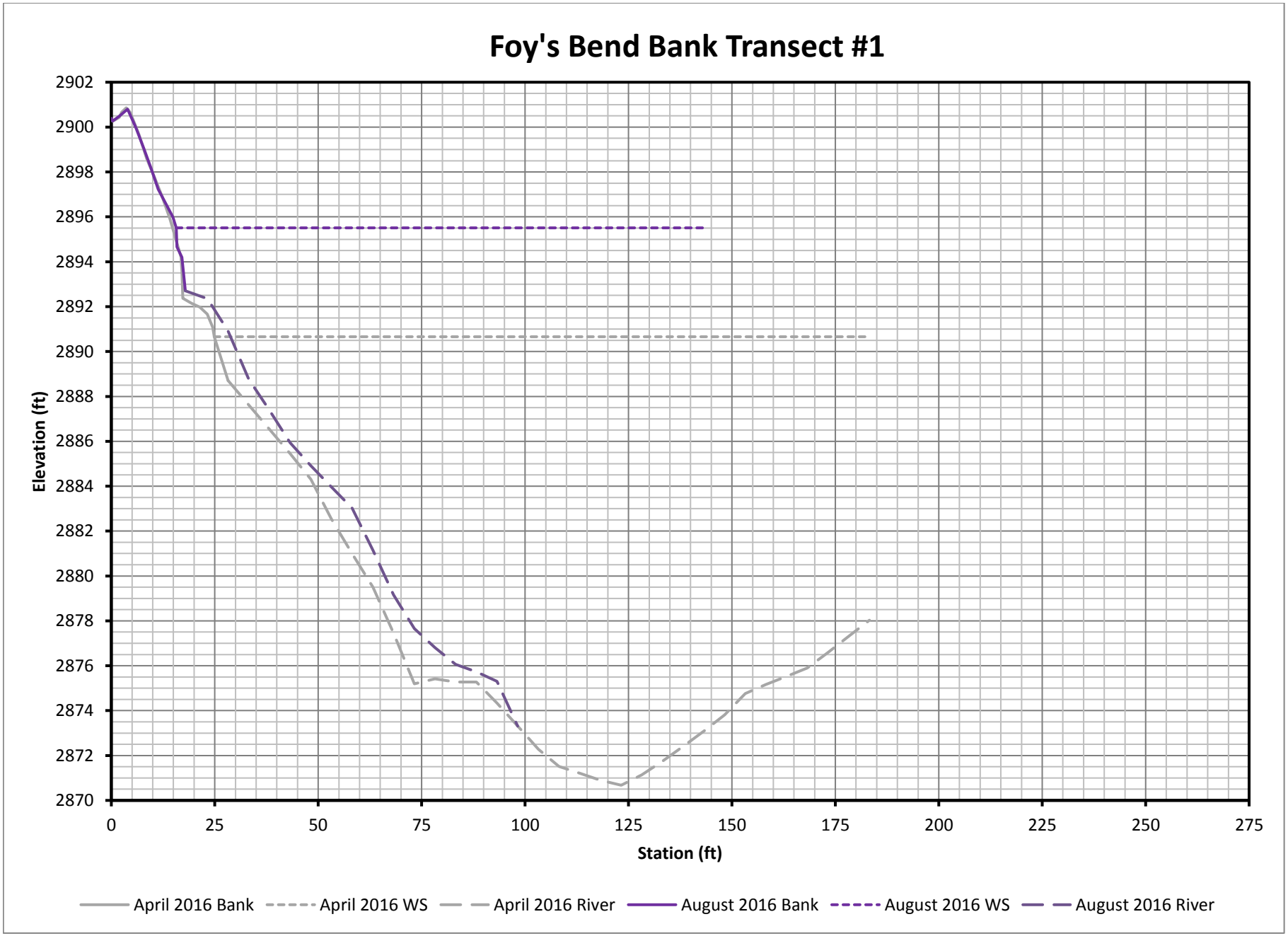
Station (ft)
Elevation of Fascine: 2893.56 ft
August 2013 XS
August 2014 XS
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #1
Elevation (ft)
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2872
2870
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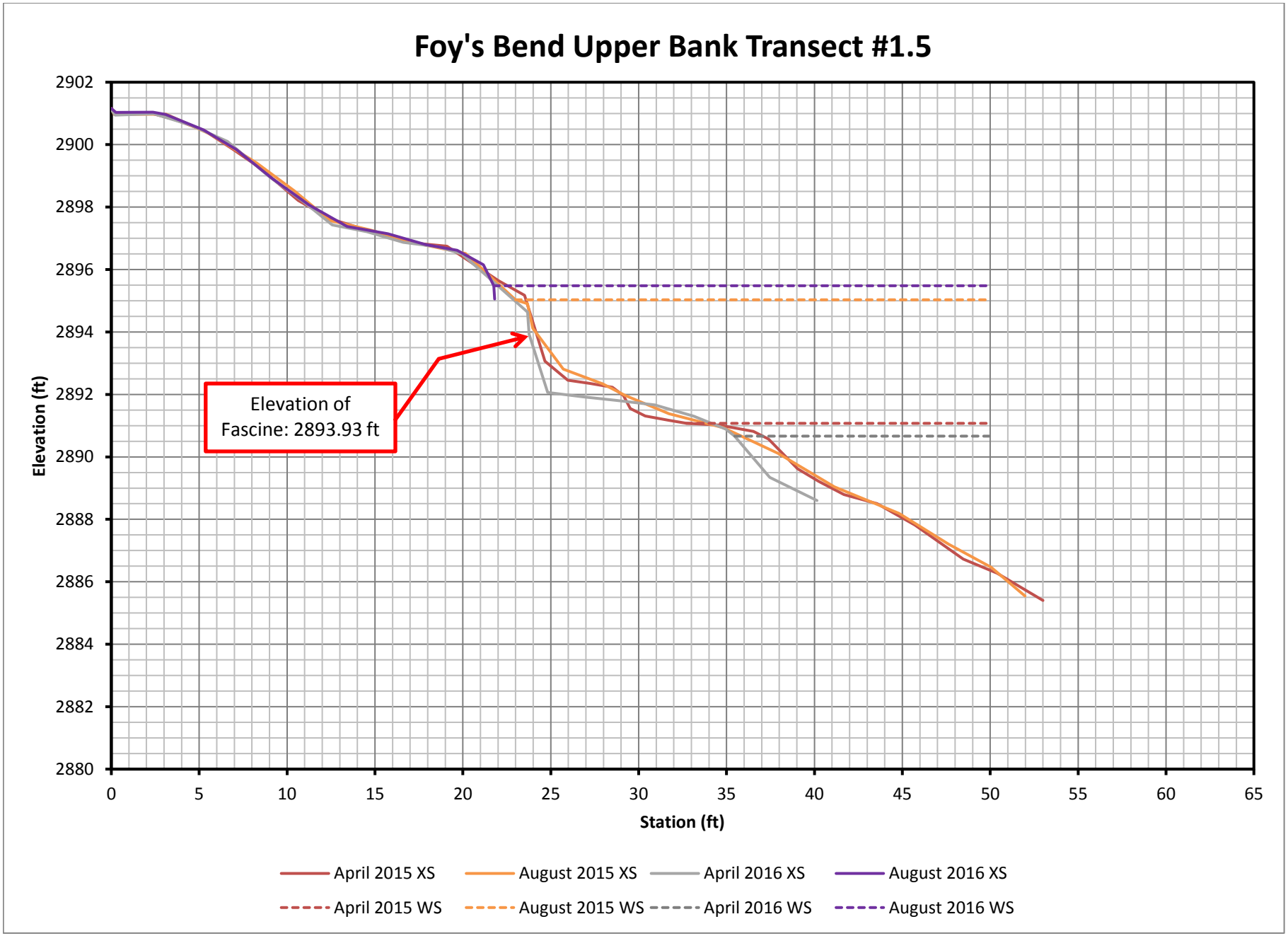
Station (ft)
April 2016 Bank
April 2016 WS
April 2016 River
August 2016 Bank
August 2016 WS
August 2016 River


Foy's Bend Upper Bank Transect #1.5
Elevation (ft)
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2882
2880
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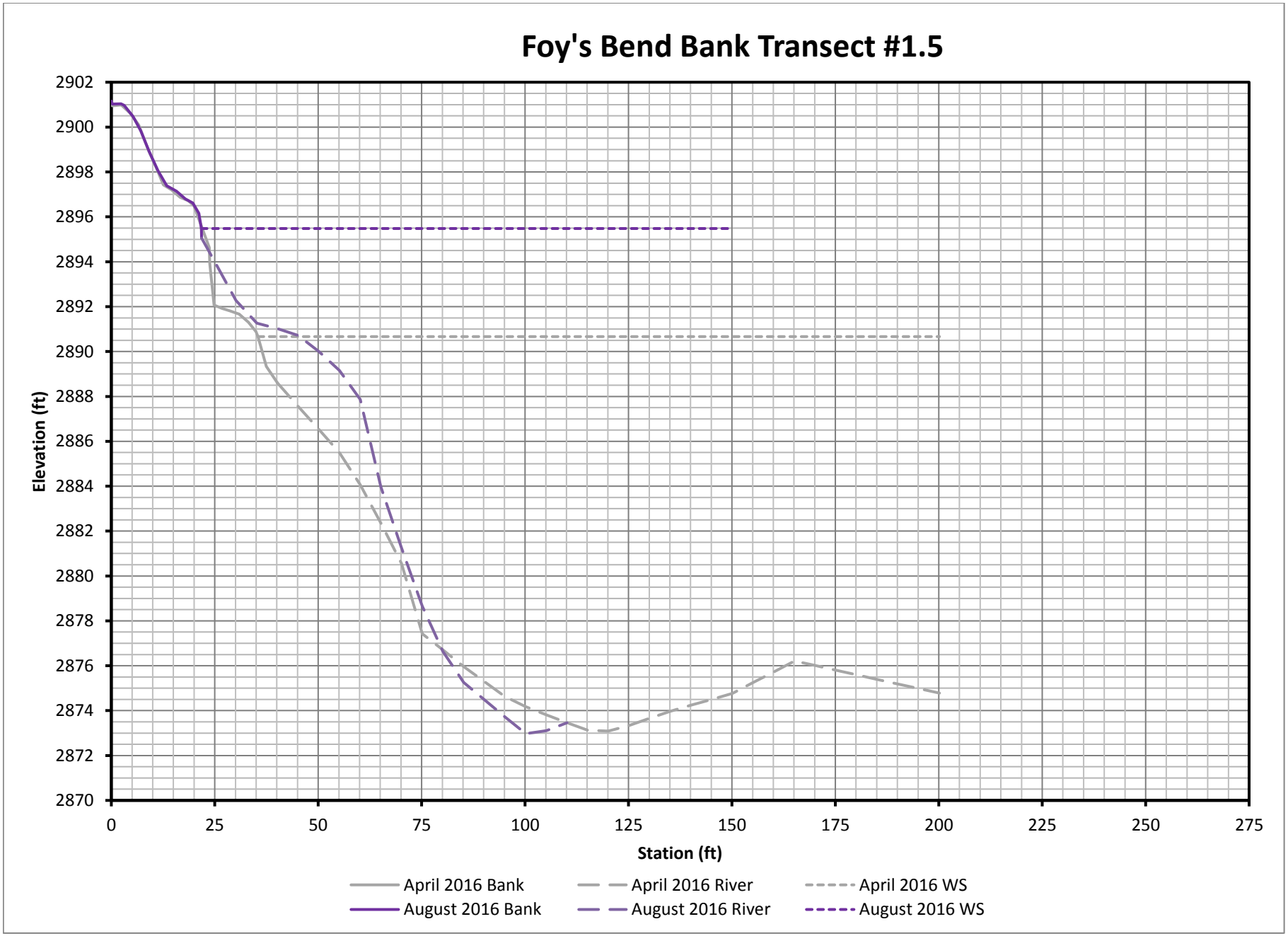
65
Station (ft)
Elevation of Fascine: 2893.93 ft
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #1.5
Elevation (ft)
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2872
2870
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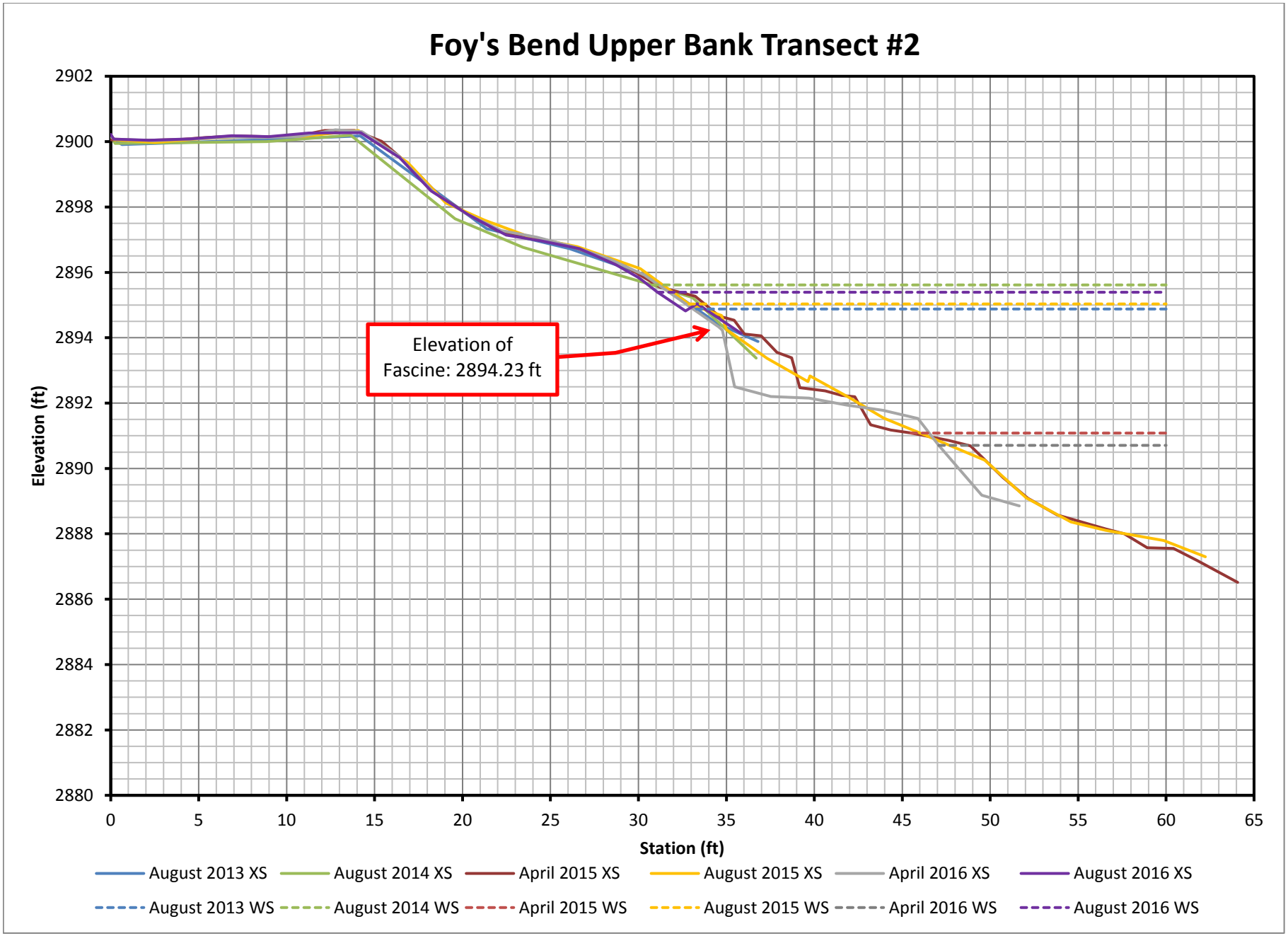
250
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #2
Elevation (ft)
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2882
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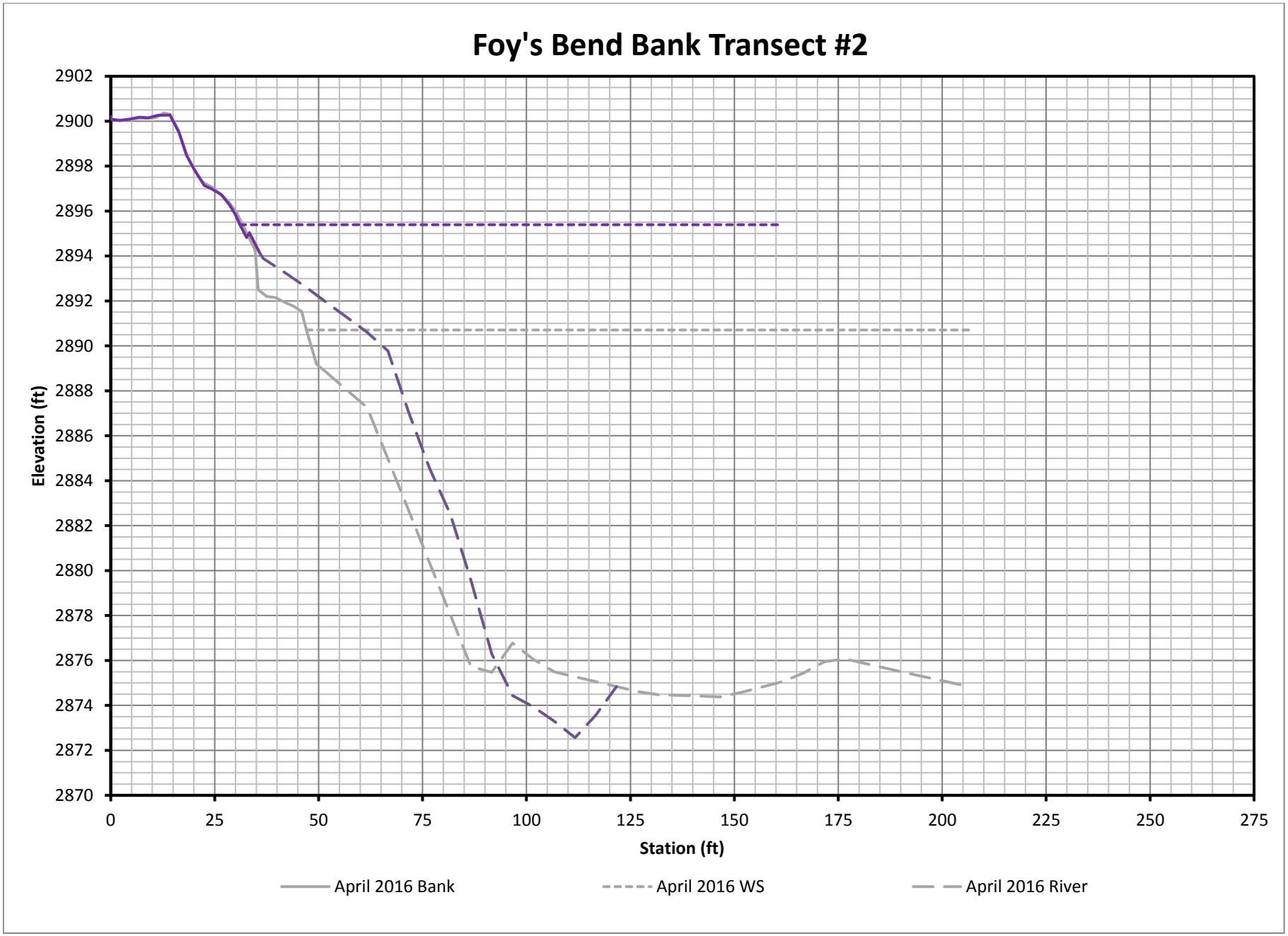
65
Station (ft)
Elevation of Fascine: 2894.23 ft
August 2013 XS
August 2014 XS
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #2
Elevation (ft)
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2874
2872
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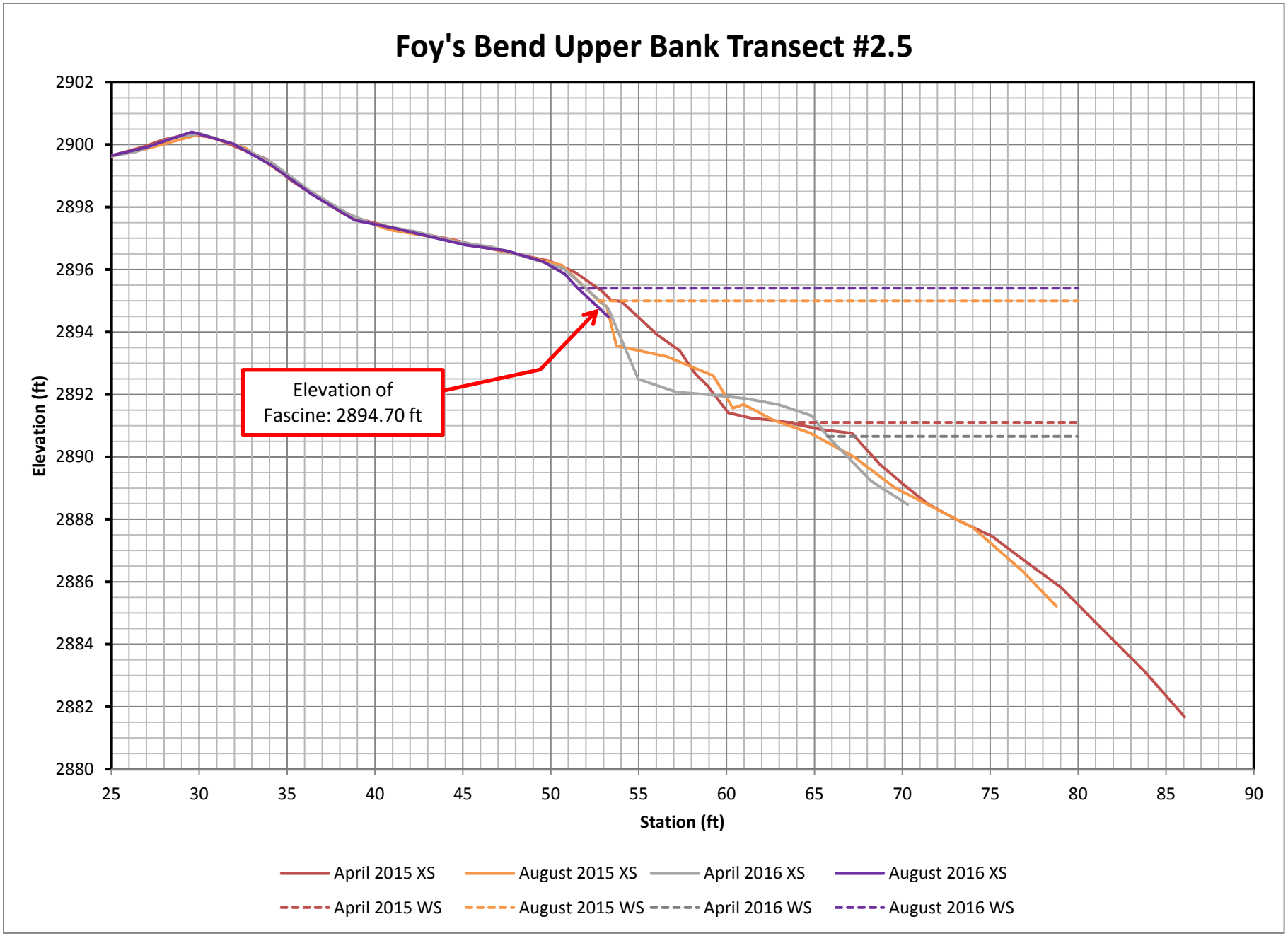
250
275
Station (ft)
April 2016 Bank
April 2016 WS
April 2016 River


Foy's Bend Upper Bank Transect #2.5
Elevation (ft)
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2882
2880
25
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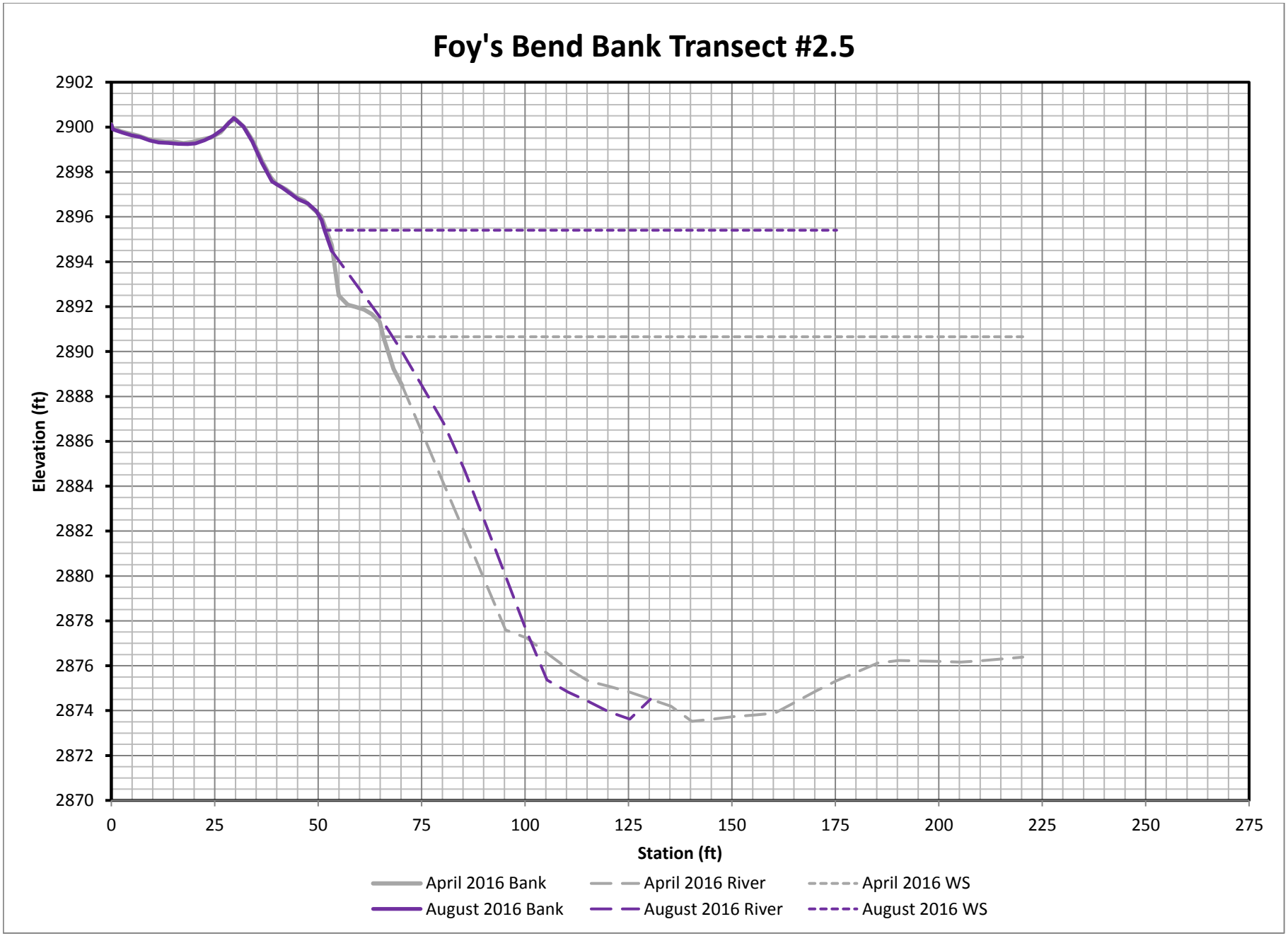
35
40
45
50
55
60
65
70
75
80
85
90
Station (ft)
Elevation of Fascine: 2894.70 ft
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #2.5
Elevation (ft)
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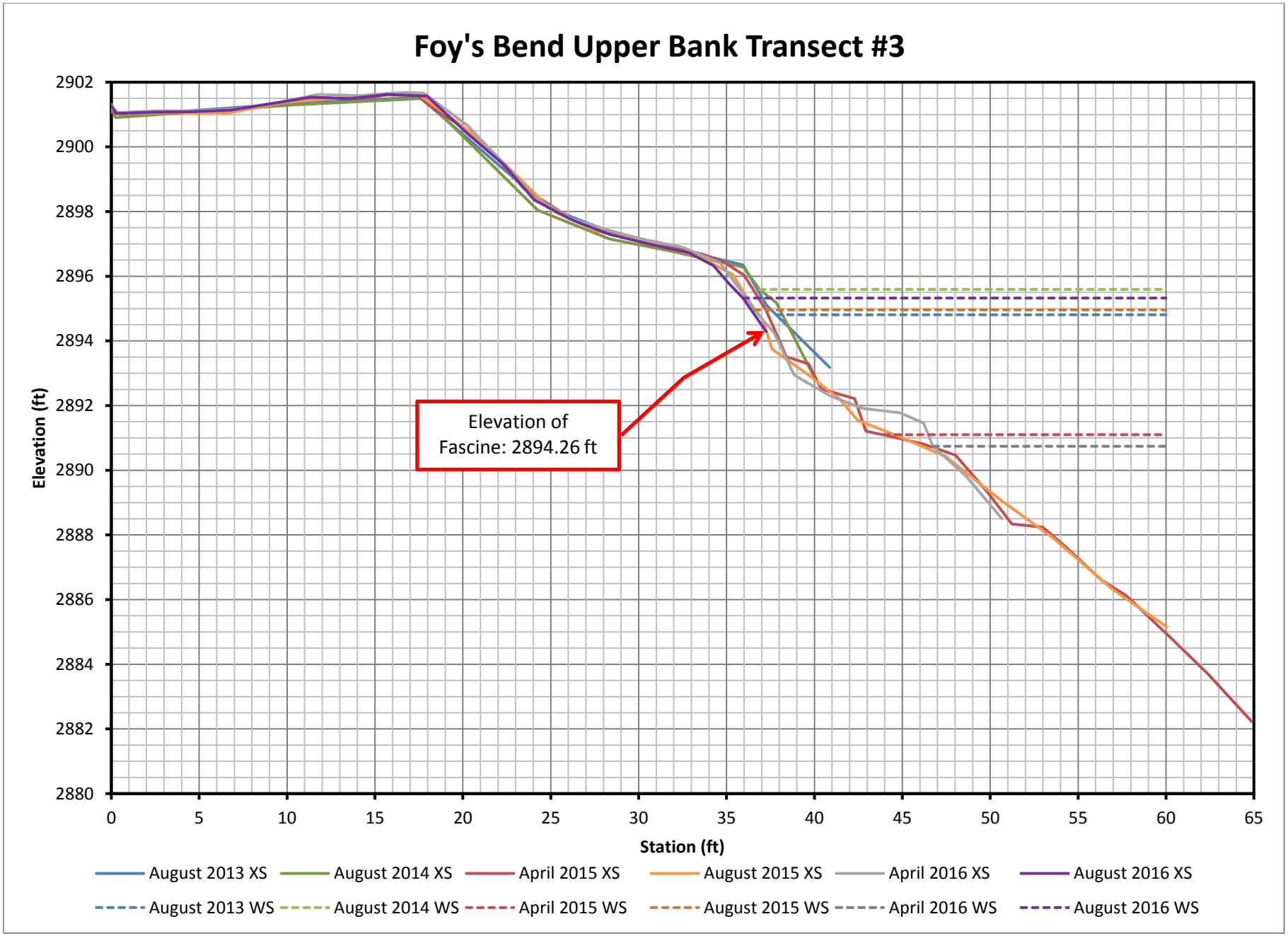
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #3
Elevation (ft)
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2882
2880
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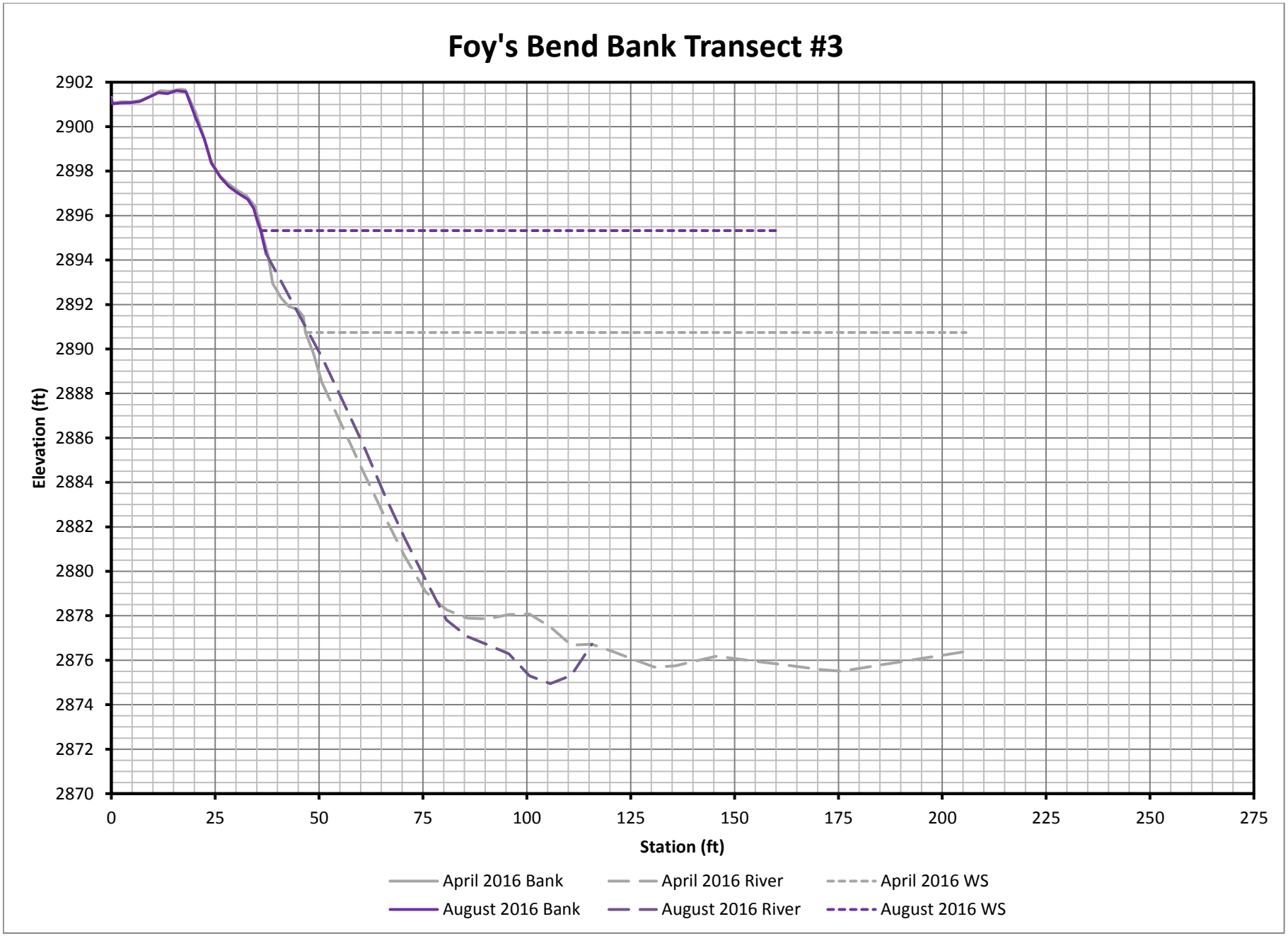
65
Station (ft)
Elevation of Fascine: 2894.26 ft
August 2013 XS
August 2014 XS
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #3
Elevation (ft)
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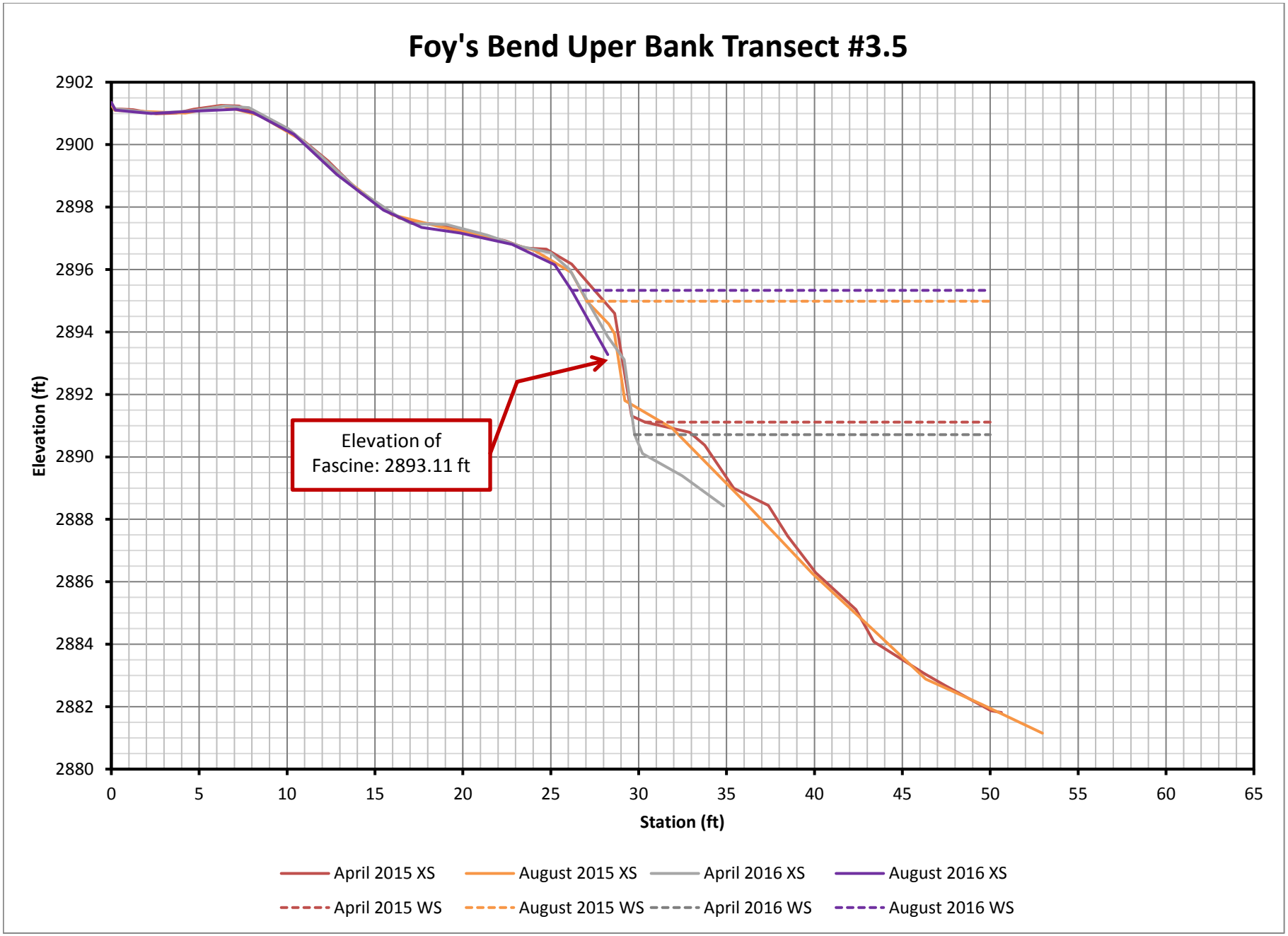
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Uper Bank Transect #3.5
Elevation (ft)
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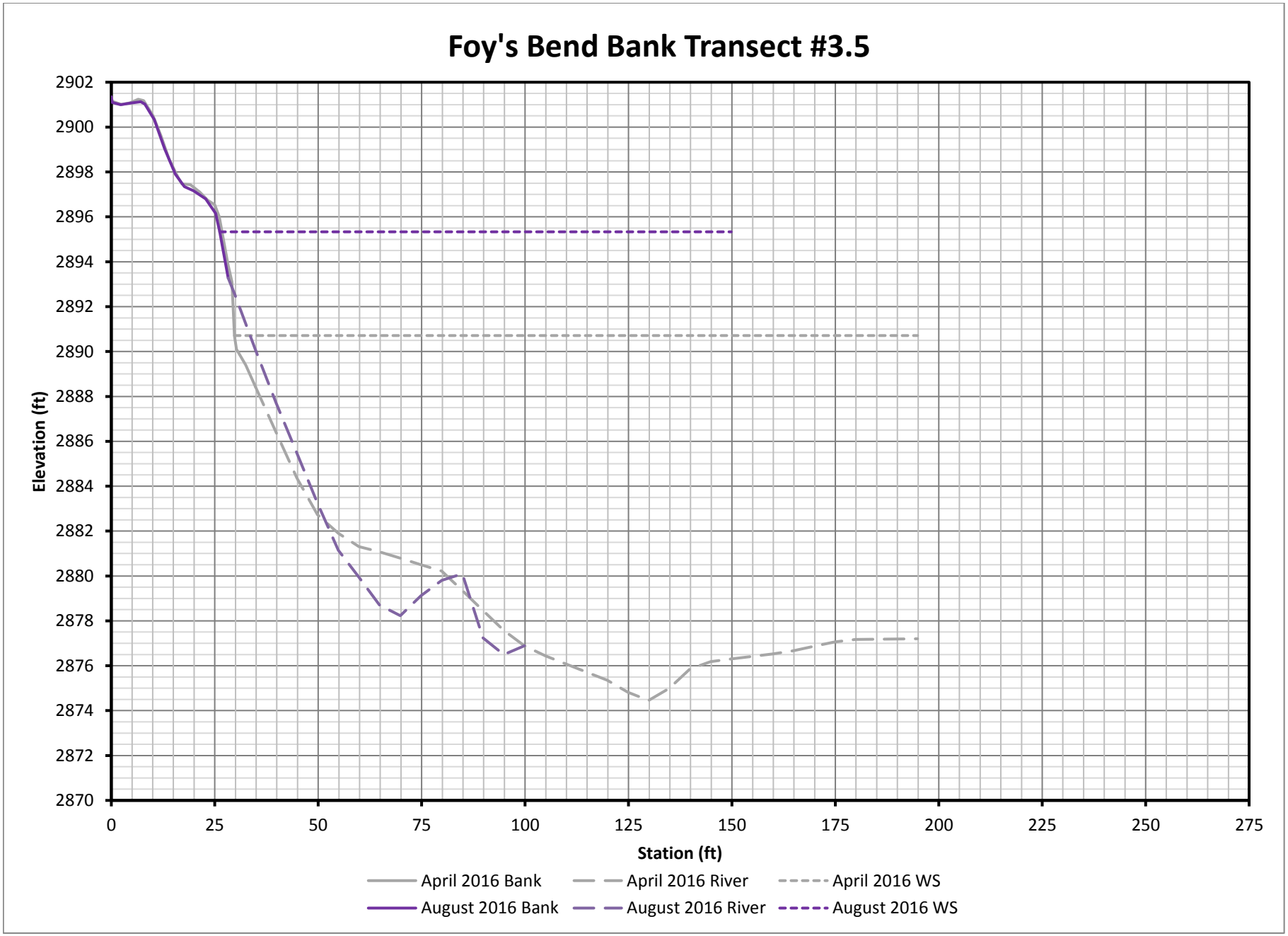
Station (ft)
Elevation of Fascine: 2893.11 ft
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #3.5
Elevation (ft)
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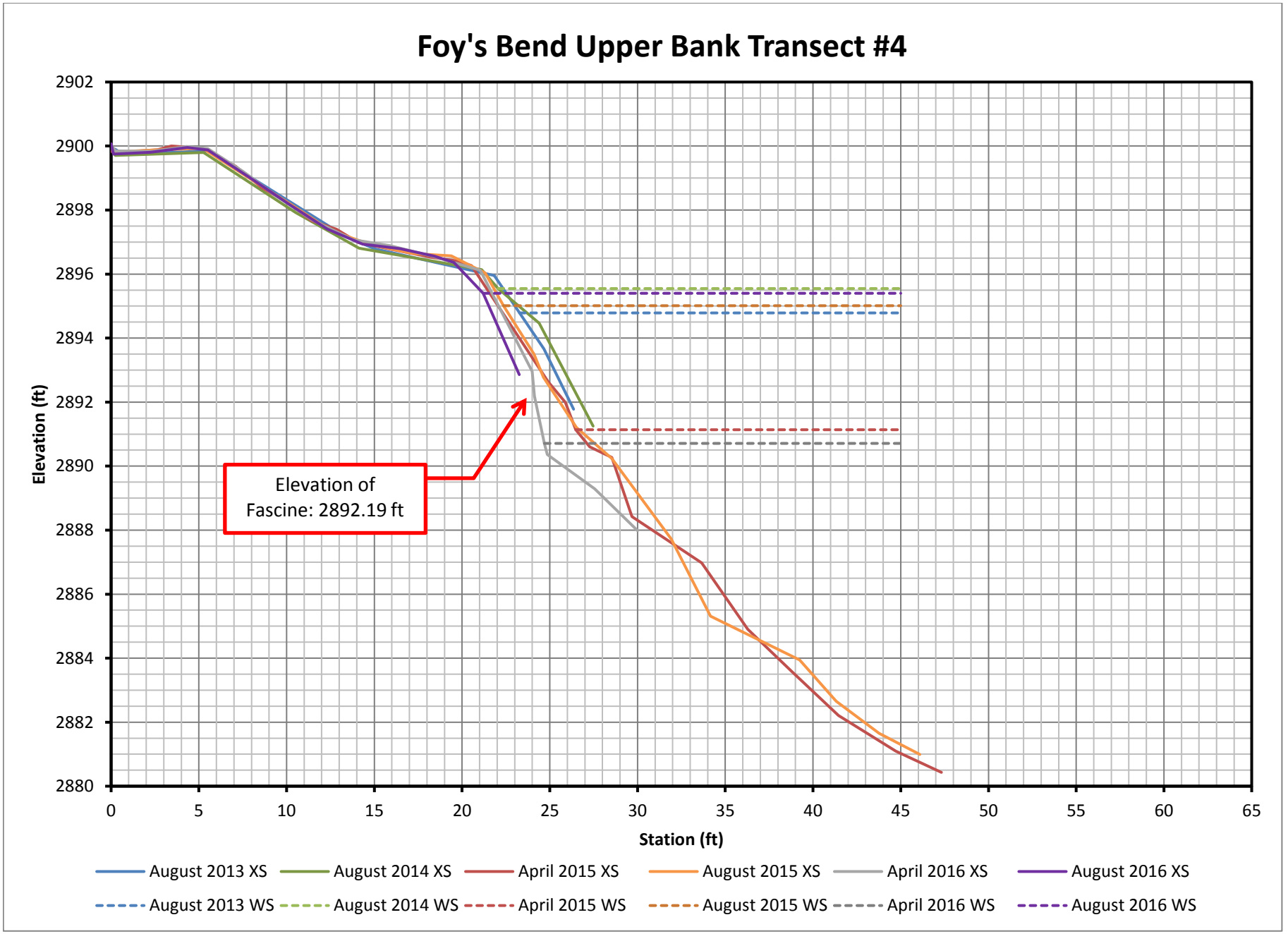
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #4
Elevation (ft)
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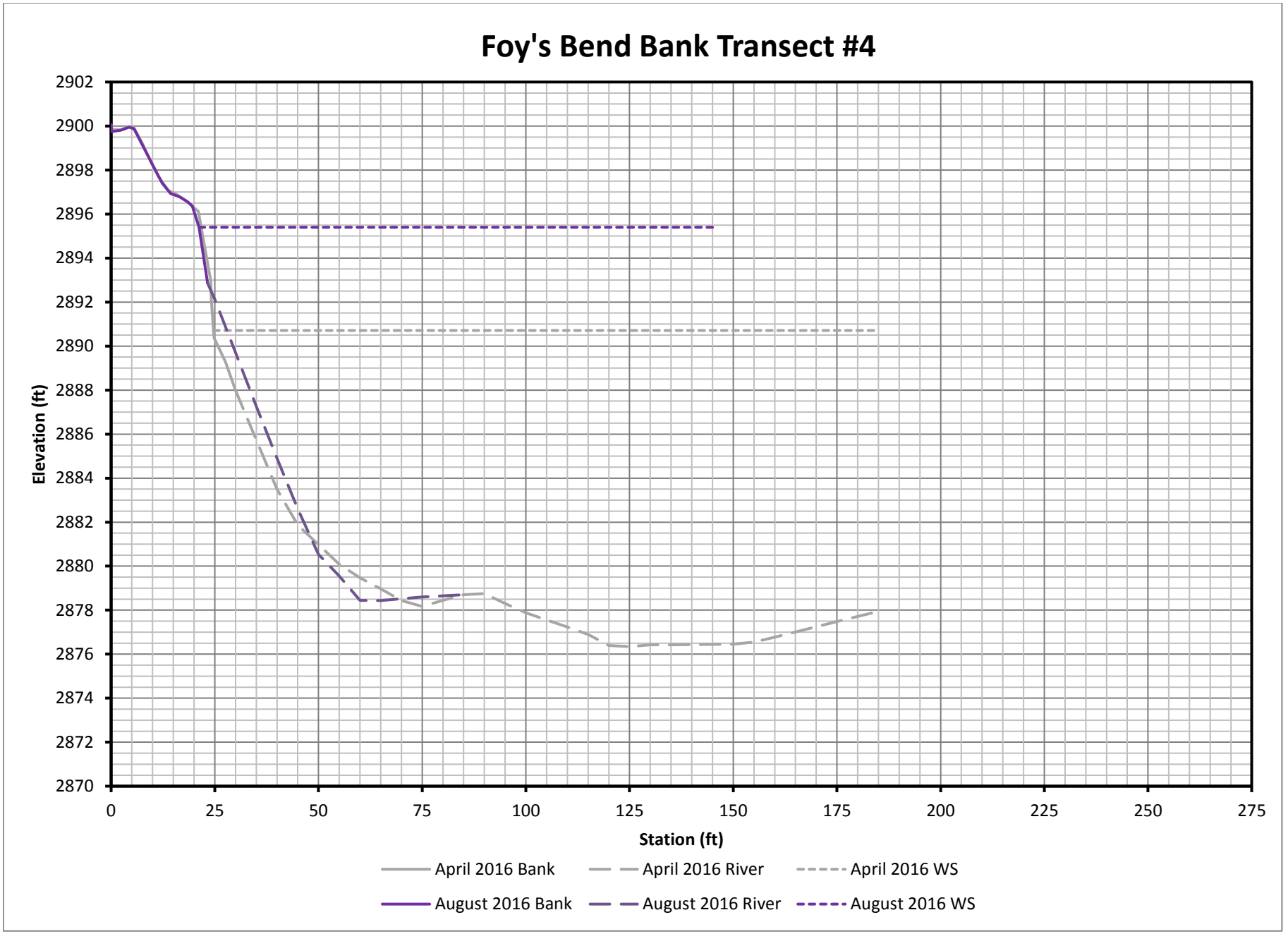
Station (ft)
Elevation of Fascine: 2892.19 ft
August 2013 XS
August 2014 XS
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #4
Elevation (ft)
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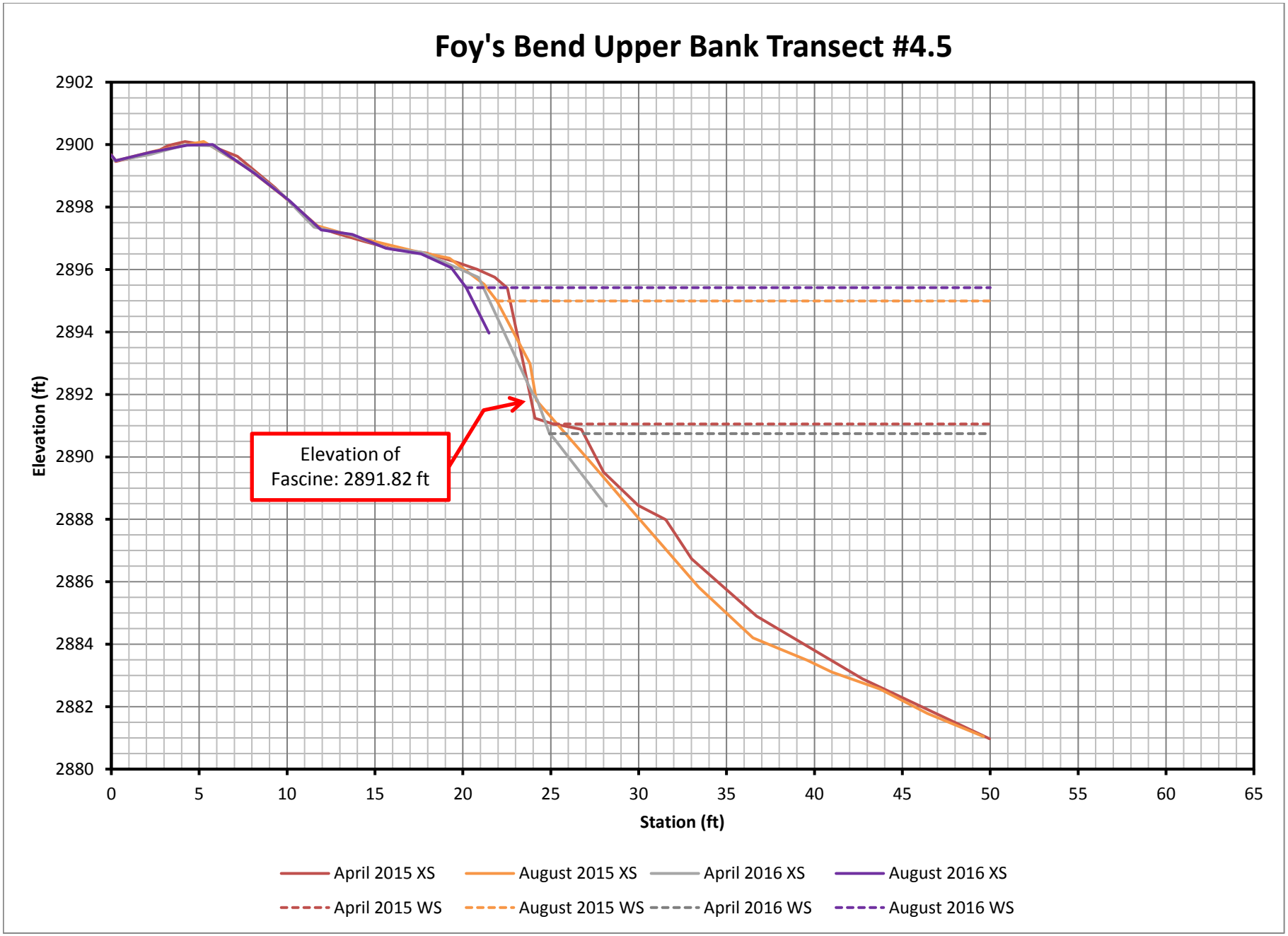
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #4.5
Elevation (ft)
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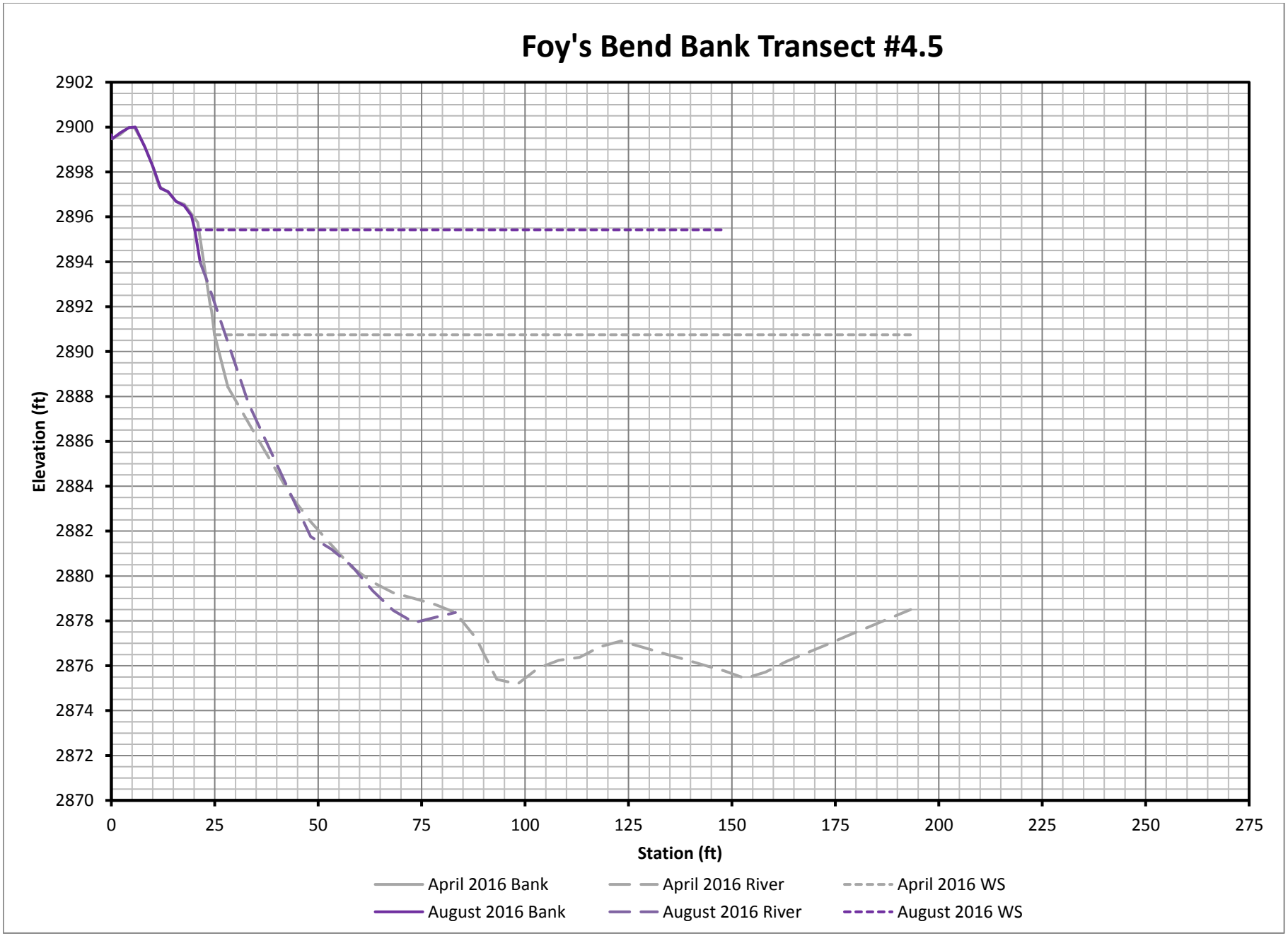
Station (ft)
Elevation of Fascine: 2891.82 ft
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #4.5
Elevation (ft)
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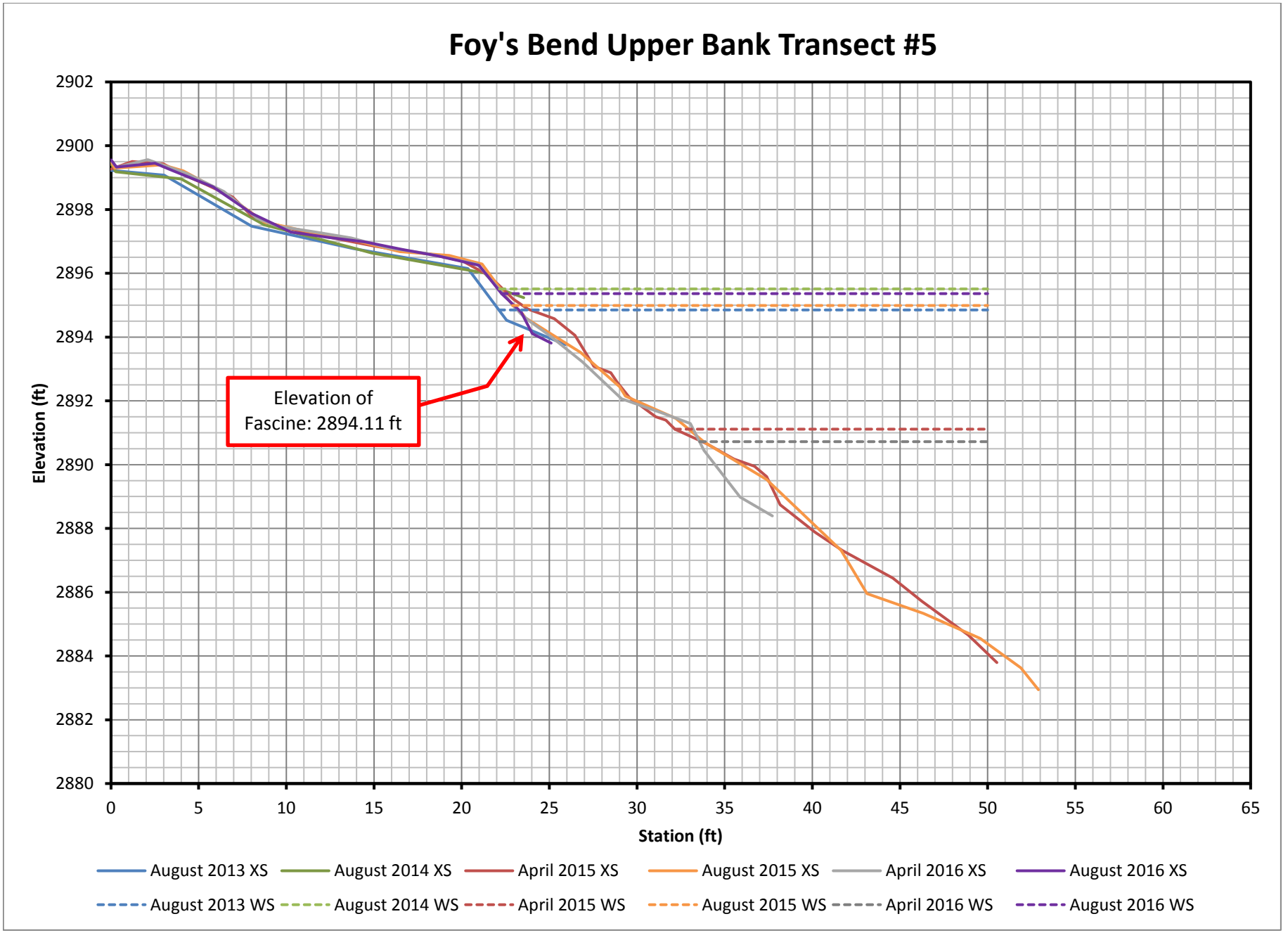
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #5
Elevation (ft)
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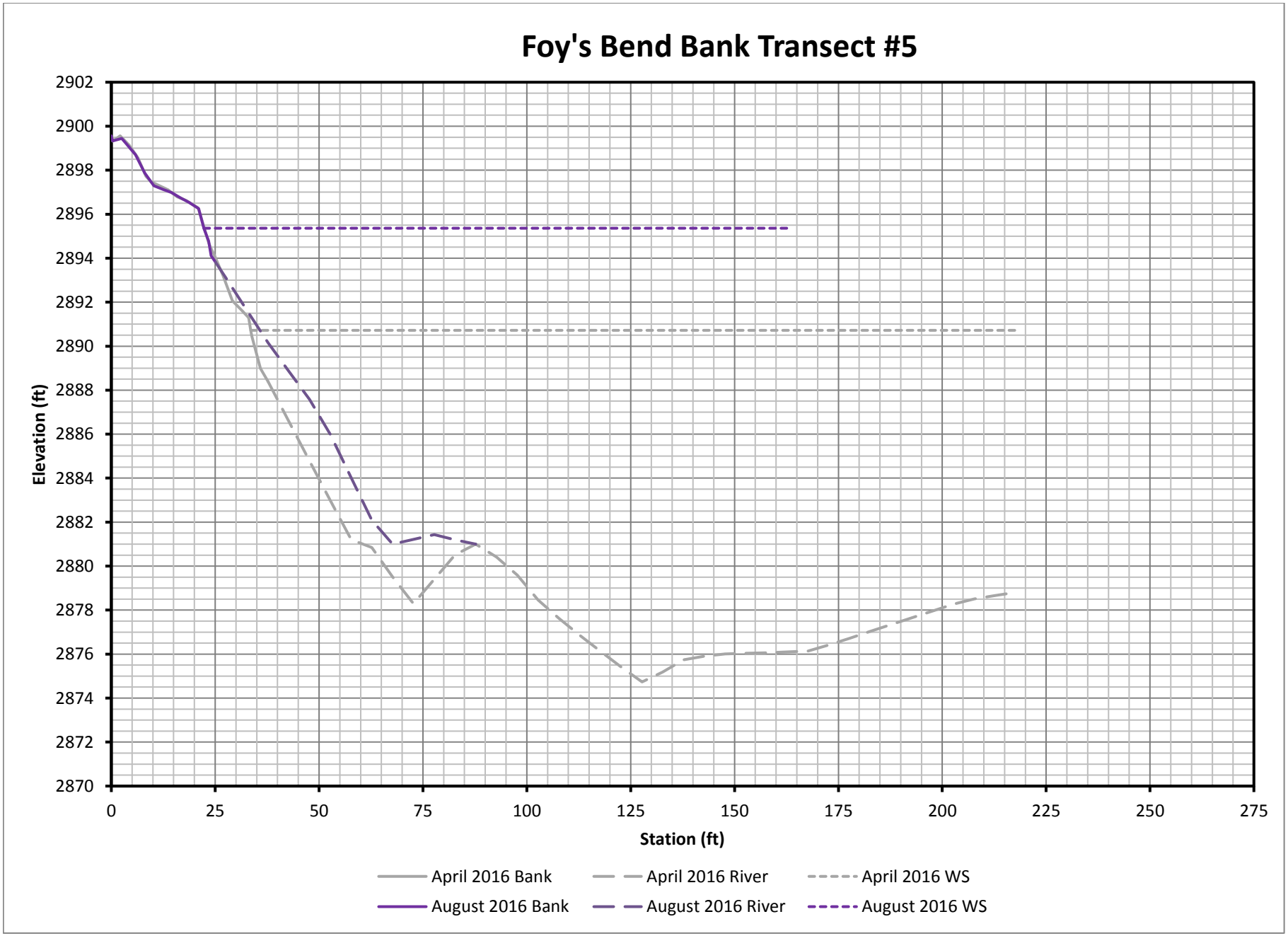
Station (ft)
Elevation of Fascine: 2894.11 ft
August 2013 XS
August 2014 XS
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #5
Elevation (ft)
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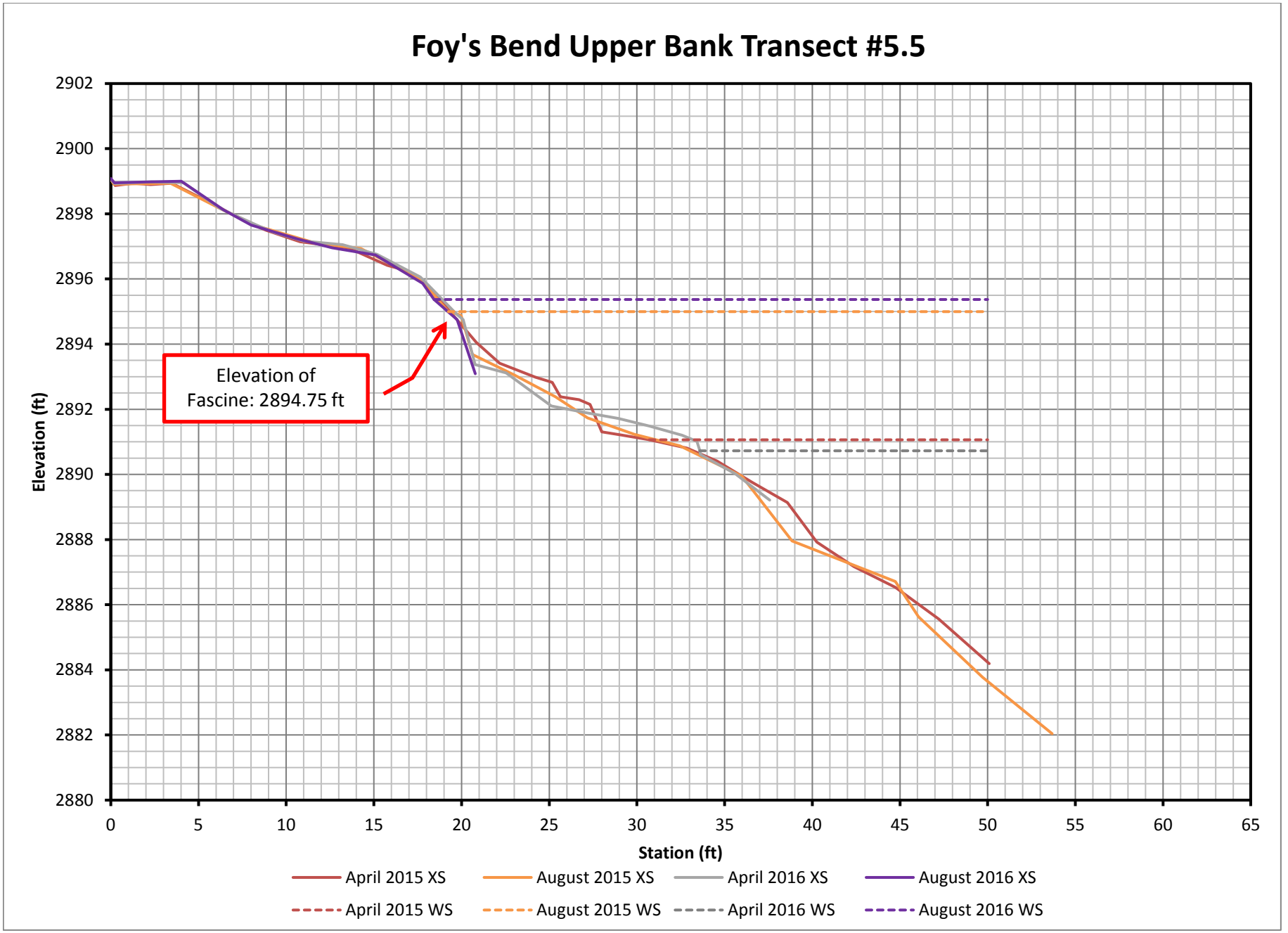
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #5.5
Elevation (ft)
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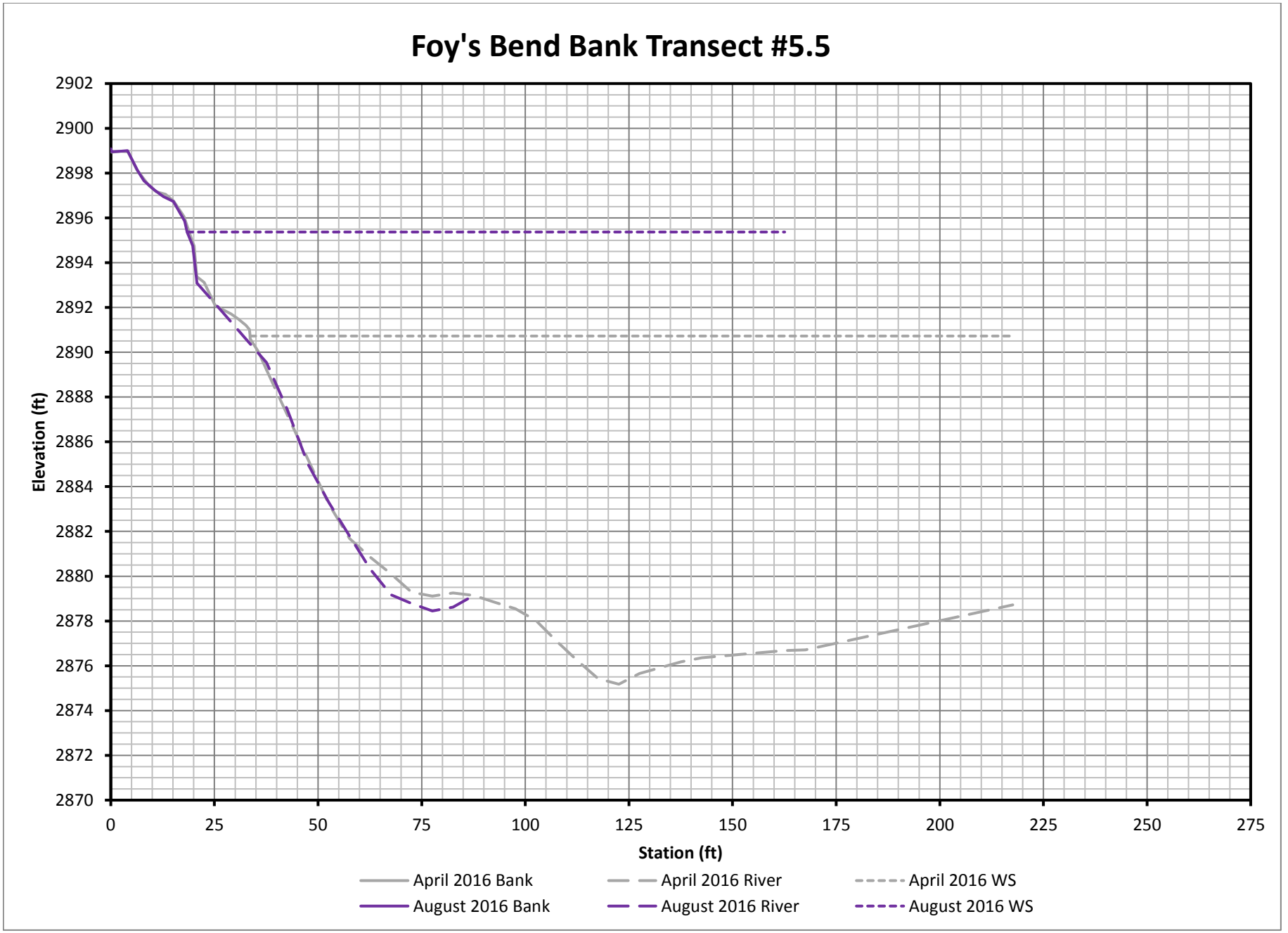
65
Station (ft)
Elevation of Fascine: 2894.75 ft
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #5.5
Elevation (ft)
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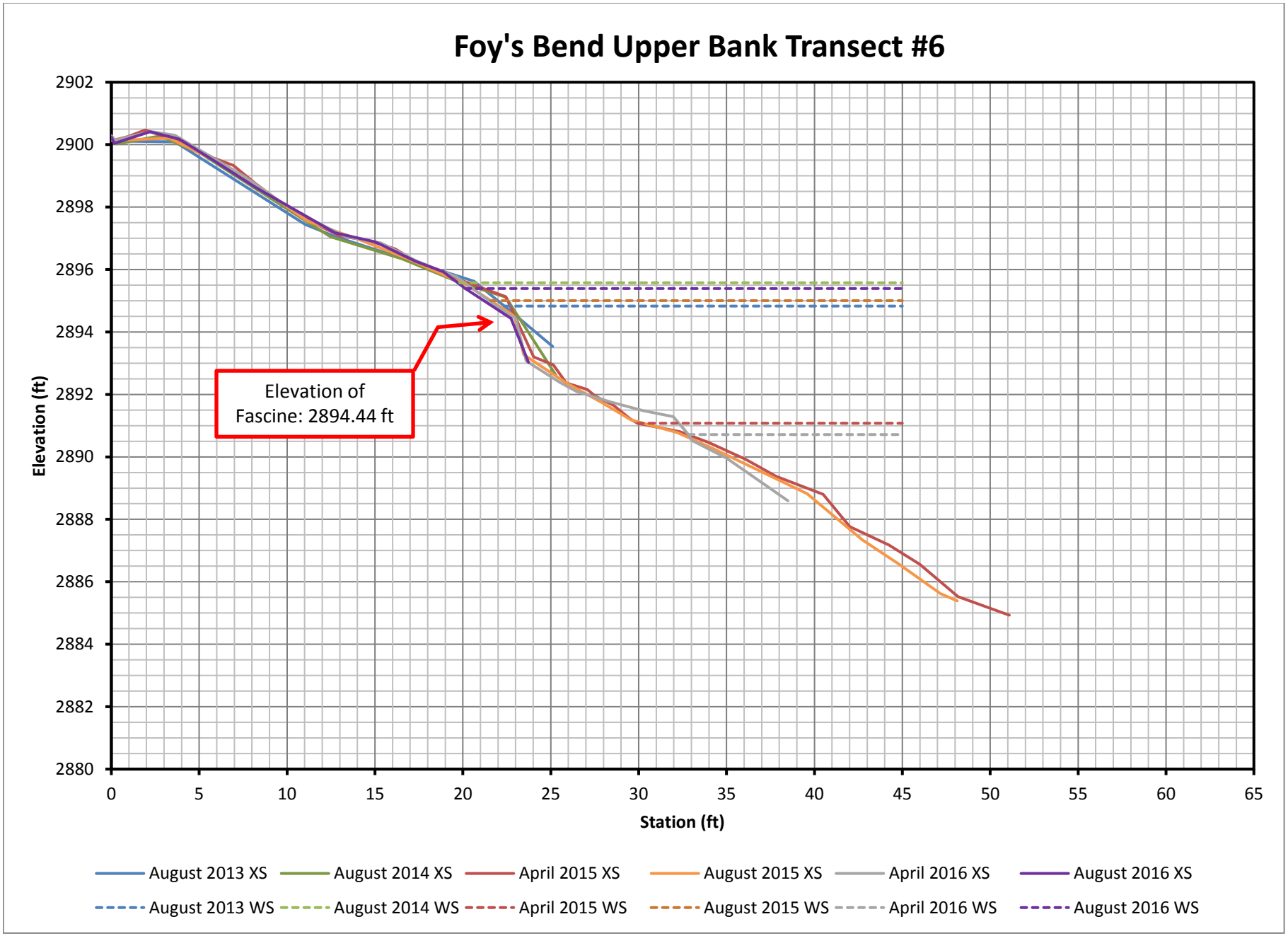
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #6
Elevation (ft)
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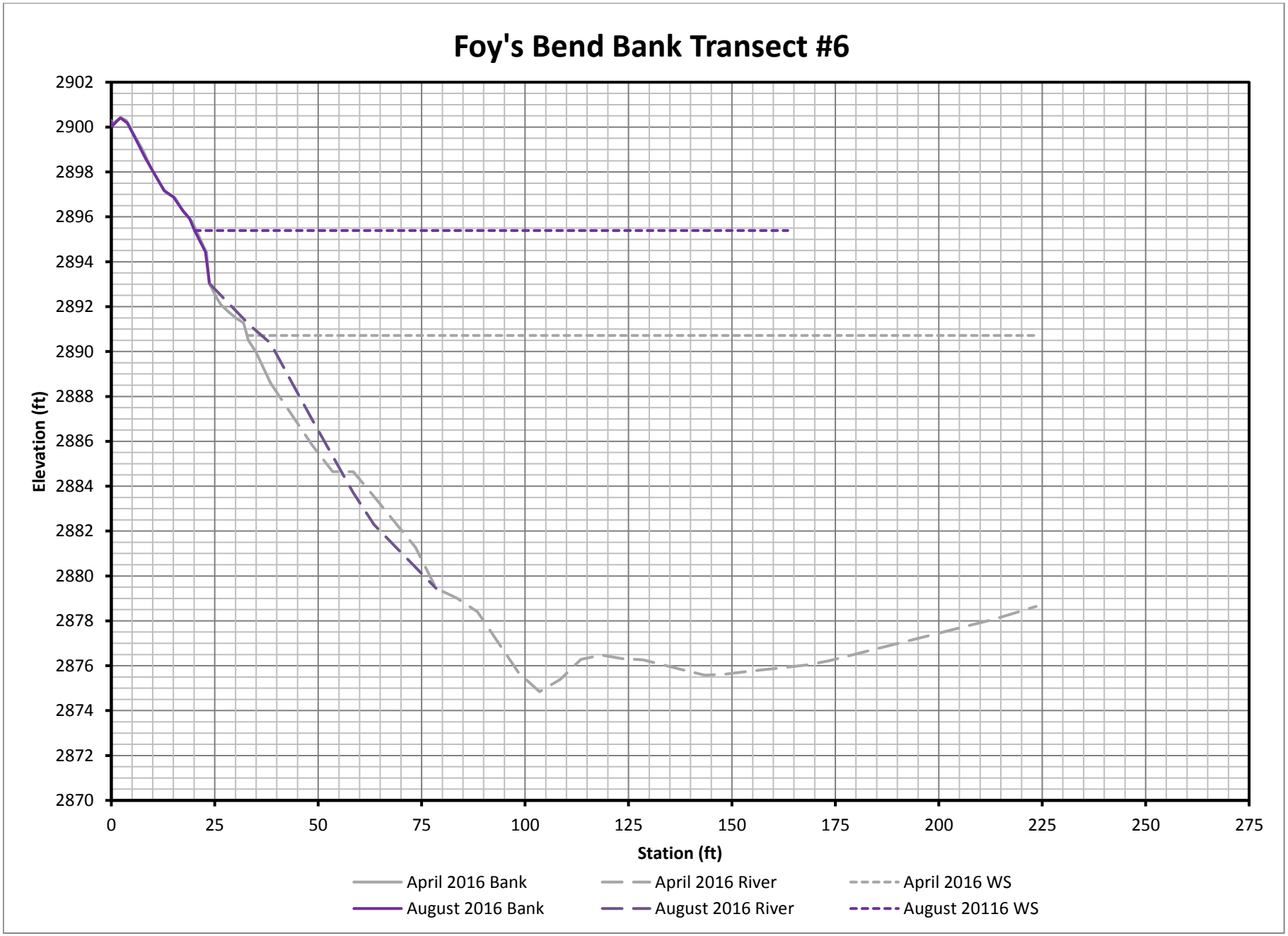
65
Station (ft)
Elevation of Fascine: 2894.44 ft
August 2013 XS
August 2014 XS
April 2015 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
April 2015 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #6
Elevation (ft)
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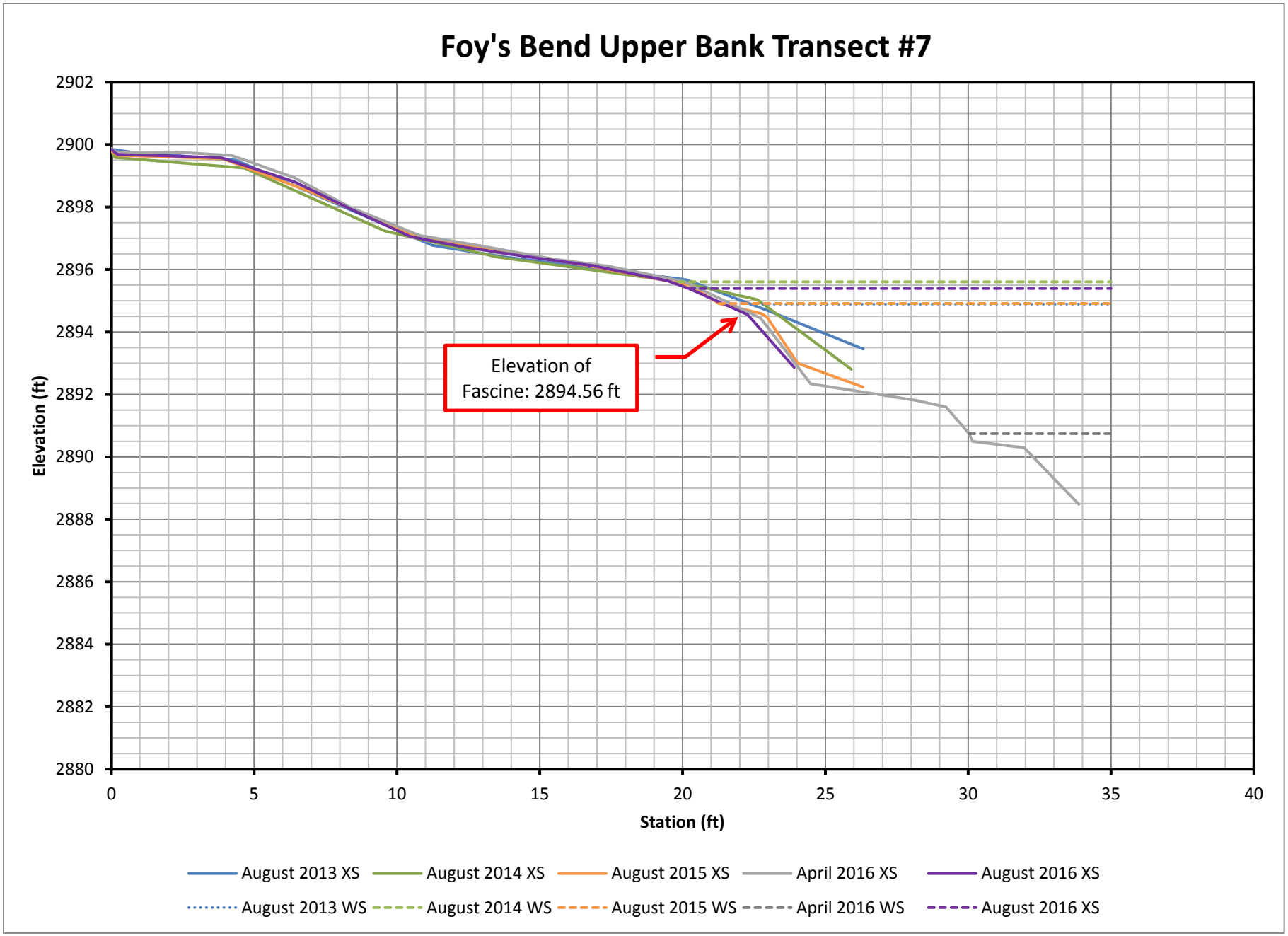
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 20116 WS


Foy's Bend Upper Bank Transect #7
Elevation (ft)
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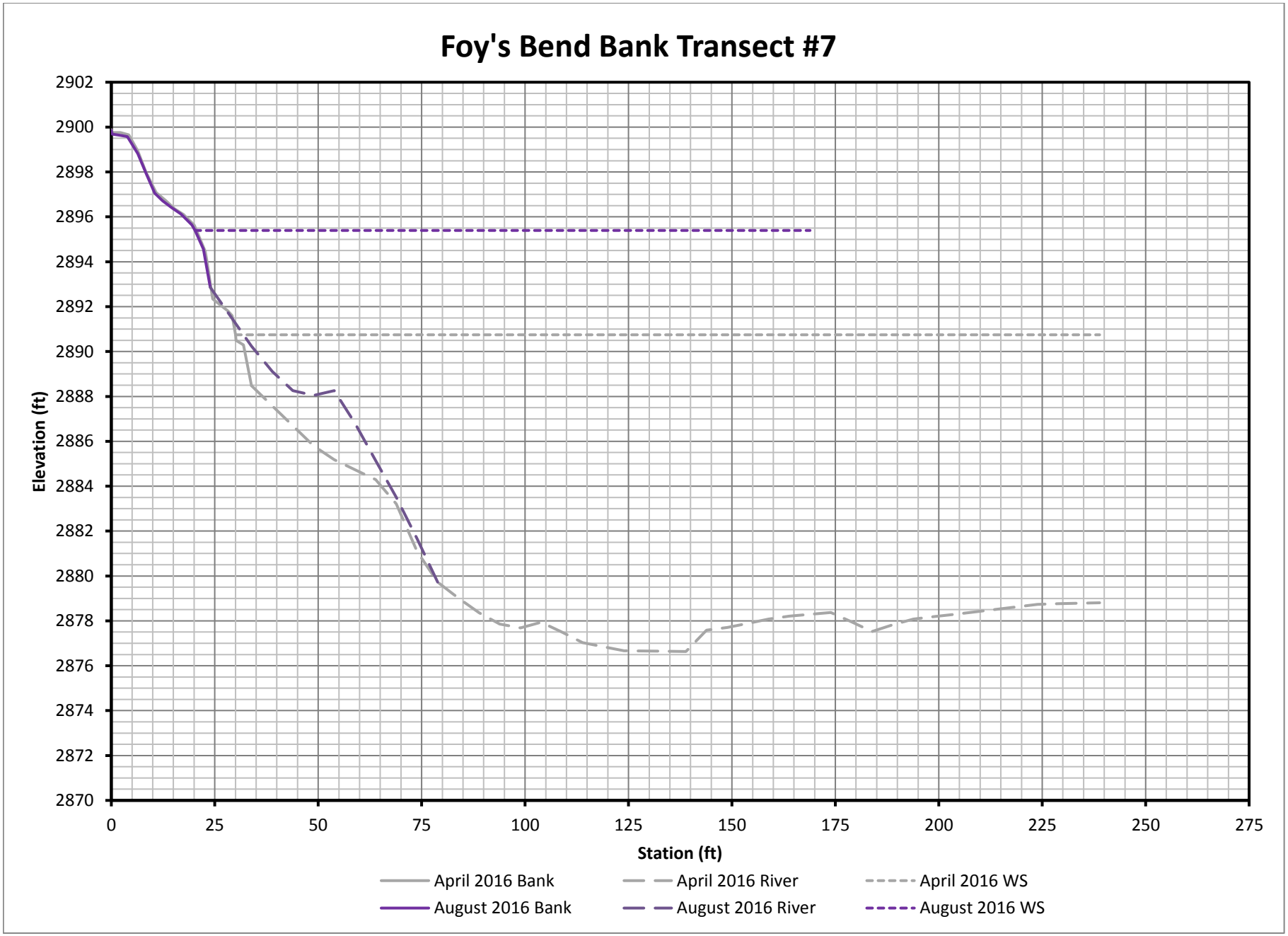
Station (ft)
Elevation of Fascine: 2894.56 ft
August 2013 XS
August 2014 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
August 2015 WS
April 2016 WS
August 2016 XS


Foy's Bend Bank Transect #7
Elevation (ft)
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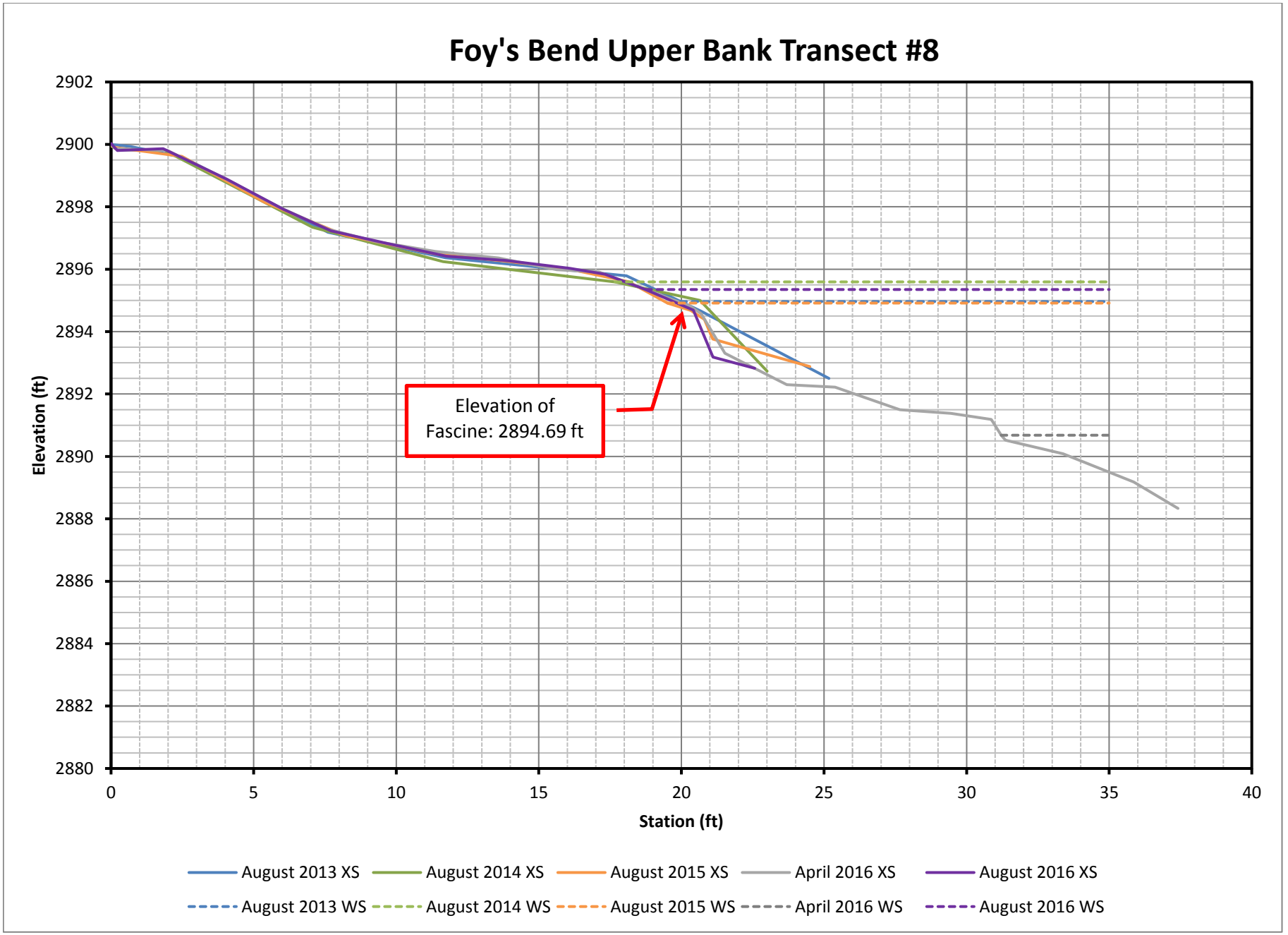
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #8
Elevation (ft)
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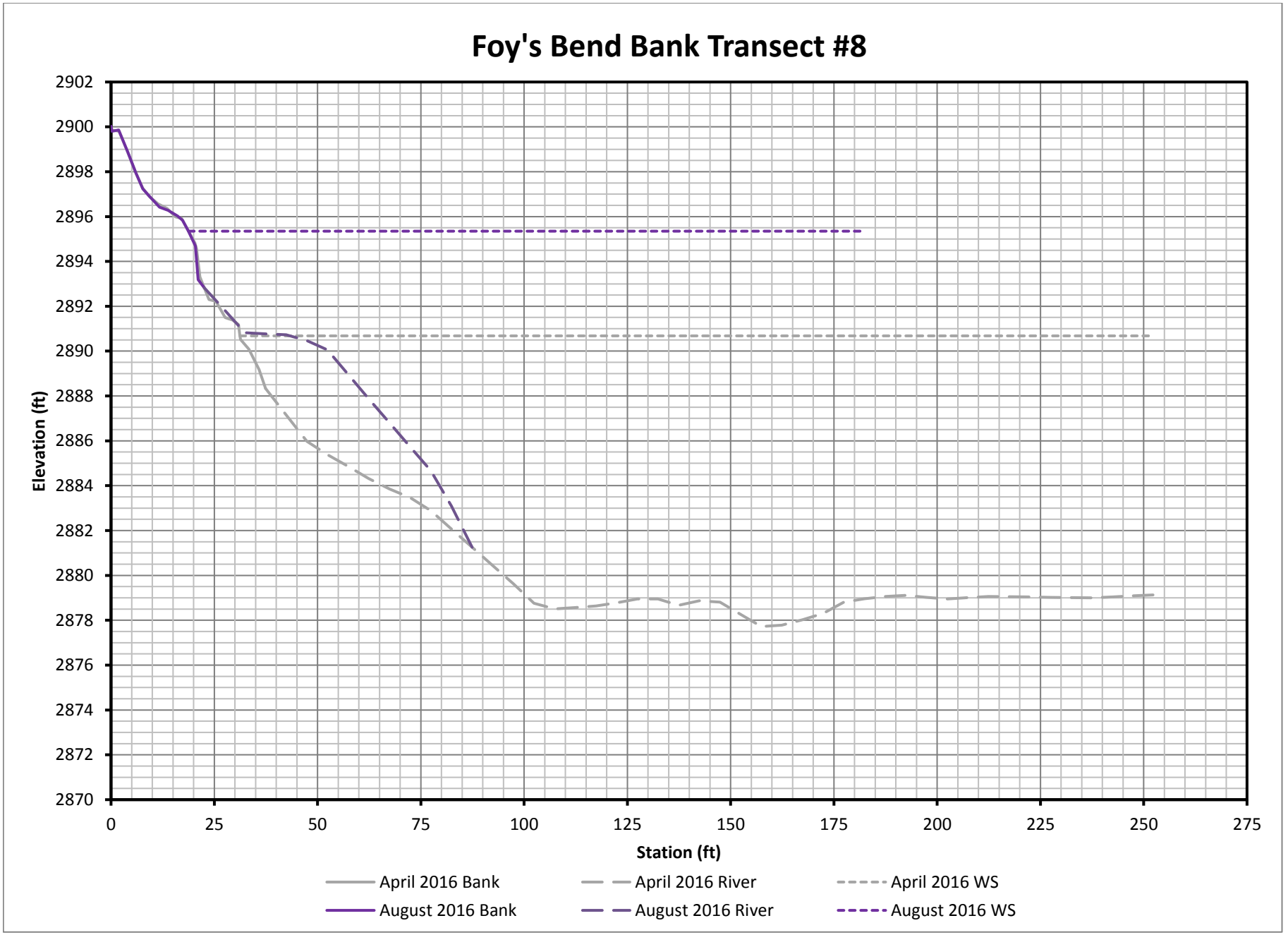
Station (ft)
Elevation of Fascine: 2894.69 ft
August 2013 XS
August 2014 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #8
Elevation (ft)
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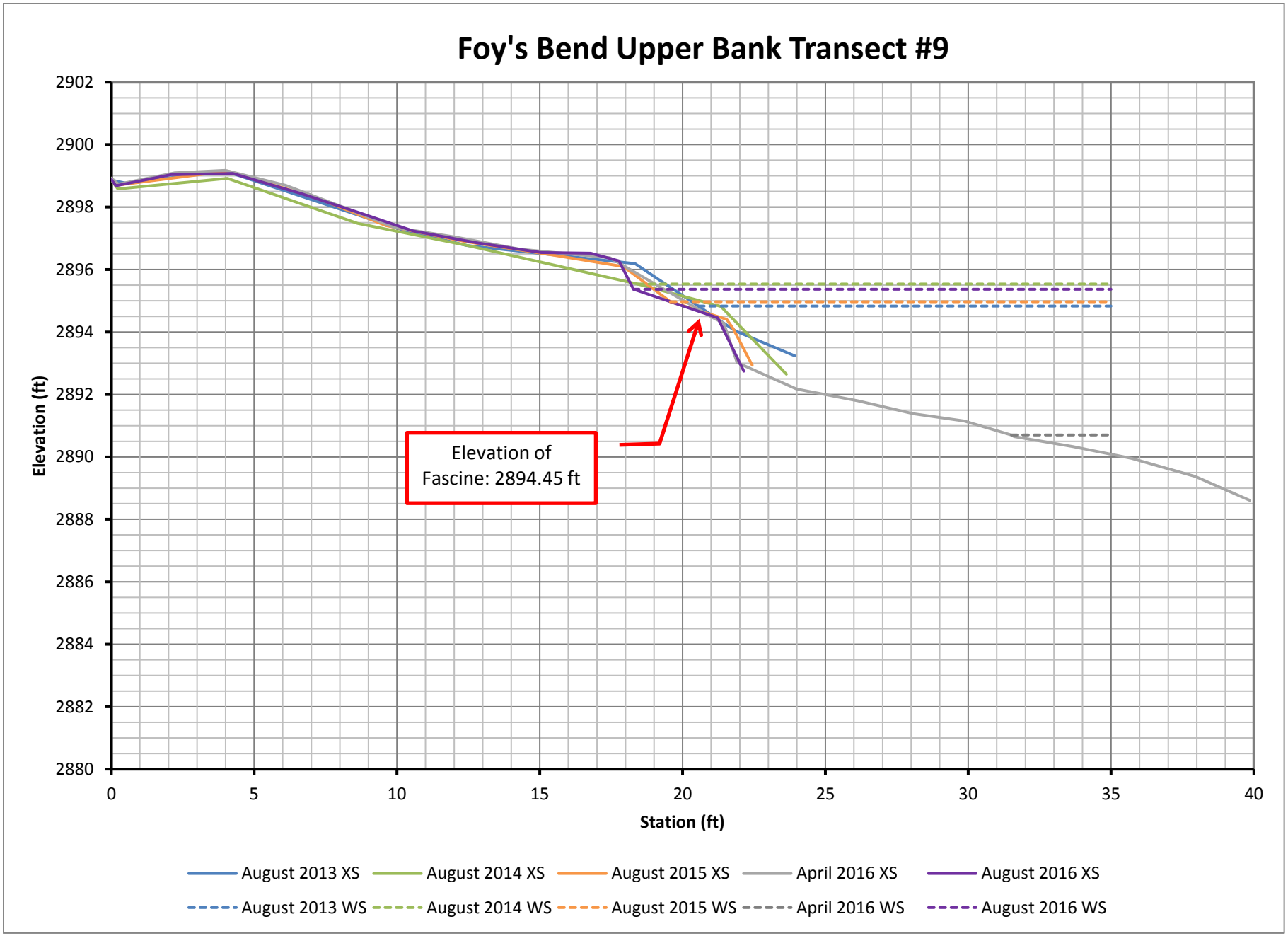
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #9
Elevation (ft)
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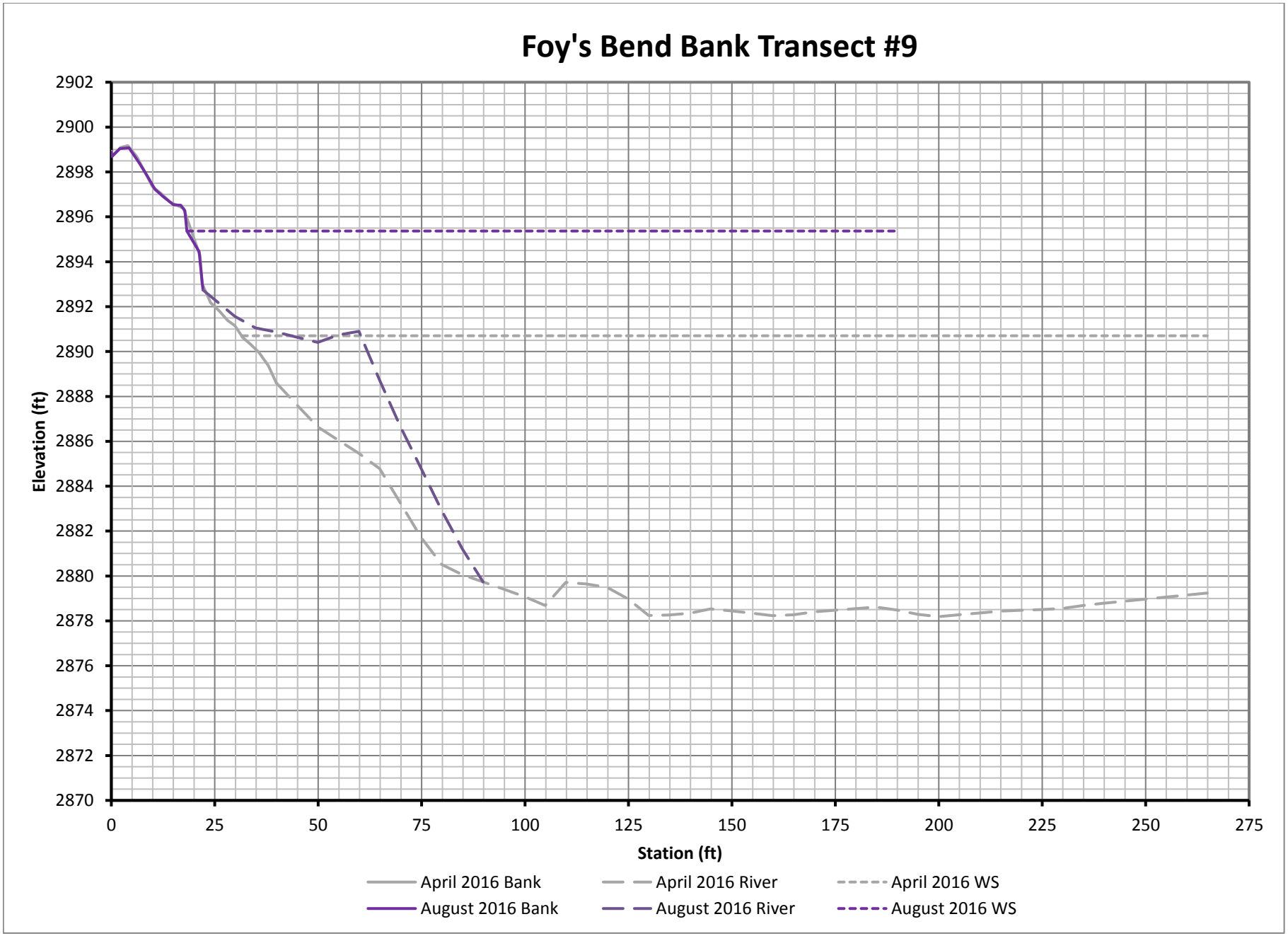
40
Station (ft)
Elevation of Fascine: 2894.45 ft
August 2013 XS
August 2014 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #9
Elevation (ft)
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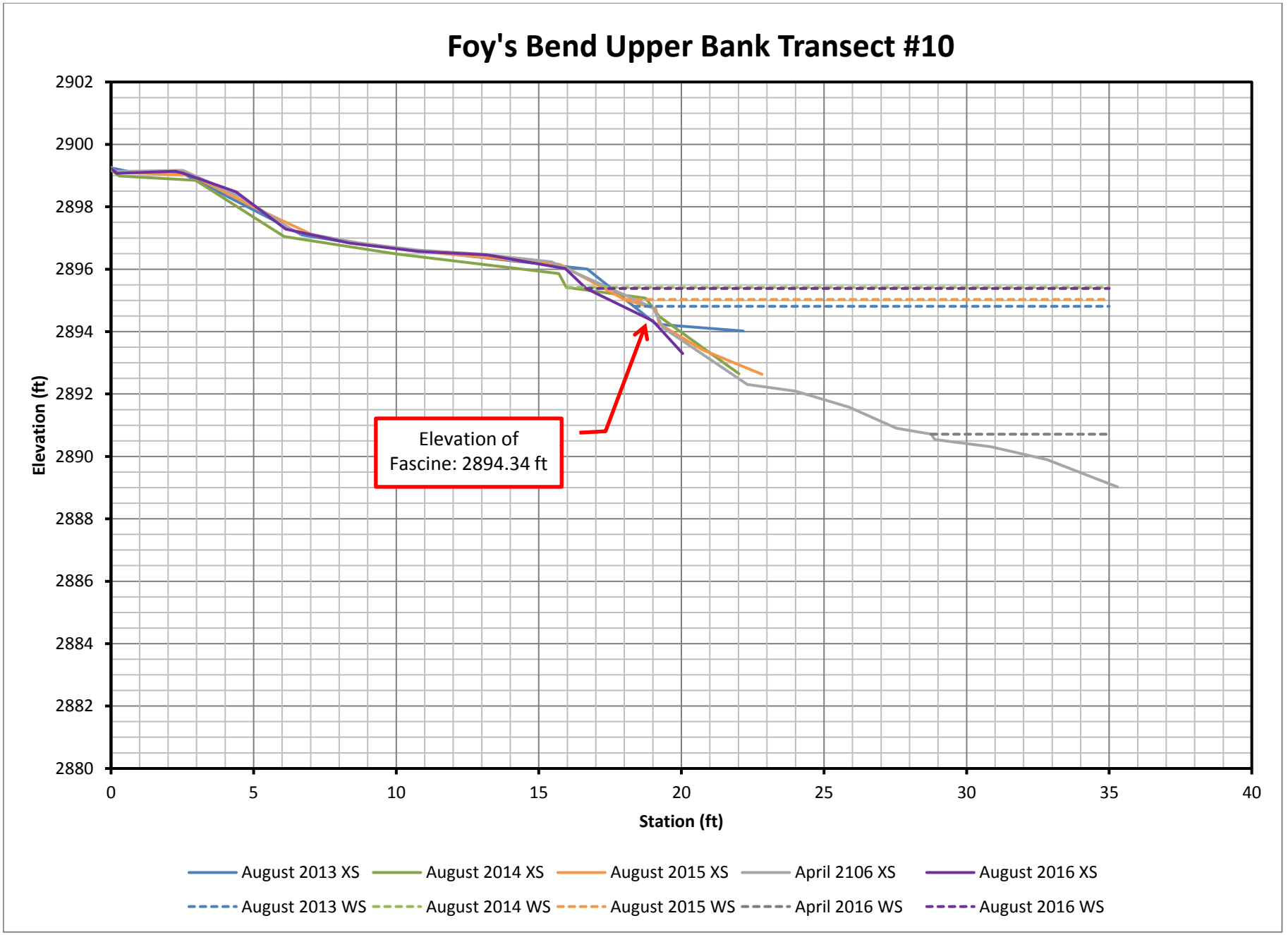
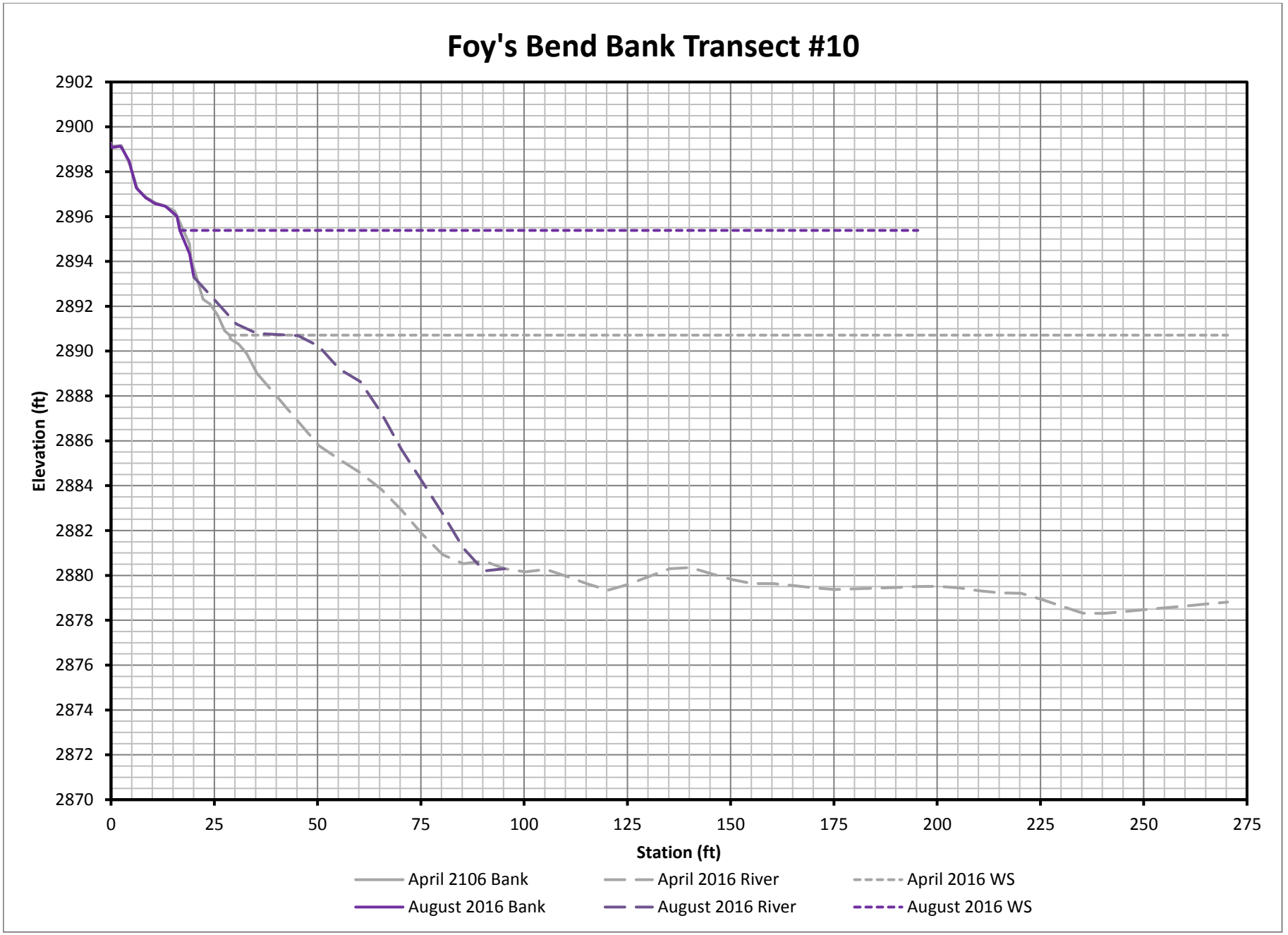
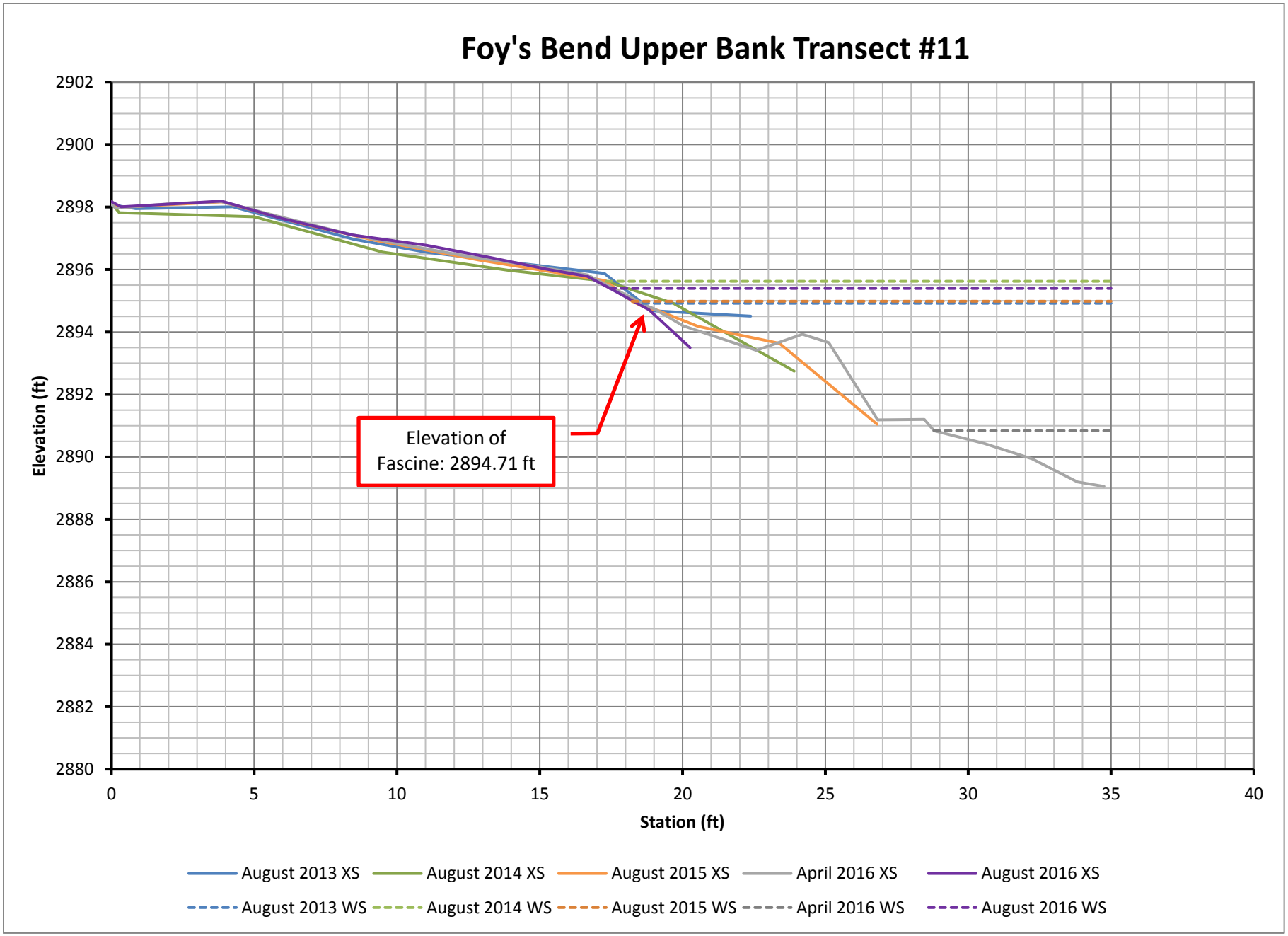
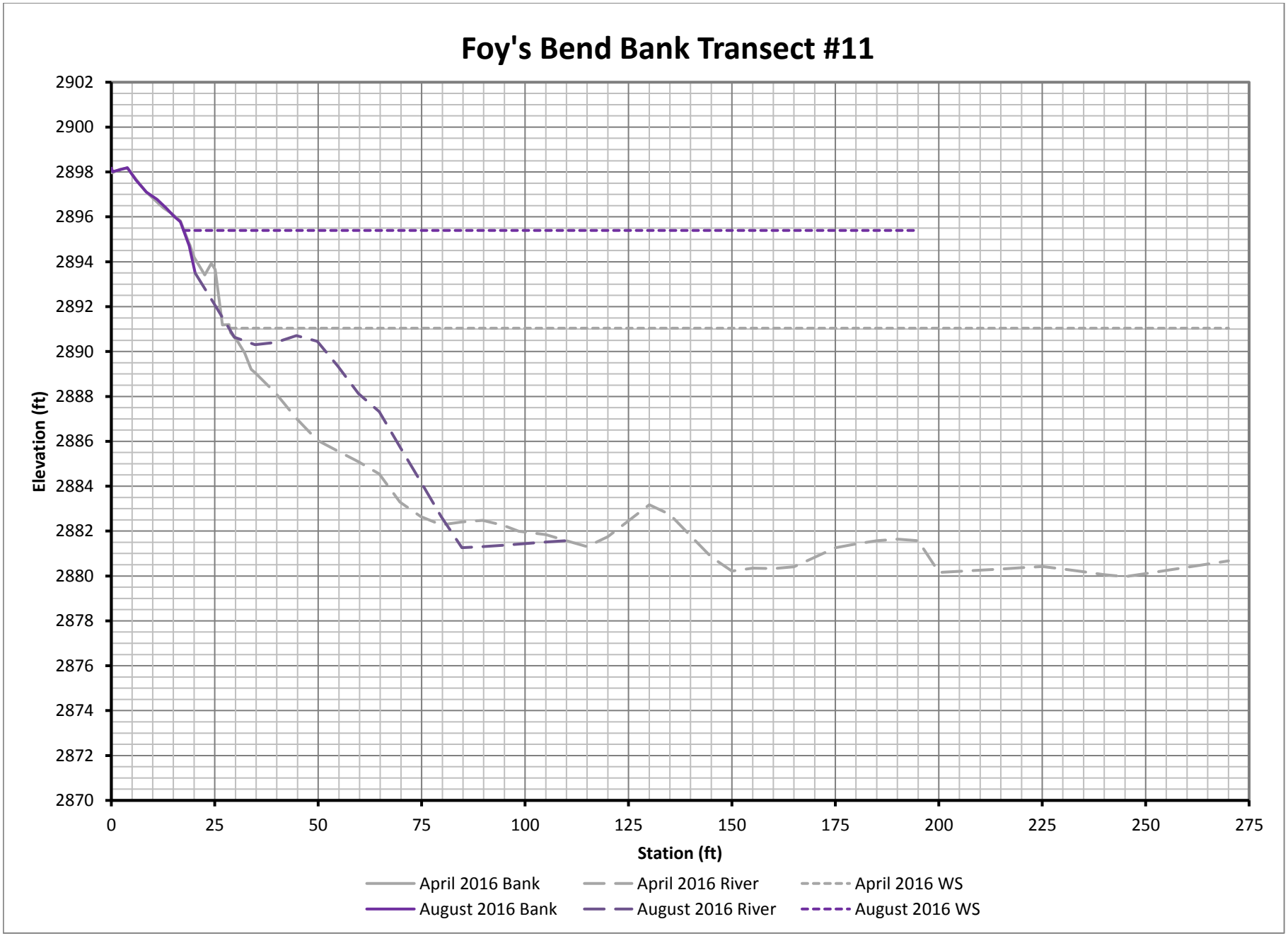
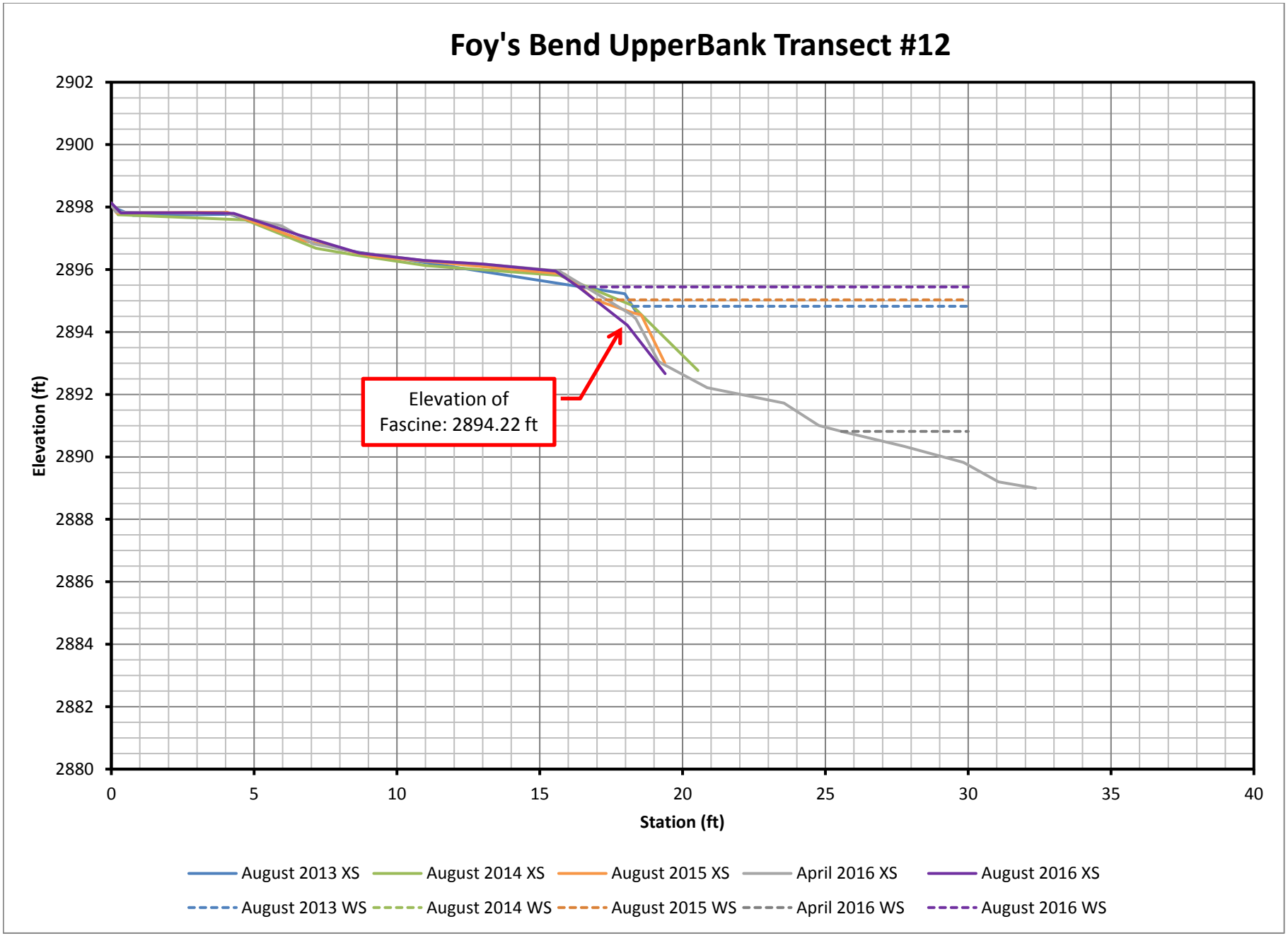
75
100
125
150
175
200
225
250
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS

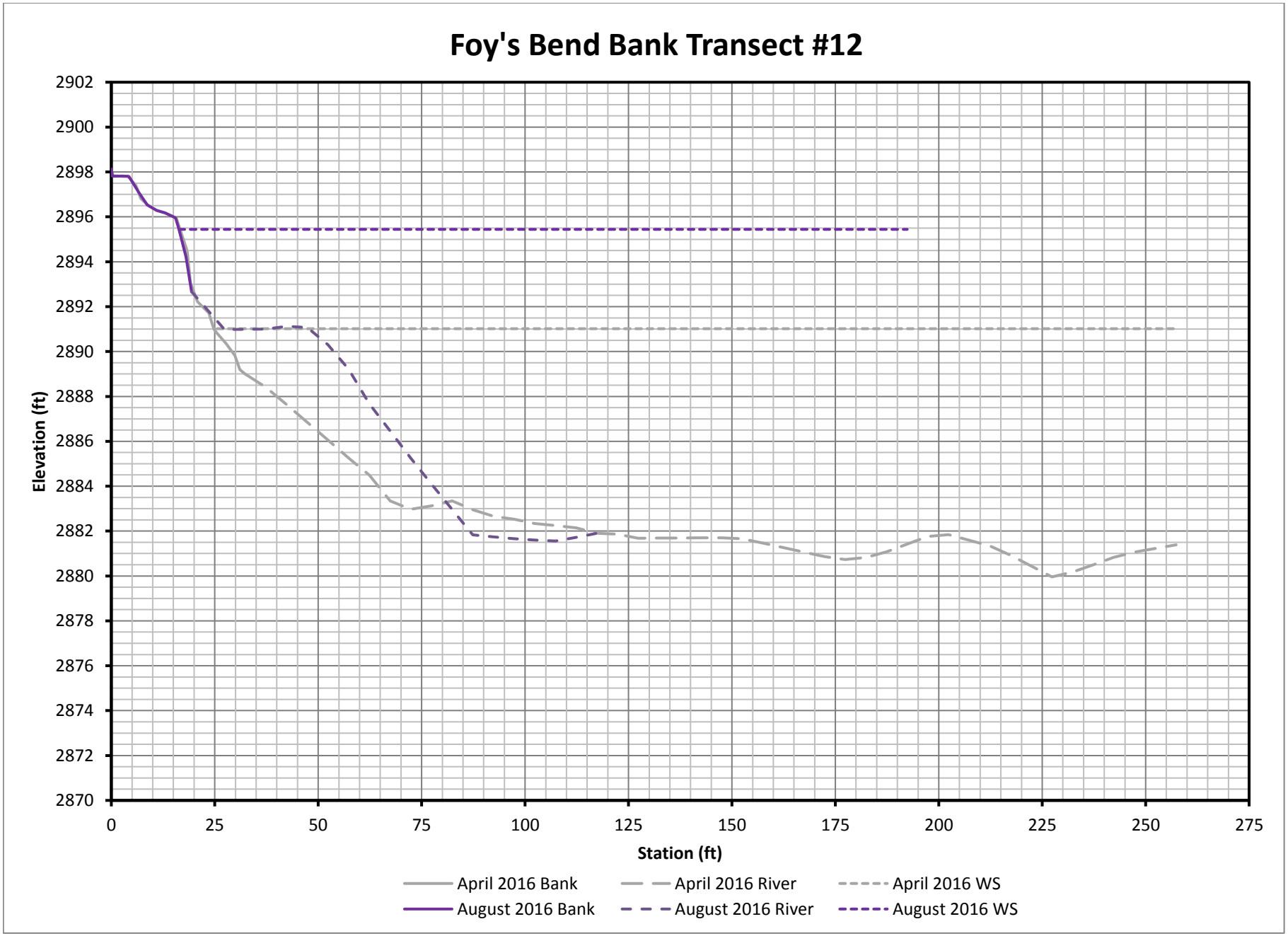

Foy's Bend Upper Bank Transect #10
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
0
5
10
15
20
25
30
35
40
Station (ft)
Elevation of Fascine: 2894.34 ft
August 2013 XS
August 2014 XS
August 2015 XS
April 2106 XS
August 2016 XS
August 2013 WS
August 2014 WS
August 2015 WS
April 2016 WS
August 2016 WS

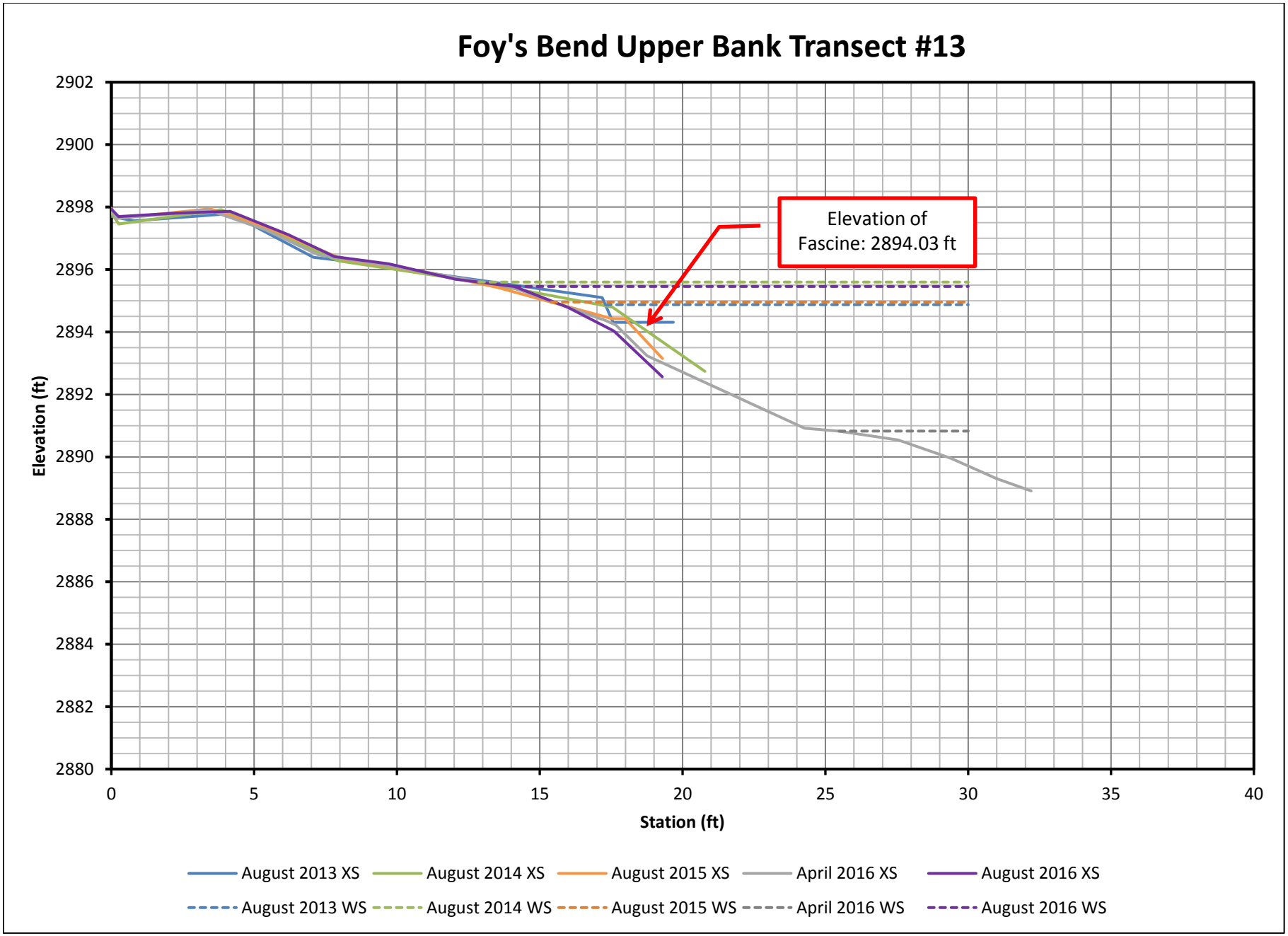

Foy's Bend Bank Transect #10
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
2878
2876
2874
2872
2870
0
25
50
75
100
125
150
175
200
225
250
275
Station (ft)
April 2106 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS

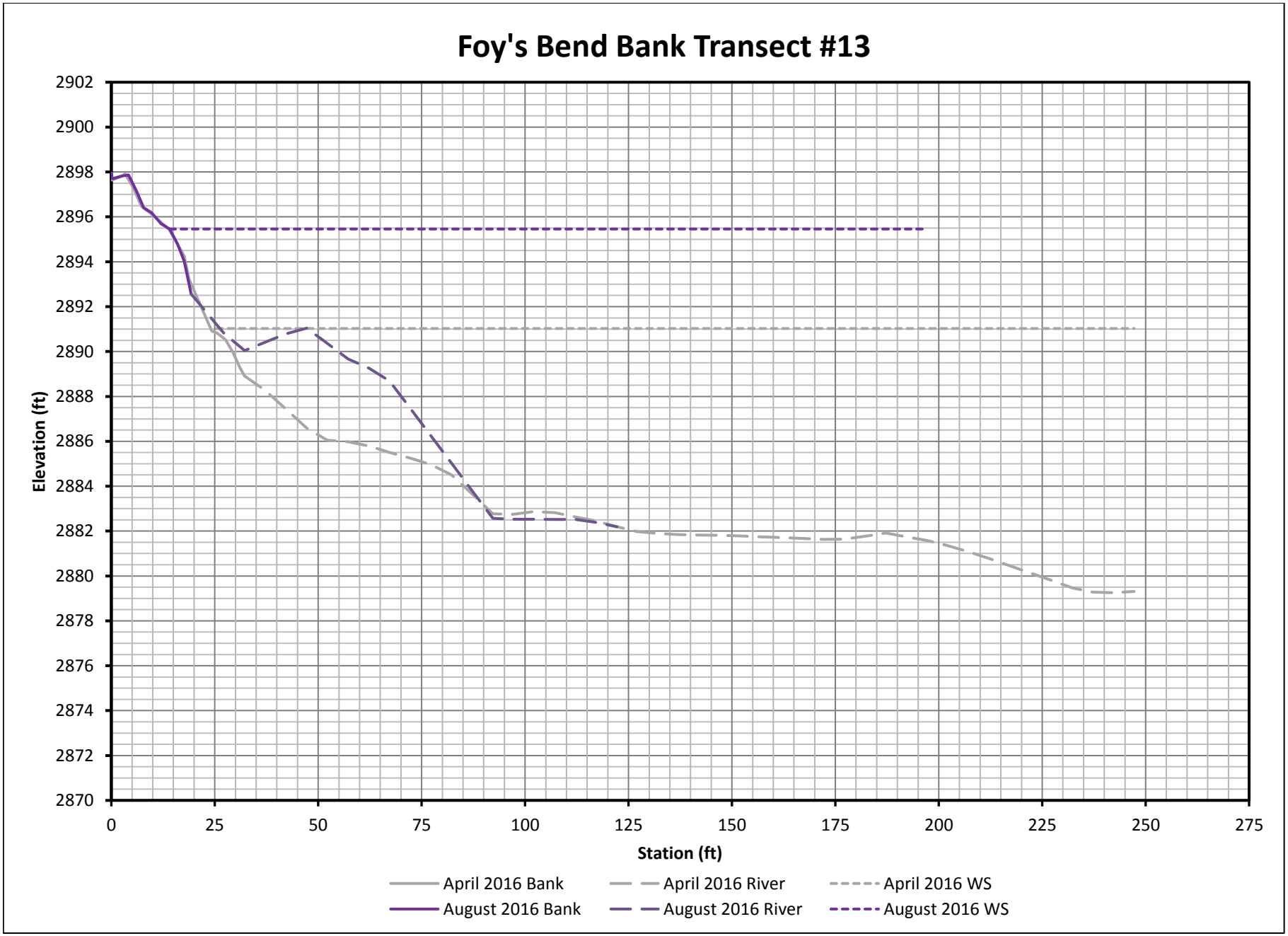

Foy's Bend Upper Bank Transect #11
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
0
5
10
15
20
25
30
35
40
Station (ft)
Elevation of Fascine: 2894.71 ft
August 2013 XS
August 2014 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
August 2015 WS
April 2016 WS
August 2016 WS

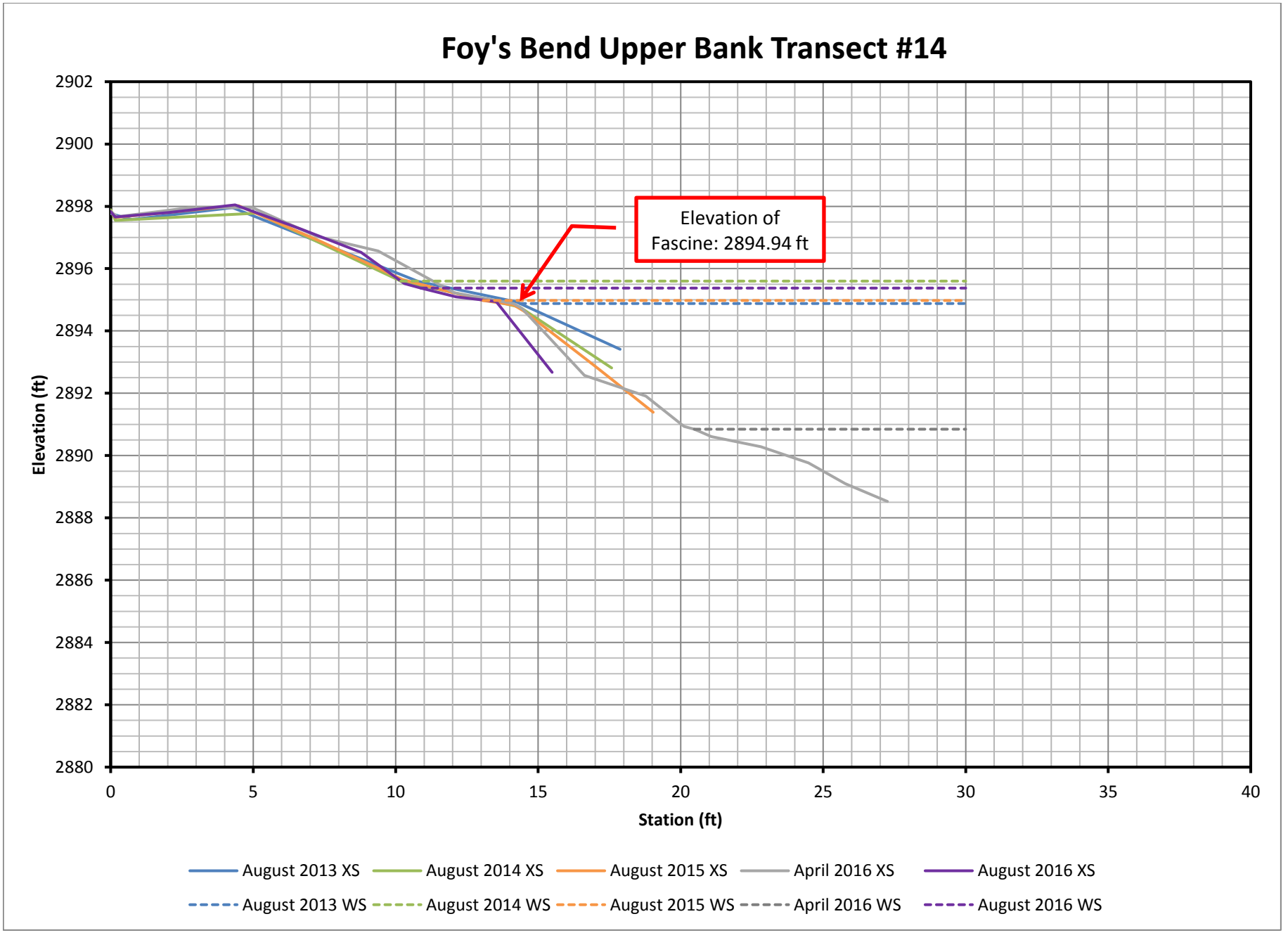

Foy's Bend Bank Transect #11
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
2878
2876
2874
2872
2870
0
25
50
75
100
125
150
175
200
225
250
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend UpperBank Transect #12
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
0
5
10
15
20
25
30
35
40
Station (ft)
Elevation of Fascine: 2894.22 ft
August 2013 XS
August 2014 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #12
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
2878
2876
2874
2872
2870
0
25
50
75
100
125
150
175
200
225
250
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #13
Elevation of Fascine: 2894.03 ft
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
0
5
10
15
20
25
30
35
40
Station (ft)
August 2013 XS
August 2014 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #13
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
2878
2876
2874
2872
2870
0
25
50
75
100
125
150
175
200
225
250
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS


Foy's Bend Upper Bank Transect #14
Elevation of Fascine: 2894.94 ft
Elevation (ft)
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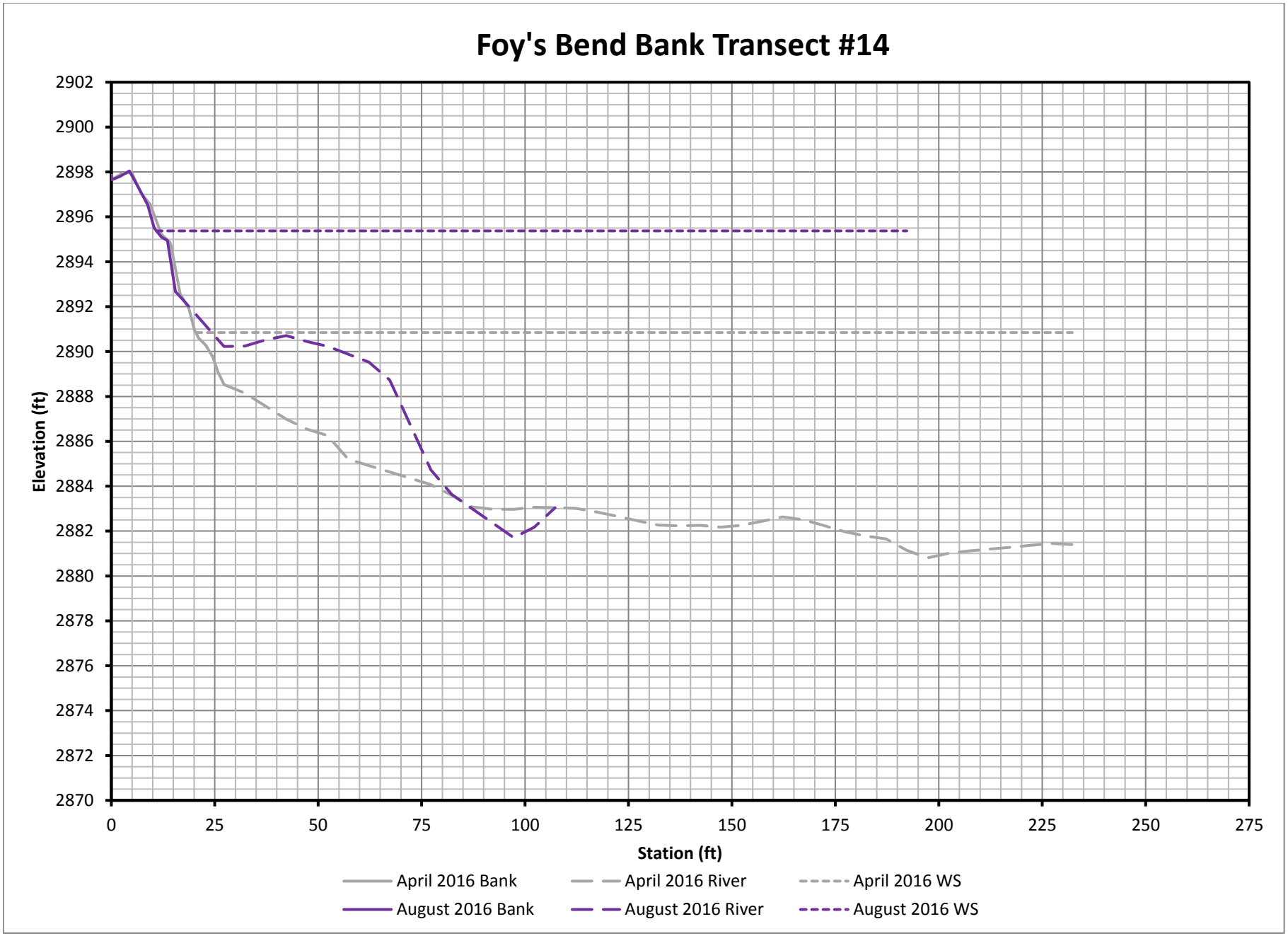
2896
2894
2892
2890
2888
2886
2884
2882
2880
0
5
10
15
20
25
30
35
40
Station (ft)
August 2013 XS
August 2014 XS
August 2015 XS
April 2016 XS
August 2016 XS
August 2013 WS
August 2014 WS
August 2015 WS
April 2016 WS
August 2016 WS


Foy's Bend Bank Transect #14
Elevation (ft)
2902
2900
2898
2896
2894
2892
2890
2888
2886
2884
2882
2880
2878
2876
2874
2872
2870
0
25
50
75
100
125
150
175
200
225
250
275
Station (ft)
April 2016 Bank
April 2016 River
April 2016 WS
August 2016 Bank
August 2016 River
August 2016 WS

Appendix C

Project Site Photos

MDT Stream Mitigation Monitoring
Foy's Bend Fisheries Conservation Area
Flathead County, Montana

PHOTO INFORMATION

PROJECT NAME: Foy's Bend Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events

CONFLUENCE

Photo Point 1: 2013
Location: Exclosure 4
Compass: 315 (Northwest)

Photo Point 1: 2016
Location: Exclosure 4
Compass: 315 (Northwest)

Photo Point 2: 2013
Location: Exclosure 6
Compass: 90 (East)

Photo Point 2: 2016
Location: Exclosure 6
Compass: 90 (East)

Photo Point 3.1: 2013
Location: Exclosure 8
Compass: 135 (Southeast)

Photo Point 3.1: 2016
Location: Exclosure 8
Compass: 135 (Southeast)

PHOTO INFORMATION

PROJECT NAME: Foy's Bend Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events

CONFLUENCE

Photo Point 3.2: 2013
Location: Exclosure 8
Compass: 158 (South-Southeast)

Photo Point 3.2: 2016
Location: Exclosure 8
Compass: 158 (South-Southeast)

Photo Point 3.3: 2013
Location: Exclosure 8
Compass: 203 (South-Southwest)

Photo Point 3.3: 2016
Location: Exclosure 8
Compass: 203 (South-Southwest)

Photo Point 4: 2013
Location: Exclosure 14
Compass: 90 (East)

Photo Point 4: 2016
Location: Exclosure 14
Compass: 90 (East)

PHOTO INFORMATION

PROJECT NAME: Foy's Bend Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events

Photo Point 5.1: 2013
Location: Upstream extent of stabilized bank
Compass: 270 (West)

Photo Point 5.1: 2016
Location: Upstream extent of stabilized bank
Compass: 270 (West)

Photo Point 5.2: 2013
Location: Restored streambank looking downstream
Compass: 45 (Northeast)

Photo Point 5.2: 2016
Location: Restored streambank looking downstream
Compass: 45 (Northeast)

Photo Point 6.1: 2013
Location: Restored streambank upstream
Compass: 270 (West)

Photo Point 6.1: 2016
Location: Restored streambank upstream
Compass: 270 (West)

PHOTO INFORMATION

PROJECT NAME: Foy's Bend Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events

CONFLUENCE

Photo Point 6.2: 2013
Location: Restored streambank looking downstream
Compass: 45 (Northeast)

Photo Point 6.2: 2016
Location: Restored streambank looking downstream
Compass: 45 (Northeast)

Photo Point 7: 2013
Location: Extent of restored streambank, looking upstream. **Compass:** 225 (Southwest)

Photo Point 7: 2016
Location: Extent of restored streambank, looking upstream. **Compass:** 225 (Southwest)

Additional Photo 1: April, 2016
Description: Eroding river bank upstream of reconstructed bank segment during low water.

Additional Photo 1: August, 2016
Description: Eroding river bank upstream of reconstructed bank segment during high water.

PHOTO INFORMATION

PROJECT NAME: Foy's Bend Stream Mitigation Site

DATE: 2016 Monitoring Event

Additional Photo 2: April, 2016
Description: Bank erosion upstream of reconstructed bank segment.

Additional Photo 3: August 2016
Description: Leading edge of coir bank and submerged woody fascine. Taken looking upstream near bank transect 1.5

Additional Photo 4: April, 2016
Description: Loss of soil in coir lift due to wave action during high water

Additional Photo 5 : April, 2016
Description: Fascine in Reach 1 is beginning to drop due to bank undercutting.

PHOTO INFORMATION

PROJECT NAME: Foy's Bend Stream Mitigation Site

DATE: April, 2016 Site Visit

Additional Photo 6: April 2016
Description: Bank sloughing and soil stripped from coir lift within Reach 2 Photo taken near transect 4.

Additional Photo 7: April 2016
Description: Bank undercutting beneath bioengineered bank treatment in Reach 2.

Additional Photo 8: April 2016
Description: Woody fascine separated from bank treatment in Reach 2.

Additional Photo 9: April 2016
Description: Bank slope beneath woody fascine in Reach 3 becoming steeper. Photo taken near survey transect 13.

Additional Photo 10: April 2016
Description: Bank slope beneath woody fascine in Reach 3 becoming steeper. Photo taken near survey transect 9.

PROJECT NAME: 2016 MDT STREAM MITIGATION — FOYS BEND

DATE: 8-9-16

T -0.5: Looking South August 2016

T -0.5: Looking North August 2016

T -0.5: Looking West Upstream August 2016

T -0.5: Looking East Downstream August 2016

T 0.0: Looking South August 2016

T 0.0: Looking North August 2016

PROJECT NAME: 2016 MDT STREAM MITIGATION — FOYS BEND

DATE: 8-9-16

T 0.0: Looking West Upstream August 2016

T 0.0: Looking East Downstream August 2016

T 0.5: Looking South August 2015

T 0.5: Looking South August 2016

T 0.5: Looking North August 2015

T 0.5: Looking North August 2016

T 0.5: Looking West Upstream August 2015

T 0.5: Looking West Upstream August 2016

T 0.5: Looking East Downstream August 2015

T 0.5: Looking East Downstream August 2016

T 1.0: Looking South July 2014

T 1.0: Looking South August 2016

T 1.0: Looking North July 2014

T 1.0: Looking North August 2016

T 1.0: Looking West Upstream July 2014

T 1.0: Looking West Upstream August 2016

T 1.0: Looking East Downstream July 2014

T 1.0: Looking East Downstream August 2016

T 1.5: Looking South August 2015

T 1.5: Looking South August 2016

T 1.5: Looking North August 2015

T 1.5: Looking North August 2016

T 1.5: Looking West Upstream August 2015

T 1.5: Looking West Upstream August 2016

T 1.5: Looking East Downstream August 2015

T 1.5: Looking East Downstream August 2016

T 2.0: Looking South July 2014

T 2.0: Looking South August 2016

T 2.0: Looking North July 2014

T 2.0: Looking North August 2016

T 2.0: Looking West Upstream July 2014

T 2.0: Looking West Upstream August 2016

T 2.0: Looking East Downstream July 2014

T 2.0: Looking East Downstream August 2016

T 2.5: Looking South August 2015

T 2.5: Looking South August 2016

T 2.5: Looking North August 2015

T 2.5: Looking North August 2016

T 2.5: Looking West Upstream August 2015

T 2.5: Looking West Upstream August 2016

T 2.5: Looking East Downstream August 2015

T 2.5: Looking East Downstream August 2016

T 3.0: Looking South July 2014

T 3.0: Looking South August 2016

T 3.0: Looking North July 2014

T 3.0: Looking North August 2016

T 3.0: Looking West Upstream July 2014

T 3.0: Looking West Upstream August 2016

T 3.0: Looking East Downstream July 2014

T 3.0: Looking East Downstream August 2016

T 3.5: Looking South August 2015

T 3.5: Looking South August 2016

T 3.5: Looking North August 2015

T 3.5: Looking North August 2016

T 3.5: Looking West Upstream August 2015

T 3.5: Looking West Upstream August 2016

T 3.5: Looking East Downstream August 2015

T 3.5: Looking East Downstream August 2016

T 4.0: Looking South July 2014

T 4.0: Looking South August 2016

T 4.0: Looking North July 2014

T 4.0: Looking North August 2016

T 4.0: Looking West Upstream July 2014

T 4.0: Looking West Upstream August 2016

T 4.0: Looking East Downstream July 2014

T 4.0: Looking East Downstream August 2016

T 4.5: Looking South August 2015

T 4.5: Looking South August 2016

T 4.5: Looking North August 2015

T 4.5: Looking North August 2016

T 4.5: Looking West Upstream August 2015

T 4.5: Looking West Upstream August 2016

T 4.5: Looking East Downstream August 2015

T 4.5: Looking East Downstream August 2016

T 5.0: Looking South July 2014

T 5.0: Looking South August 2016

T 5.0: Looking North July 2014

T 5.0: Looking North August 2016

T 5.0: Looking West Upstream July 2014

T 5.0: Looking West Upstream August 2016

T 5.0: Looking East Downstream July 2014

T 5.0: Looking East Downstream August 2016

T 5.5: Looking South August 2015

T 5.5: Looking South August 2016

T 5.5: Looking North August 2015

T 5.5: Looking North August 2016

T 5.5: Looking West Upstream August 2015

T 5.5: Looking West Upstream August 2016

T 5.5: Looking East Downstream August 2015

T 5.5: Looking East Downstream August 2016

T 6.0: Looking South July 2014

T 6.0: Looking South August 2016

T 6.0: Looking North July 2014

T 6.0: Looking North August 2016

T 6.0: Looking West Upstream July 2014

T 6.0: Looking West Upstream August 2016

T 6.0: Looking East Downstream July 2014

T 6.0: Looking East Downstream August 2016

T 7.0: Looking South July 2014

T 7.0: Looking South August 2016

T 7.0: Looking North July 2014

T 7.0: Looking North August 2016

T 7.0: Looking West Upstream July 2014

T 7.0: Looking West Upstream August 2016

T 7.0: Looking East Downstream July 2014

T 7.0: Looking East Downstream August 2016

T 8.0: Looking South July 2014

T 8.0: Looking South August 2016

T 8.0: Looking North July 2014

T 8.0: Looking North August 2016

T 8.0: Looking West Upstream July 2014

T 8.0: Looking West Upstream August 2016

T 8.0: Looking East Downstream July 2014

T 8.0: Looking East Downstream August 2016

T 9.0: Looking South July 2014

T 9.0: Looking South August 2016

T 9.0: Looking North July 2014

T 9.0: Looking North August 2016

T 9.0: Looking West up stream July 2014

T 9.0: Looking West Upstream August 2016

T 9.0: Looking East Downstream July 2014

T 9.0: Looking East Downstream August 2016

T 10.0: Looking South July 2014

T 10.0: Looking South August 2016

T 10.0: Looking North July 2014

T 10.0: Looking North August 2016

T 10.0: Looking West Upstream July 2014

T 10.0: Looking West Upstream August 2016

T 10.0: Looking East Downstream July 2014

T 10.0: Looking East Downstream August 2016

T 11.0: Looking South July 2014

T 11.0: Looking South August 2016

T 11.0: Looking North July 2014

T 11.0: Looking North August 2016

T 11.0: Looking West Upstream July 2014

T 11.0: Looking West Upstream August 2016

T 11.0: Looking East Downstream July 2014

T 11.0: Looking East Downstream August 2016

T 12.0: Looking South July 2014

T 12.0: Looking South August 2016

T 12.0: Looking North July 2014

T 12.0: Looking North August 2016

T 12.0: Looking West Upstream July 2014

T 12.0: Looking West Upstream August 2016

T 12.0: Looking East down stream July 2014

T 12.0: Looking East Downstream August 2016

T 13.0: Looking South July 2014

T 13.0: Looking South August 2016

T 13.0: Looking North July 2014

T 13.0: Looking North August 2016

T 13.0: Looking West Upstream July 2014

T 13.0: Looking West Upstream August 2016

T 13.0: Looking East Downstream July 2014

T 13.0: Looking East Downstream August 2016

T 14.0: Looking South July 2014

T 14.0: Looking South August 2016

T 14.0: Looking North July 2014

T 14.0: Looking North August 2016

T 14.0: Looking West Upstream July 2014

T 14.0: Looking West Upstream August 2016

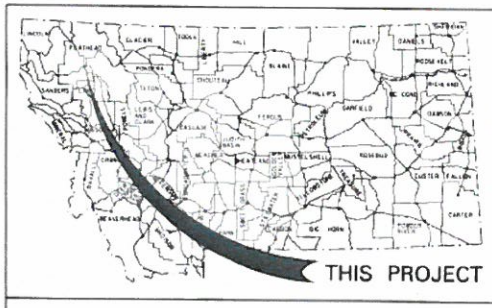
T 14.0: Looking East Downstream July 2014

T 14.0: Looking East Downstream August 2016

Appendix D

Foy’s Bend Mitigation Design Sheets

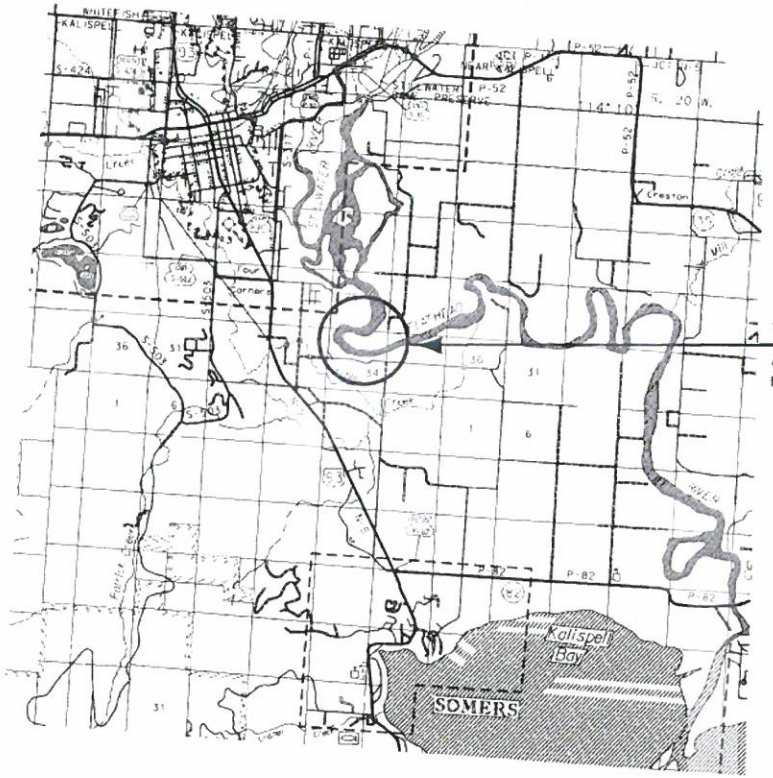
MDT Stream Mitigation Monitoring
Foy's Bend Fisheries Conservation Area
Flathead County, Montana



MONTANA DEPARTMENT OF TRANSPORTATION

FEDERAL AID PROJECT NH 15(99)
AQUATIC RESOURCES MITIGATION
FOY'S BEND STREAM MITIGATION
FLATHEAD COUNTY

LENGTH N/A miles



MONTANA
DEPARTMENT OF TRANSPORTATION

APPROVED : JANUARY 14 20 15

TIM REARDON,
DIRECTOR OF TRANSPORTATION

BY
BUREAU CHIEF,
ENVIRONMENTAL SERVICES

MONTANA
THOMAS S. MARTIN
11228PE
REGISTERED PROFESSIONAL ENGINEER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED :

DIVISION ADMINISTRATOR DATE

MDT MONTANA DEPARTMENT OF TRANSPORTATION	C:\DGN\2038013ENPVP001.DGN 1/8/2013 12:24:45 PM u7213	DESIGNED BY Rose Salyards, PE	12/05/2012	FOY'S BEND STREAM MITIGATION	NH 15(99)
		REVIEWED BY		UPN 2038013	SHEET 1
		CHECKED BY			

TABLE OF CONTENTS

NOTES

UTILITIES

CALL THE UTILITIES UNDERGROUND LOCATION CENTER (1-800-424-5555) OR OTHER NOTIFICATION SYSTEM FOR THE MARKING AND LOCATION OF ALL LINES AND SERVICE BEFORE EXCAVATING. ALL CLEARANCES OR DEPTHS PROVIDED FOR UTILITIES ARE FROM EXISTING GROUND LINE.

PIEZOMETERS

DO NOT DISTURB EXISTING PIEZOMETERS ON THE PROJECT.

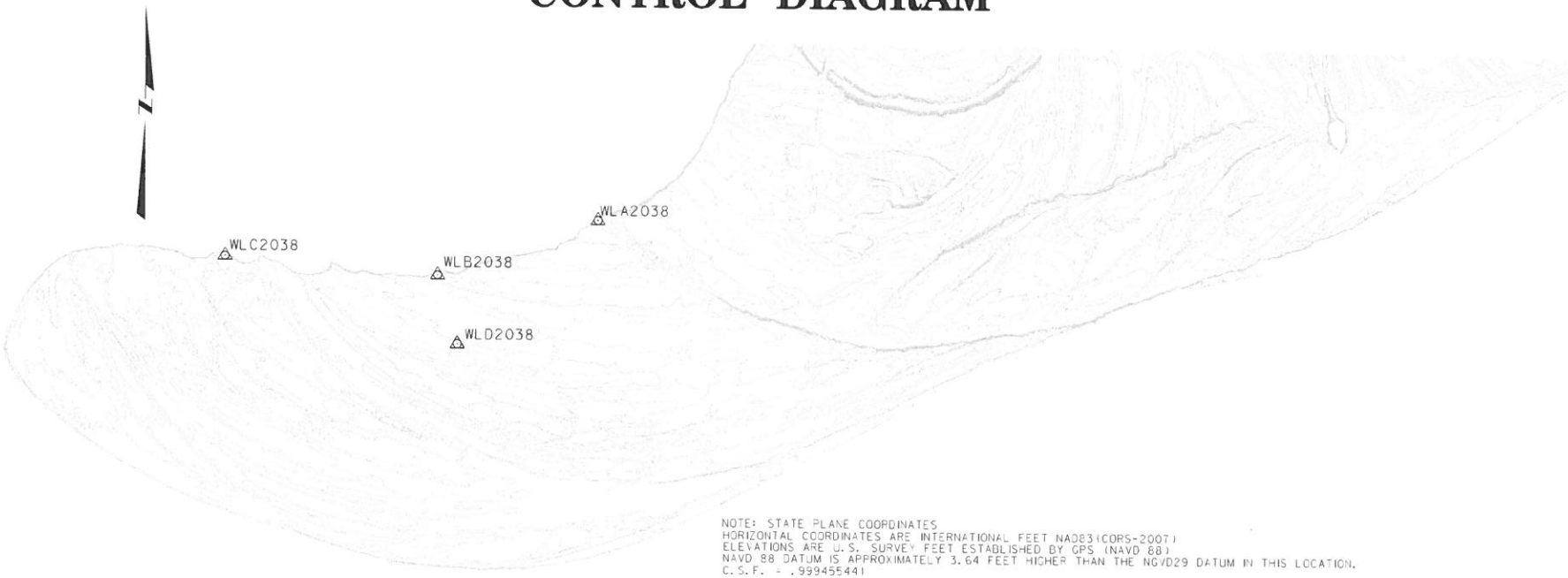
STAGING AREA

STAGING AREA LOCATION MUST BE APPROVED BY BOTH THE PROJECT MANAGER AND MT FISH, WILDLIFE, & PARKS (FWP). COORDINATE WITH FWP AT LEAST 2 WEEKS PRIOR TO CONSTRUCTION TO DETERMINE A LOCATION. FWP CONTACTS:
JOEL TOHTZ (406) 751-4570
KRIS TEMPEL (406) 751-4573
ALAN WOOD (406) 751-4595

WETLANDS

WETLANDS EXIST WITHIN THE PROJECT AREA AND BEYOND THE PROJECT LIMITS. A WETLAND DELINEATION HAS NOT BEEN COMPLETED FOR THIS PROJECT. IMPACTS TO WETLAND AREAS ARE NOT ANTICIPATED IN ASSOCIATION WITH THE PLANNED WORK SO NO PERMITS FOR FOR WETLAND IMPACTS HAVE BEEN OBTAINED. ANY ACTION IMPACTING WETLAND AREAS WITHOUT THE APPROPRIATE PERMITTING IS THE RESPONSIBILITY OF THE CONTRACTOR.

CONTROL DIAGRAM



NOTE: STATE PLANE COORDINATES
HORIZONTAL COORDINATES ARE INTERNATIONAL FEET NAD83(CORS-2007)
ELEVATIONS ARE U.S. SURVEY FEET ESTABLISHED BY GPS (NAVD 88)
NAVD 88 DATUM IS APPROXIMATELY 3.64 FEET HIGHER THAN THE NGVD29 DATUM IN THIS LOCATION.
C.S.F. = .999945441

NOTE: THE ELEVATIONS WERE ESTABLISHED FROM GPS OPUS SOLUTIONS AND ARE NEAR NAVD88 ELEVATIONS
ELEVATION BETWEEN CONTROL POINTS WAS ESTABLISHED BY TERRESTRIAL MEASUREMENTS USING A TRIMBLE
S6 ROBOTIC TOTAL STATION.

THIS PROJECT UTILIZES LIDAR SURVEY DATA COLLECTED BETWEEN SEPTEMBER 22 AND 29, 2009 AS PART OF THE FLATHEAD CHANNEL MIGRATION ZONE STUDY COMMISSIONED BY THE MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY, MONTANA FISH, WILDLIFE, AND PARKS, AND THE FLATHEAD LAKERS.

CONTROL MARK ABSTRACT

POINT NAME/NUMBER	N OR Y COORDINATE	E OR X COORDINATE	POINT ELEVATION	LOCATION AND DESCRIPTION
A2038	810,332.138	1,458,149.392	2,900.63	WLA2038 FROM THE INTERSECTION OF HOLT STAGE AND STEEL BRIDGE ROAD ON THE EAST SIDE OF THE NEWLY REPLACED OLD STEEL BRIDGE GO SOUTH ON STEEL BRIDGE ROAD 4.8 MILES TO A FWP PARKING CORAL WITH GREEN GATES. TURN WEST AND FOLLOW GRAVEL DRIVE BETWEEN LIGHT GREEN STEEL SHOP AND A BROWN TRAILER HOUSE AT 920 FEET TURN RIGHT ON A FARM FIELD ROAD GOING WESTERLY AT 1200 FEET ROAD TURNS SOUTHERLY STOP AT 1285 FEET AND THE POINT LIES 45 FEET NORTHERLY OF THE FARM ROAD. IT IS ALSO 85 FEET FROM A POWERPOLE WHICH BEARS 34 DEGREES. MARK IS 8 FEET WEST OF TOP OF BANK. SET A 2" A.C. MARKED WLA2038 2012. WITNESS POST SET 3 FEET NORTH.
B2038	809,484.721	1,457,854.826	2,901.65	WLB2038 FROM POINT WLA2038 FOLLOW THE FARM FIELD ROAD IN A DOWNSTREAM DIRECTION STAYING ON THE RIVER SIDE OF THE HAYFIELD 965 FEET MARK IS NORTH TOWARDS THE RIVER 35 FEET. MARK IS DOWNSTREAM 95 FEET FROM AN 8 FOOT HIGH T-POST. SET A 2" A.C. MARK WLB2038 2012 WITNESS POST 3 FEET NORTH.
C2038	808,361.675	1,457,949.167	**2,899.94**	WLC2038 FROM THE INTERSECTION OF HOLT STAGE AND STEEL BRIDGE ROAD ON THE EAST SIDE OF THE NEWLY REPLACED OLD STEEL BRIDGE GO SOUTH ON STEEL BRIDGE ROAD 4.8 MILES TO A FWP PARKING CORAL WITH GREEN GATES. TURN WEST AND FOLLOW GRAVEL DRIVE BETWEEN LIGHT GREEN STEEL SHOP AND A BROWN TRAILER HOUSE AT 920 FEET TURN RIGHT ON A FARM FIELD ROAD GOING WESTERLY AT 1200 FEET ROAD TURNS SOUTHERLY GO AROUND A DEAD COTTONWOOD AND CONTINUE WEST ALONG THE NORTH EDGE OF THE FIELD DRIVE WESTERLY TO 3400 FEET AND THE POINT BEARS 320 DEGREES AT 105 FEET. SET A 2" A.C. MARKED WLC2038 2012 WITNESS POST 3 FEET EAST.
D2038	809,588.808	1,457,489.729	2,901.38	WLD2038 FROM WLB2038 GO 350 FEET AT AN AZIMUTH OF 186 DEGREES. SET A 2" A.C. MARKED WLB2038 2012 WITH A WITNESS POST 3 FEET SOUTH. MARK IS NORTH FROM THE SOUTH EDGE OF THE FIELD 35 FEET.

SUMMARY

GRADING				
GRADING	cubic yards			REMARKS
	UNCL. EXC.	EXCESS EXCAVATION *	EMB.+	
	2,030	2,030		BANK EXCAVATION
	230	115		FASCINE TRENCH
TOTAL	2,230	* 2,145		

* FOR INFORMATION ONLY

EXCLOSURE FENCING			
STATION	FENCE SPECIAL DESIGN (lin. ft)		REMARKS
	17,780		ALL EXCLOSURES
TOTAL	17,780		

REVEGETATION									
STATION	lump sum	cu. yards	acres	acres	acres	lump sum	sq. yards	sq. yards	REMARKS
	TREE & SHRUB PLANTING *	TOPSOIL SALVAGING & PLACING	COMPOST	UPLAND SEEDING	WETLAND SEEDING	WILLOW CUTTINGS	EROSION CONTROL BLANKET-BIO	COIR EROSION CONTROL NET	
		500	0.66	0.35	0.31	1	1,350	1,950	BANK RESTORATION AREA
	1								PLANTING ZONES
TOTAL	1	500	0.66	0.35	0.31	1	1,350	1,950	

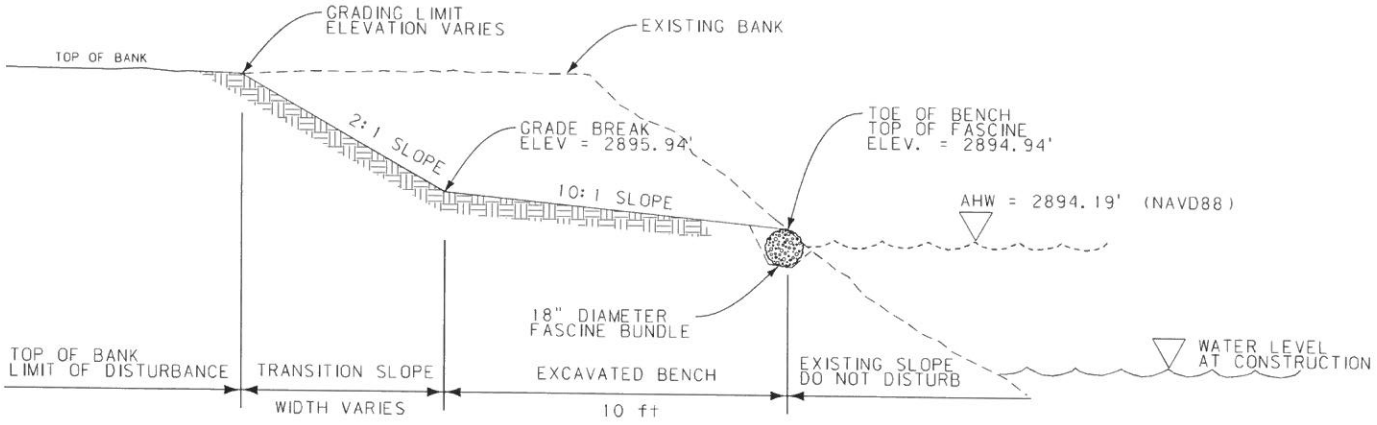
* TREE & SHRUB PLANTING INCLUDES BANK RESTORATION AREA (PLANTING ZONE 15)

LOCATION	WILLOW STAKES (each) *	FASCINE (lin. ft.)	REMARKS
BANK RESTORATION AREA		1,350	18" DIAMETER
BANK RESTORATION AREA	675		1 STAKE PER 2 FEET
TOTAL	675	1,350	

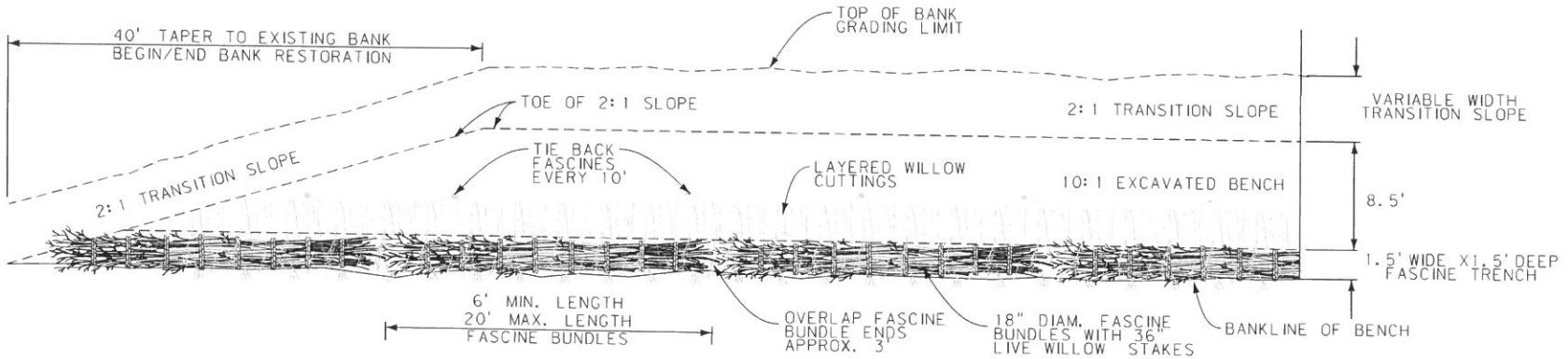
* FOR INFORMATION ONLY. COST OF WILLOW STAKES INCLUDED IN COST OF FASCINE.

BANK RESTORATION DETAIL

TYPICAL SECTION



PLAN VIEW



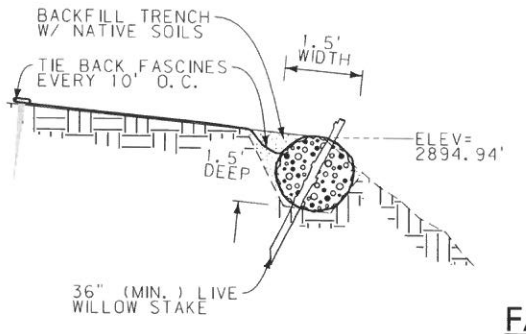
NOTE:

PREPARE 18" DIAMETER FASCINE BUNDLES WITH 1/2" TO 2" CONIFER SLASH & WILLOW CUTTINGS WITH ALL BRANCH ENDS FACING THE SAME DIRECTION. TIE EVERY 12" ON CENTER. POSITION END TO END AND OVERLAP ENDS APPROX. 3' OR MORE LEAVING NO GAPS BETWEEN BUNDLES. PLACE BUNDLES ENTIRELY WITHIN THE TRENCH AT THE SPECIFIED ELEVATION.

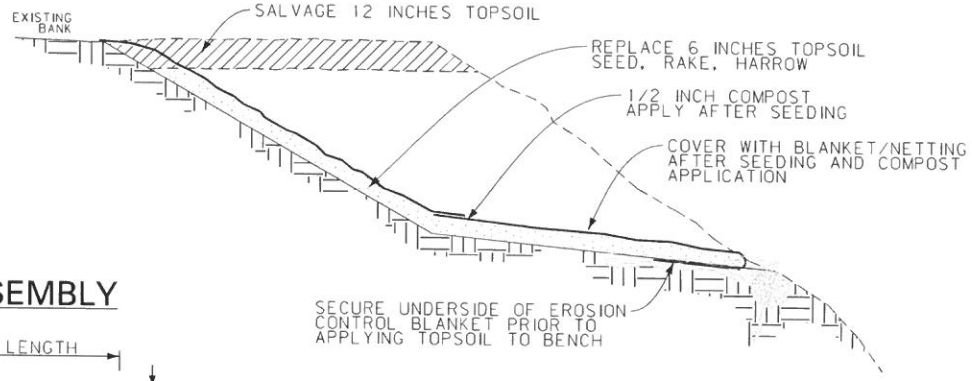
MDT MONTANA DEPARTMENT OF TRANSPORTATION	C:\DGN\2038013ENPVP001.DGN	DESIGNED BY	Wade Salyards, PE	12/05/2012	FOY'S BEND STREAM MITIGATION	NH 15(99)
	1/14/2013	REVIEWED BY				
	2:32:04 PM u7713	CHECKED BY			UPN 2038013	SHEET 5

BANK RESTORATION DETAIL

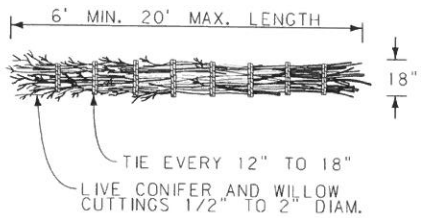
FASCINE INSTALLATION



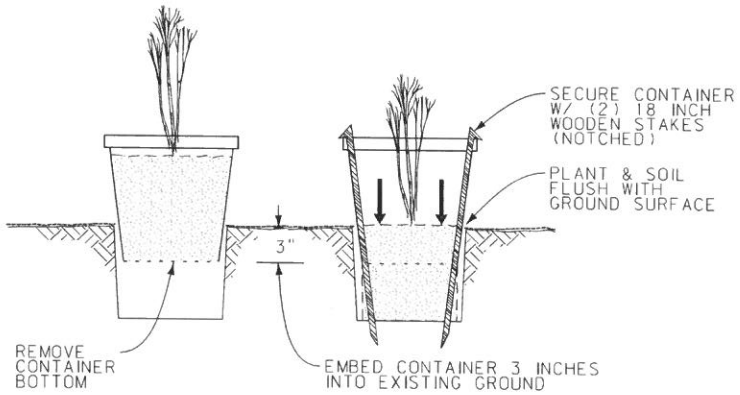
TOPSOIL SALVAGE & PLACE



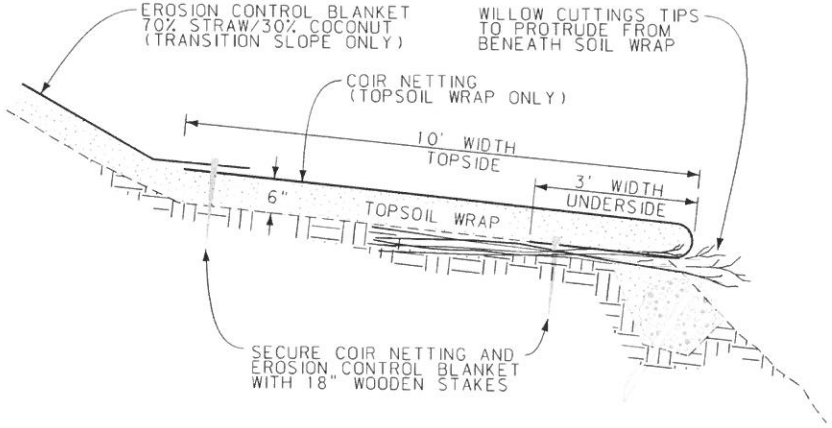
FASCINE ASSEMBLY



RODENT PROTECTION



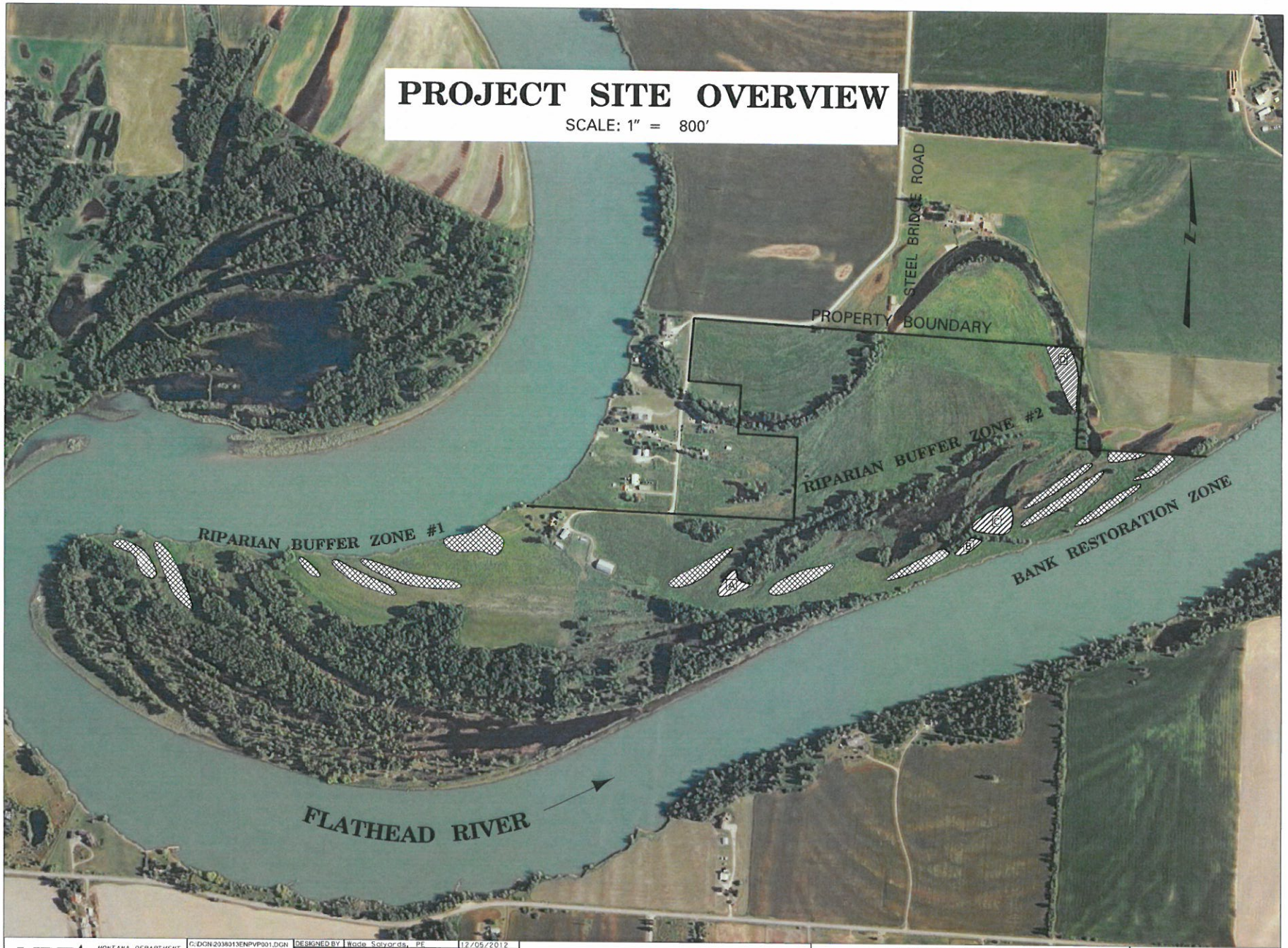
TOPSOIL WRAP



MDT ★ MONTANA DEPARTMENT OF TRANSPORTATION	C:\DGN\2038013ENPVP001.DGN	DESIGNED BY	Wade Salyards, PE	12/05/2012	FOY'S BEND STREAM MITIGATION / NH 15(99)
	1/14/2013	REVIEWED BY			
	2:32:05 PM u7713	CHECKED BY			UPN 2038013 / SHEET 6

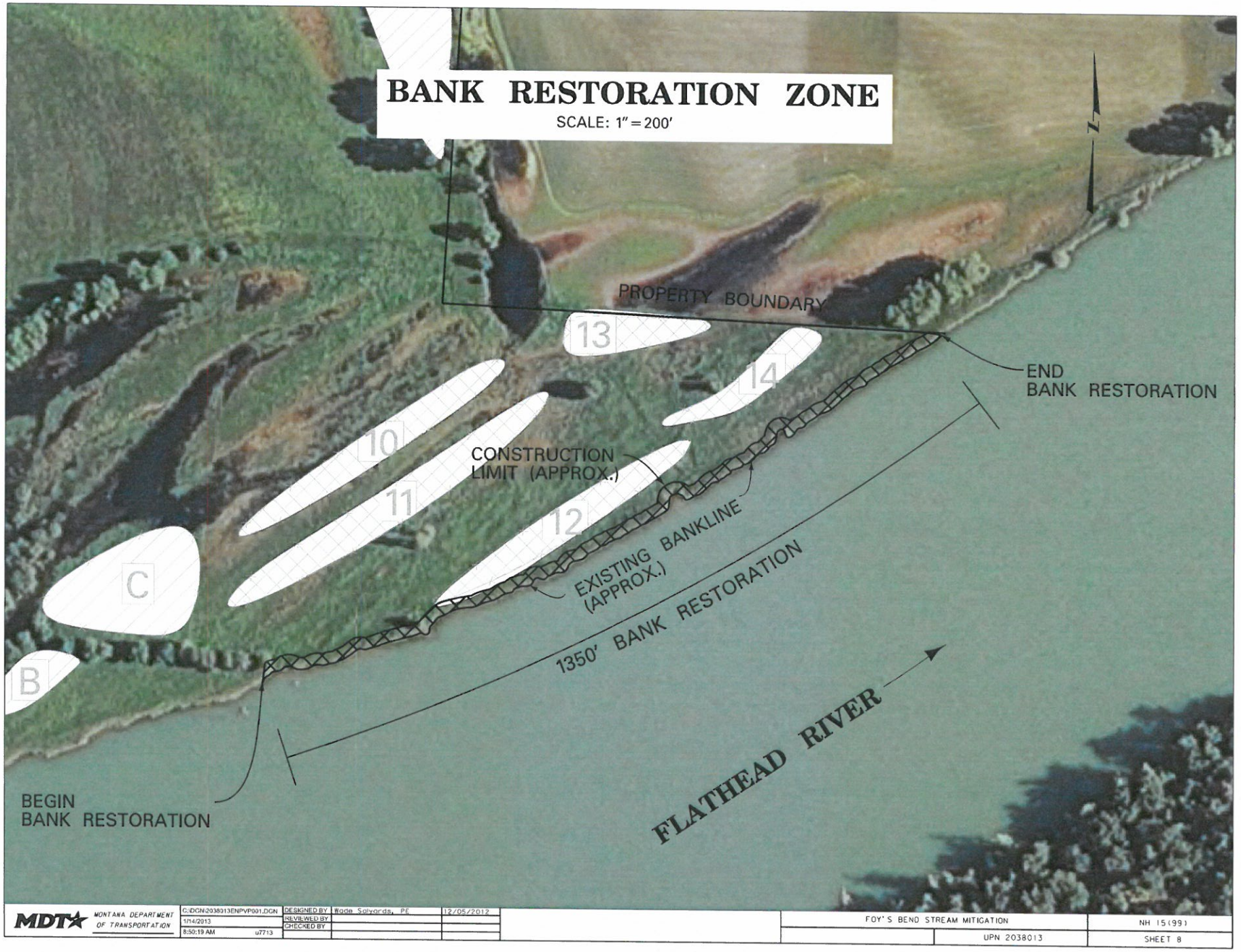
PROJECT SITE OVERVIEW

SCALE: 1" = 800'



MDT MONTANA DEPARTMENT OF TRANSPORTATION	C:\DGN\2038013ENPVP001.DGN	DESIGNED BY	Wade Salyards, PE	12/05/2012
	1/9/2013	REVIEWED BY		
	12:24:55 PM u7713	CHECKED BY		

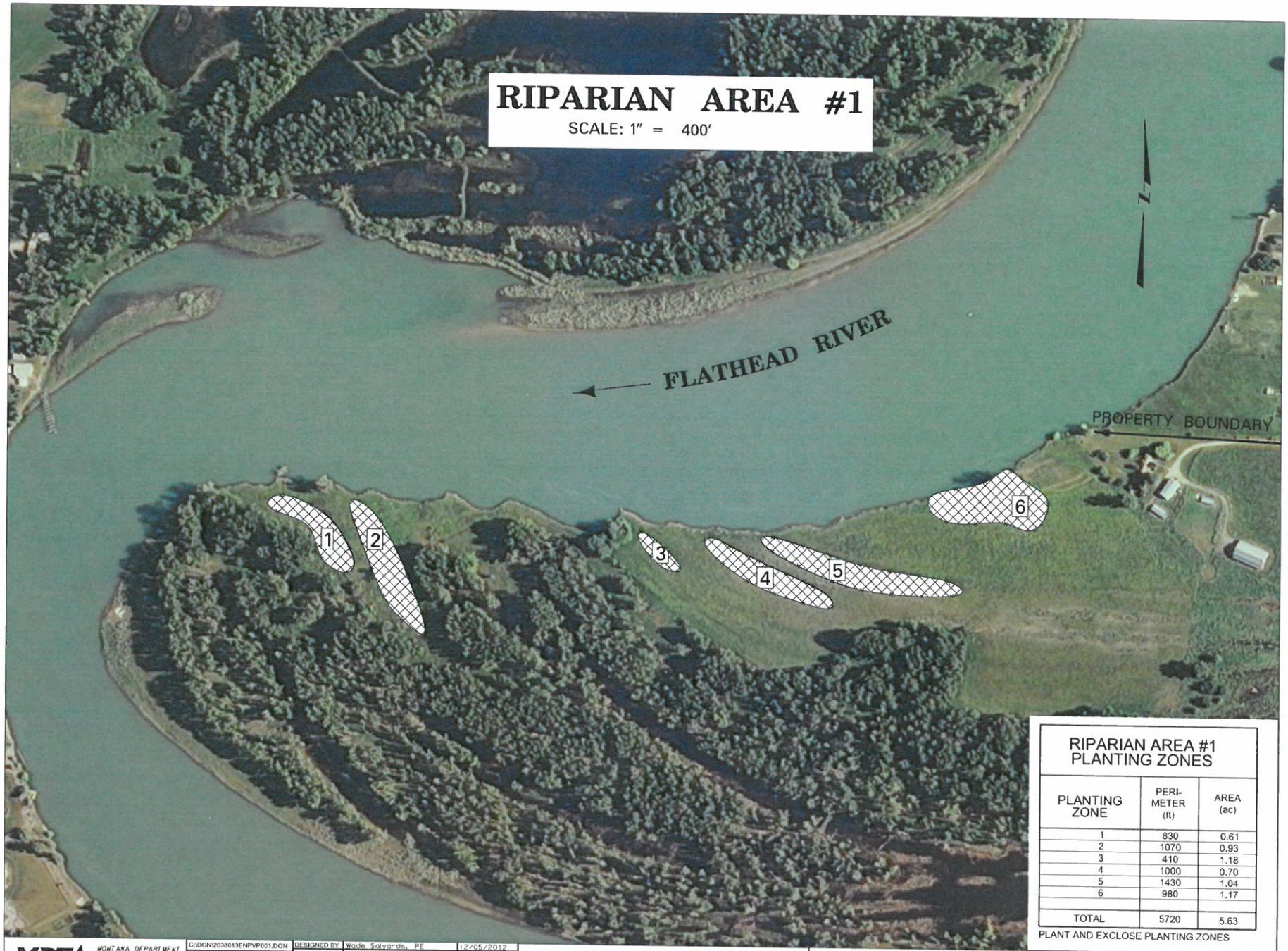
FOY'S BEND STREAM MITIGATION		NH 15(99)
	UPN 2038013	SHEET 7



MDT MONTANA DEPARTMENT OF TRANSPORTATION	C:\DGN\2038013ENPVP001.DGN	DESIGNED BY	Wade Salyards, PE	12/05/2012	FOY'S BEND STREAM MITIGATION	NH 15(99)
	1/14/2013	REVIEWED BY				
	8:50:19 AM u7713	CHECKED BY			UPN 2038013	SHEET 8

RIPARIAN AREA #1

SCALE: 1" = 400'



RIPARIAN AREA #1 PLANTING ZONES		
PLANTING ZONE	PERI-METER (ft)	AREA (ac)
1	830	0.61
2	1070	0.93
3	410	1.18
4	1000	0.70
5	1430	1.04
6	980	1.17
TOTAL	5720	5.63

PLANT AND EXCLOSE PLANTING ZONES

MDT MONTANA DEPARTMENT OF TRANSPORTATION

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1/9/2013	REVIEWED BY		
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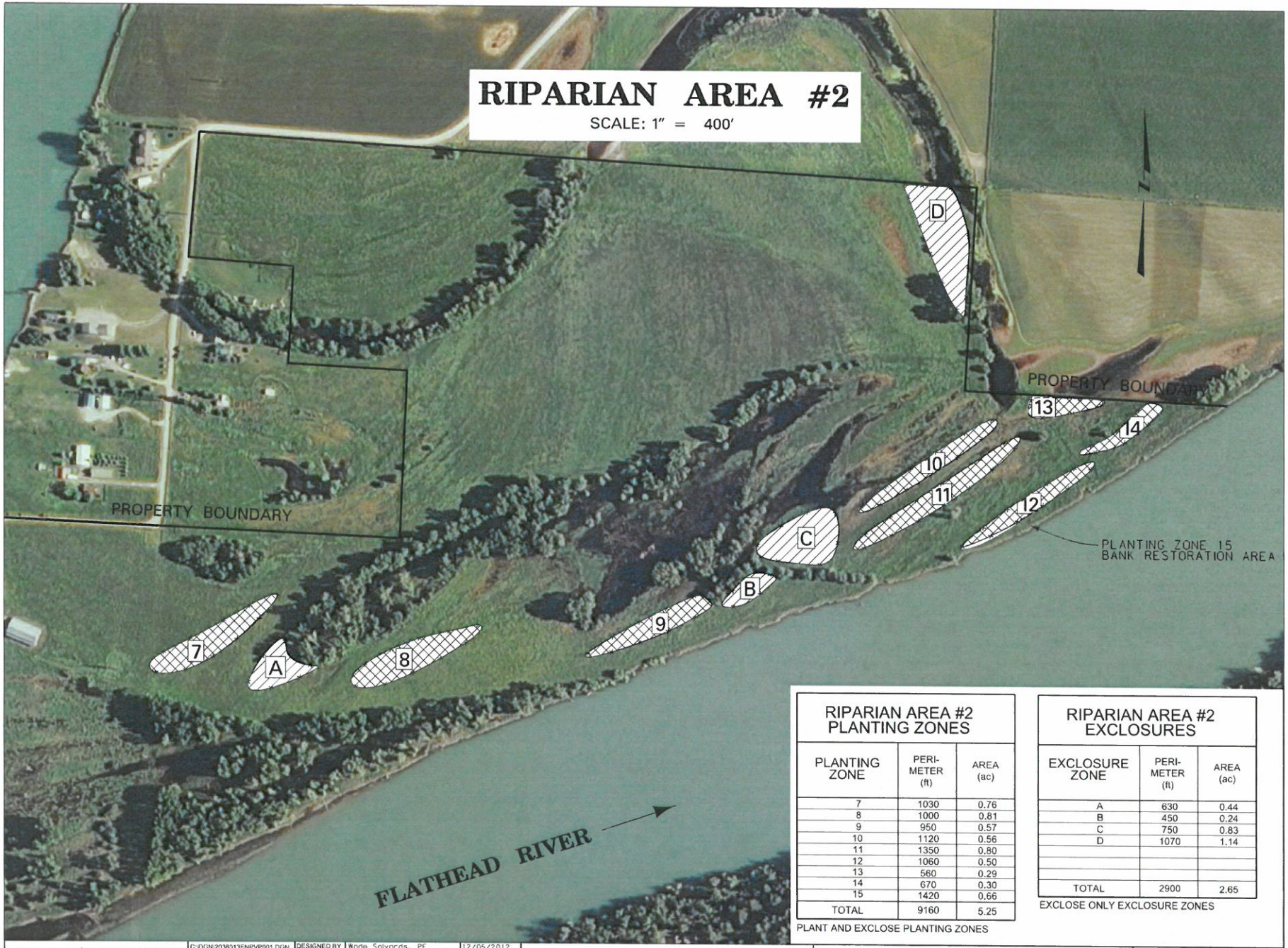
FOY'S BEND STREAM MITIGATION | NH 15(99)

UPN 2038013 | SHEET 9



RIPARIAN AREA #2 PLANTING ZONES

PLANTING ZONE	PERI-METER (ft)	AREA (ac)
7	1030	0.76
8	1000	0.81
9	950	0.57
10	1120	0.56
11	1350	0.80
12	1060	0.50
13	560	0.29
14	670	0.30
15	1420	0.66
TOTAL	9160	5.25

PLANT AND EXCLOSE PLANTING ZONES

RIPARIAN AREA #2 EXCLOSURES

EXCLOSURE ZONE	PERI-METER (ft)	AREA (ac)
A	630	0.44
B	450	0.24
C	750	0.83
D	1070	1.14
TOTAL	2900	2.65

EXCLOSE ONLY EXCLOSURE ZONES

MDT MONTANA DEPARTMENT OF TRANSPORTATION

C:\DGN\2038013ENPVP001.DGN	DESIGNED BY	Wade Salyards, PE	12/05/2012
1/9/2013	REVIEWED BY		
12:25:11 PM u7713	CHECKED BY		

FOY'S BEND STREAM MITIGATION | NH 15(99)
UPN 2038013 | SHEET 10

FENCING EXCLOSURE COORDINATE TABLES

FENCING EXCLOSURE COORDINATES

POINT	EXCLOSURE	N OR Y COORDINATE	E OR X COORDINATE
1000	1	1 457 904.412	807 733.283
1001	1	1 457 877.732	807 824.400
1002	1	1 457 846.604	807 904.405
1003	1	1 457 768.785	807 919.962
1004	1	1 457 675.402	808 013.301
1005	1	1 457 710.976	808 062.193
1006	1	1 457 816.734	808 006.564
1007	1	1 457 893.295	807 951.075
1008	1	1 457 966.668	807 788.842
1009	1	1 457 722.409	807 939.839
1010	2	1 457 958.419	807 999.977
1011	2	1 457 797.689	808 068.860
1012	2	1 457 584.048	808 144.804
1013	2	1 457 533.104	808 208.868
1014	2	1 457 445.743	808 306.265
1015	2	1 457 613.146	808 253.315
1016	2	1 457 784.348	808 179.978
1017	2	1 457 913.306	808 104.417
1018	3	1 457 813.531	808 974.054
1019	3	1 457 737.935	809 042.947
1020	3	1 457 706.807	809 078.505
1021	3	1 457 702.348	809 165.805
1022	3	1 457 866.892	808 587.388
1023	4	1 457 815.754	809 178.511
1024	4	1 457 729.041	809 267.405
1025	4	1 457 653.445	809 380.746
1026	4	1 457 606.754	809 531.866
1027	4	1 457 575.626	809 640.762
1028	4	1 457 640.105	809 631.872
1029	4	1 457 713.477	809 451.861
1030	4	1 457 795.743	809 278.517
1031	4	1 457 826.871	809 242.959
1032	5	1 457 793.520	809 387.413
1033	5	1 457 713.477	809 547.423
1034	5	1 457 655.669	809 691.876
1035	5	1 457 635.658	809 840.774
1036	5	1 457 631.211	810 098.567
1037	5	1 457 697.914	810 031.897
1038	5	1 457 715.701	809 769.658
1039	5	1 457 780.180	809 582.980
1040	5	1 457 849.105	809 378.523
1041	6	1 458 067.872	810 210.718
1042	6	1 458 009.166	810 277.174
1043	6	1 457 970.688	810 364.254
1044	6	1 457 830.690	810 301.059
1045	6	1 457 891.416	810 207.464
1046	6	1 457 884.051	810 137.239
1047	6	1 457 870.362	809 981.736
1048	6	1 457 968.373	809 914.249
1049	6	1 457 995.907	810 018.235
1050	6	1 458 007.024	810 118.241
1051	6	1 458 044.821	810 171.577
1052	6	1 458 062.609	810 196.023

* PLANTING ZONE 15 IS DEFINED BY THE BANK RESTORATION AREA. FENCE ALL DISTURBED AREAS WITHIN THE CONSTRUCTION LIMITS OF THE BANK RESTORATION AREA.

FENCING EXCLOSURE COORDINATES

POINT	EXCLOSURE	N OR Y COORDINATE	E OR X COORDINATE
1053	7	1 457 909.700	811 793.438
1054	7	1 457 811.870	811 635.651
1055	7	1 457 747.391	811 506.754
1056	7	1 457 696.253	811 408.970
1057	7	1 457 645.115	811 440.083
1058	7	1 457 674.019	811 580.092
1059	7	1 457 754.062	811 695.655
1060	7	1 457 851.891	811 802.328
1061	7	1 457 938.604	811 873.443
1062	8	1 457 809.635	812 457.368
1063	8	1 457 832.981	812 515.705
1064	8	1 457 801.853	812 546.818
1065	8	1 457 576.178	812 154.016
1066	8	1 457 642.324	812 041.231
1067	8	1 457 759.053	812 243.466
1068	8	1 457 797.962	812 379.586
1069	9	1 457 937.098	813 243.780
1070	9	1 457 908.192	813 268.228
1071	9	1 457 892.627	813 297.120
1072	9	1 457 825.921	813 174.883
1073	9	1 457 790.345	813 105.986
1074	9	1 457 712.521	812 888.182
1075	9	1 457 716.968	812 828.175
1076	9	1 457 857.051	813 074.871
1077	9	1 457 905.969	813 179.328
1078	10	1 458 523.655	814 194.093
1079	10	1 458 459.173	814 100.748
1080	10	1 458 305.784	813 954.064
1081	10	1 458 221.254	813 758.485
1082	10	1 458 183.454	813 754.040
1083	10	1 458 285.737	813 940.729
1084	10	1 458 505.867	814 260.768
1085	11	1 458 463.620	814 276.325
1086	11	1 458 341.325	814 098.526
1087	11	1 458 267.948	813 987.401
1088	11	1 458 167.889	813 827.382
1089	11	1 458 105.630	813 747.373
1090	11	1 458 052.265	813 729.593
1091	11	1 458 216.807	814 045.186
1092	11	1 458 399.137	814 269.658
1093	11	1 458 459.173	814 305.217
1094	12	1 458 383.572	814 516.354
1095	12	1 458 261.278	814 311.885
1096	12	1 458 176.783	814 196.315
1097	12	1 458 098.960	814 102.971
1098	12	1 458 085.300	814 090.172
1099	12	1 458 121.280	814 191.843
1100	12	1 458 219.031	814 356.335
1101	12	1 458 327.984	814 511.909
1102	12	1 458 379.125	814 551.914

FENCING EXCLOSURE COORDINATES

POINT	EXCLOSURE	N OR Y COORDINATE	E OR X COORDINATE
1103	13	1 458 585.914	814 583.028
1104	13	1 458 587.569	814 401.408
1105	13	1 458 591.297	814 328.109
1106	13	1 458 563.679	814 322.997
1107	13	1 458 503.643	814 311.885
1108	13	1 458 543.667	814 500.796
1109	13	1 458 563.679	814 571.916
1110	14	1 458 575.142	814 716.858
1111	14	1 458 568.126	814 756.383
1112	14	1 458 548.114	814 774.163
1113	14	1 458 483.631	814 691.930
1114	14	1 458 421.372	814 620.811
1115	14	1 458 408.031	814 531.911
1116	14	1 458 394.690	814 485.239
1117	14	1 458 419.149	814 489.684
1118	14	1 458 452.502	814 596.363
1119	14	1 458 563.679	814 694.153
1120	A	1 457 770.598	811 877.829
1121	A	1 457 727.401	811 875.289
1122	A	1 457 695.638	811 908.307
1123	A	1 457 682.932	811 966.723
1124	A	1 457 688.014	812 007.360
1125	A	1 457 605.431	811 837.191
1126	A	1 457 590.185	811 719.089
1127	A	1 457 719.777	811 796.554
1128	A	1 457 784.574	811 861.320
1129	B	1 457 988.240	813 508.257
1130	B	1 458 016.133	813 407.967
1131	B	1 457 950.062	813 359.707
1132	B	1 457 881.450	813 282.237
1133	B	1 457 888.180	813 397.132
1134	B	1 457 972.675	813 479.364
1135	C	1 458 023.915	813 692.366
1136	C	1 458 031.142	813 592.354
1137	C	1 458 044.483	813 450.115
1138	C	1 458 073.389	813 419.000
1139	C	1 458 120.083	813 436.780
1140	C	1 458 231.260	813 632.359
1141	C	1 458 215.695	813 707.923
1142	D	1 459 290.636	814 072.182
1143	D	1 459 208.048	814 103.932
1144	D	1 459 116.565	814 131.872
1145	D	1 459 017.418	814 123.348
1146	D	1 458 926.062	814 114.470
1147	D	1 458 833.437	814 117.007
1148	D	1 458 886.728	814 080.228
1149	D	1 458 929.788	814 049.322
1150	D	1 459 239.812	813 931.213
1151	D	1 459 283.013	813 910.893
1152	D	1 459 293.177	813 912.163
1153	D	1 459 283.109	814 035.872
* 1154	15	1 457 950.000	813 806.000
* 1155	15	1 458 560.000	814 968.000