MONTANA DEPARTMENT OF TRANSPORTATION
STREAM MITIGATION MONITORING REPORT

Clark Fork River
Granite County, Montana

Project Completed: 2013
Monitoring Report #3: December, 2015

Prepared for:

MONTANA MDT DEPARTMENT OF TRANSPORTATION

Prepared by:

CONFLUENCE

MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT

YEAR 2015

Clark Fork River
Granite County, Montana

Permit No.
MFWP: SPA MDT R2-14-2012
USACE: NWO-2012-00831-MTH

Prepared for:

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Cover Photo: 2015 view of Clark Fork River with riprap and willow plantings looking east.

1.0 INTRODUCTION

The following report presents the third year of monitoring results of a bank stabilization project on Interstate 90 along the Clark Fork River approximately 24 miles west of Drummond, Montana. In 2013, the Montana Department of Transportation (MDT) requested authorization for placement of approximately 200 cubic yards of rip rap along 150 linear feet of the Clark Fork River to protect Interstate 90 from bank erosion and encroachment upon the highway right-of-way. This report evaluates the monitoring results in comparison to project performance standards as required by the U.S. Army Corps of Engineers (USACE) in permit NWO-2012-00831-MTH.

The approved U.S. Army Corps 404 permit requires monitoring for three years post-construction, and outlines the following performance standards:

1. Minimum of 80 percent survival of plantings three years after planting.

2. Riprap must be covered with topsoil, seeded, and sprigged with willows above the ordinary high water mark.

Additional reporting requirements include:

1. Annual report detailing the extent of revegetation efforts and survival rates of plantings.

2. Photographs of the site prior to, during, and immediately following construction, as well as for three years post-construction, must be a part of the monitoring reports.

Inspection of the site in 2013, 2014, and 2015 provides the opportunity to determine whether the project is meeting, or moving toward the intended performance targets. MDT has met the minimum requirement of performing three years of monitoring at this site; subsequent monitoring efforts will be at the discretion of MDT and the U.S. Army Corps based on the site's ability to meet performance standards.

2.0 SITE LOCATION

The project site is located north of the westbound lane of Interstate 90 between mile posts 137 and 138, and is 24 miles west of Drummond, MT. The site lies within Section 24, Township 11 North, Range 15 West, Granite County, Montana (Latitude: 46.170007°N; Longitude: -113.4392°W) (Figure 1).

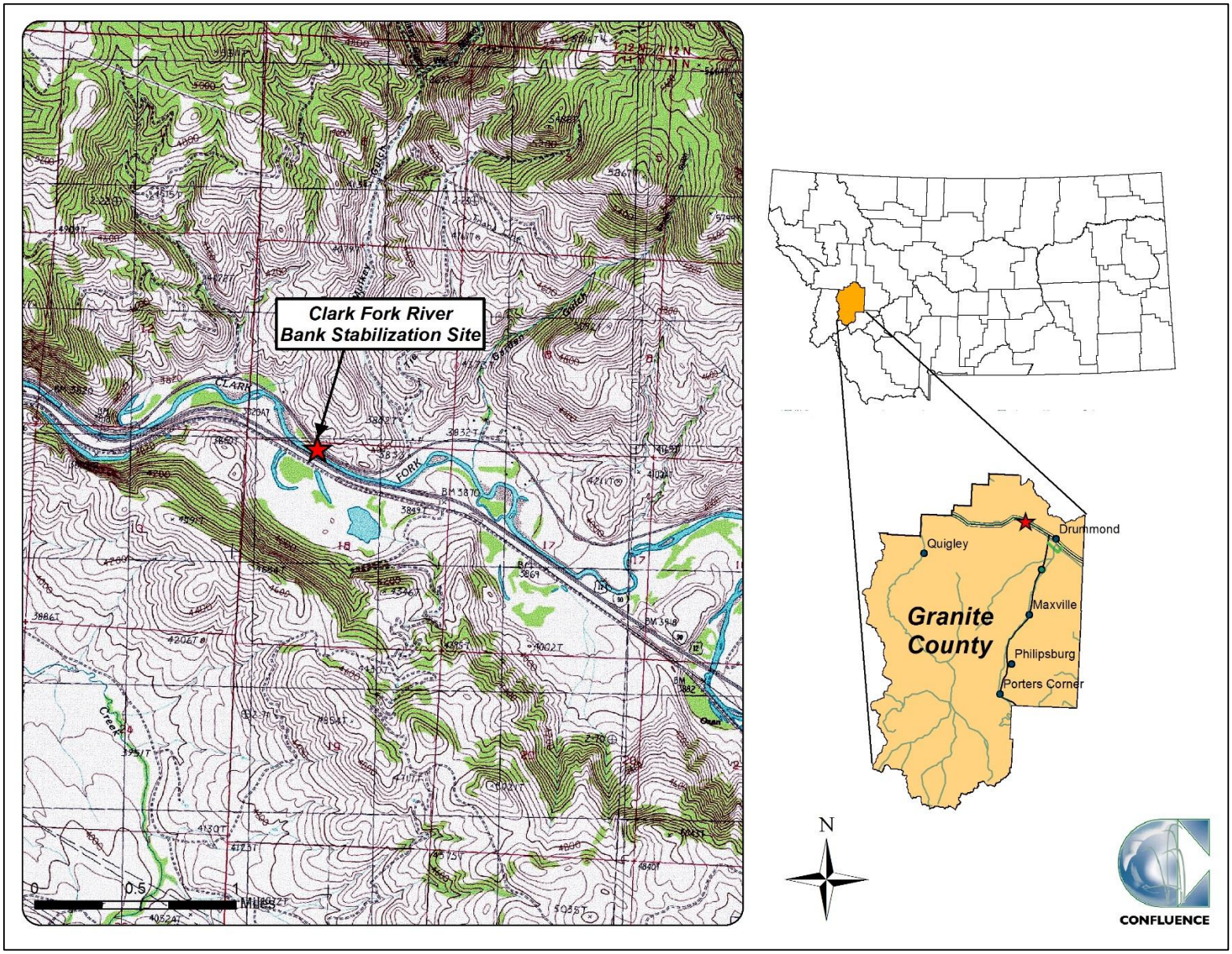

Figure 1. Project location of Clark Fork River bank stabilization site.

3.0 MONITORING METHODS

The project site was inspected for the third year on July 22, 2015. Monitoring inspections included:

- Documenting the overall stream bank stability,
- Recording the number of live and dead willow stems observed beneath and above the installed riprap,
- Documenting vegetation establishment throughout the site,
- Documenting any noxious and invasive species presence,
- Documenting site conditions by repeating photo points established in 2013.

4.0 MONITORING RESULTS

4.1. Bank Stability

Inspection of the site in 2015 indicated minor loss of smaller sized riprap installed on the bank, likely as a result of shear forces during spring runoff. A similar observation was documented following runoff in 2014. Some of the smaller sized rock placed along the bank appeared to mobilize or slough, exposing additional planted willow stems beneath the bank. All larger rock remained in place and overall, the bank remains stable. Placement of additional rock to maintain stability does not appear to be warranted at this time.

Bank erosion was noted in 2014 immediately upstream of the placed riprap. This bank eroded further in 2015, and has exposed approximately six additional linear feet of the riprap that was keyed in to the bank during construction (See Photo 7 in Appendix A). Although the erosion noted to date has yet to threaten the stability of the bank, additional observations may be warranted to ensure the riprap is not flanked over time.

4.2. Woody Planting Establishment

Woody vegetation plantings included willow cuttings placed above and beneath the riprap. Willow cuttings installed beneath the riprap were placed vertically with the stems set in saturated substrate, then covered by a layer of soil and filter fabric. Rock was then placed on the fabric over the willow cuttings to secure the bank. This approach intended for willows to grow through the fabric and voids in the riprap, eventually establishing a vegetated bank. Additional willow cuttings were installed on the bank just above the riprap to serve as a buffer between the adjacent hill slope and the stabilized bank (see Photos 1, 4, 8, 9, and 10 in Appendix A). The project did not include installation of containerized plants, although some *cornus alba* (red-osier dogwood) were also observed growing above the riprap. All dogwood observed were considered volunteers and were not included in the planted woody vegetation inventory.

Willows stems ranging from three to seven feet tall were observed along the top of the riprap bank just above the uppermost layer of rock (See Photo 1 and Photo 4 of willow

establishment in Appendix A). These willows are approximately 24" taller than observed during the 2014 monitoring event, and indicate successful establishment three years following their placement. Planted willow cutting survival rates were determined by dividing the number of live willows observed (67) by the total number of willows observed above the riprap (101). Using this method, the success rate of willows planted above the riprap is 66% (Table 1). If the number of surviving willows above the riprap (67) is compared to the total number of willow shoots inspected above the riprap in 2013 (345), the survival rate is 19%.

Willow cuttings planted beneath the riprap have largely been unable to successfully establish (See Photos 2 and 9 in Appendix A). In 2015, 11 willow stems were observed sprouting through the riprap, while an additional 39 dead stems were found in the voids between rock layers. It is possible some woody roots have established beneath the riprap and have yet to produce stems. To date, the survival rate of willows planted beneath the riprap is 22%. The overall survival rate of willows observed beneath and above the riprap is 52% (Table 1).

Table 1. Number of live and dead willow stems observed along the Clark Fork River bank stabilization site from 2013-2015.

Year	Location	Total Plants Inspected	Surviving Plants	Plant Survival Rate
2013	Willows planted above riprap	345	260	75%
	Willows planted beneath riprap	0	0	N/A
	Total - 2013	**345**	**260**	**75%**
2014	Willows planted above riprap	275	275	100%
	Willows planted beneath riprap	52	2	4%
	Total 2014	**327**	**277**	**85%**
2015	Willows planted above riprap	101	67	66%
	Willows planted beneath riprap	50	11	22%
	Total 2015	**151**	**78**	**52%**

4.3. Vegetation Composition

Table 2 provides a comprehensive list of vegetative species identified at the Clark Fork River bank stabilization site. In 2015, 49 plant species were observed as compared to 35 species in 2014 and 14 species in 2013. Woody plants establishing above the riprapped bank included *Salix exigua* (narrow-leaf willow), *Salix drummondia* (Drummond's willow) and *Cornus alba (*red osier dogwood*).*

Vegetation has continued to establish between the north edge of the highway and the stabilized bank (see Photos 5 and 12 in Appendix A), although dry conditions during the growing season in 2015 appears to have limited the overall percent cover of this area. Two additional species of noxious weed species were noted in 2015, bringing the total number of species observed to five. Noxious weed species observed are summarized

in Table 3. All weed species were identified in trace amounts, which is defined as infestations covering less than 1% of the inspected area.

Table 2. Comprehensive list of plant species identified at the Clark Fork River site from 2013 to 2015*.

Scientific Name	Common Name	WMVC Indicator Status
Agropyron cristatum	Crested Wheatgrass	NL
Agrostis stolonifera	**Creeping Bentgrass**	**FAC**
Alopecurus arundinaceus	Creeping Meadow-Foxtail	FAC
Bromus inermis	**Smooth Brome**	**FAC**
Chenopodium album	Lamb's-Quarters	FACU
Cirsium arvense	Canadian Thistle	FAC
Cornus alba	Red Osier	FACW
Dactylis glomerata	Orchard Grass	FACU
Dasiphora fruticosa	Golden-Hardhack	FAC
Descurainia sophia	**Herb Sophia**	**NL**
Elymus repens	Creeping Wild Rye	FAC
Elymus trachycaulus	**Slender Wild Rye**	**FAC**
Epilobium ciliatum	**Fringed Willowherb**	**FACW**
Equisetum hyemale	Tall Scouring-Rush	FACW
Euphorbia esula	**Leafy Spurge**	**NL**
Festuca idahoensis	Bluebunch Fescue	FACU
Helianthus annuus	Common Sunflower	FACU
Hordeum jubatum	Fox-Tail Barley	FAC
Kochia scoparia	Mexican Kochia	NL
Lactuca serriola	Prickly Lettuce	FACU
Lepidium campestre	**Field Pepper-Grass**	**NL**
Lepidium perfoliatum	**Clasping Pepperwort**	**FACU**
Leucanthemum vulgare	**Ox-Eye Daisy**	**FACU**
Linaria dalmatica	Dalmatian Toadflax	NL
Melilotus officinalis	Yellow Sweet-Clover	FACU
Onopordum acanthium	Scotch Thistle	NL
Panicum capillare	Common Panic Grass	FAC
Pascopyrum smithii	Western-Wheat Grass	FACU
Persicaria amphibia	Water Smartweed	OBL
Phalaris arundinacea	Reed Canary Grass	FACW
Phleum pratense	Common Timothy	FAC
Poa palustris	Fowl Blue Grass	FAC
Poa pratensis	Kentucky Blue Grass	FAC
Polygonum* sp. *	**Knotweed ****	**NL**
Populus trichocarpa	Narrow-Leaf Cottonwood	FACW
Rumex crispus	Curly Dock	FAC
Salix drummondiana	Drummond's Willow	FACW
Salix exigua	Narrow-Leaf Willow	FACW
Salix lasiandra	**Pacific Willow**	**FACW**
Silene noctiflora	**Night-flowering Catchfly**	**NL**
Sinapis arvensis	Corn Mustard	NL
Sisymbrium altissimum	**Tall Hedge-Mustard**	**FACU**
Sonchus arvensis	Field Sow-Thistle	FACU
Tanacetum vulgare	Common Tansy	FACU
Thlaspi arvense	Field Pennycress	UPL
Tragopogon dubius	**Meadow Goat's-beard**	**NL**
Trifolium pratense	Red Clover	FACU
Trifolium repens	White Clover	FAC
Verbascum thapsus	Great Mullein	FACU

*Based on 2014 NWPL (Lichvar *et al*., 2014)
** Not Japanese Knotweed; likely *Polygonum aviculare*
New species identified in 2015 are **bolded**.

Table 3. Montana State listed noxious weed species observed in 2015 at the Clark Fork River bank stabilization site*.

Category	Scientific Name	Common Name
Priority 2B	*Cirsium arvense*	Canadian Thistle
	Euphorbia esula	**Leafy Spurge**
	Linaria dalmatica	Dalmatian Toadflax
	Leucanthemum vulgare	**Ox-Eye Daisy**
	Tanacetum vulgare	Common Tansy

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

4.4. Photo Documentation

Photographs were taken at the upstream and downstream extents, and several additional areas within the project area to document the installed bank protection measures and the extent and density of vegetation establishment along the riprap and within the project staging area adjacent to Interstate 90. Photographs taken in 2013 and 2015 are included in Appendix A.

5.0 COMPARISON OF RESULTS TO PERFORMANCE STANDARDS

Monitoring of the Clark Fork River bank stabilization site is intended to document whether the project is meeting performance standards outlined in the permits issued for project construction. The third year of monitoring indicates one of two performance standards are being met three years post-construction (Table 4).

Table 4. Performance results of Clark Fork bank stabilization project 3 years following construction.

Parameter	Success Criteria	Status	Meeting Performance Criteria?
Woody planting survival	Minimum of 80% survival of plantings three years after planting.	**52**% of observed woody plantings have survived	No
Construction detail	Riprap must be covered with topsoil, seeded, and sprigged with willows above the ordinary high water mark.	Riprap has been covered with topsoil, seeded, and sprigged with willows above the ordinary high water mark	Yes

5.1. Woody Planting Survival

The observed woody planting survival within the project reach was 52%, which does not meet the target performance standard of 80% three years following installation. Several more dead stems were observed along the top of the bank in 2015 as compared to the 2014 monitoring results, although it should be noted that the percent cover provided primarily by planted and to a lesser extent volunteer woody vegetation has increased along the top of the bank due to maturation of the woody species. Observed survival of woody plantings installed above the riprap was 66%. Although a greater number of willows have been observed sprouting from the riprap each year, they continue to show poor survival rates, with 22% of those observed having successfully established.

5.2. Construction Details

The area above the riprap has been reclaimed by seeding and sprigging woody cuttings through a layer of topsoil. This area exhibits continued woody and herbaceous establishment as indicated by maturation of surviving willows and forbs. Weed management efforts should reduce the potential for colonization by new species and spread of those currently inhabiting the site.

6.0 MONITORING SUMMARY

The Clark Fork River bank stabilization site has been monitored for three years following construction of the project in 2013. Overall, stabilization efforts along the project reach appear largely successful with some loss of the smaller sized fraction of bank protection materials along the top of the bank. The toe of the stabilized bank has not adjusted laterally since monitoring efforts were initiated in 2013. A short segment of unprotected bank has eroded toward the upstream extent of the riprap that has been keyed into the bank. To date, the river does not appear to be eroding rapidly enough to flank the riprap; although additional observations should be conducted to ensure further erosion upstream of the riprap does not jeopardize the stabilization project. If the bank continues to erode, placement of additional riprap may be recommended to maintain protection of the highway. If necessary, the extent of additional riprap installation should be evaluated based on anticipated erosive activity, flow direction, bar formation, existing bank materials, and vegetative composition.

Woody vegetation establishment has been documented along the upper bank above the riprap. Woody vegetation along the upper bank includes dogwood and two willow species, with average heights of approximately 5 feet. Woody vegetation placed beneath the riprap during construction has shown limited success. As a result, the bank toe has little cover or shade along the stabilized reach.

The upper river bank area and highway embankment exhibits a large amount of weedy and undesirable species and approximately 15% bare ground (Photo 12, Appendix A). The majority of this area lies within the roadway clear zone, which is regularly mowed and used for maintenance activities. As such, this area is expected to take additional time to establish desirable species as compared to undisturbed areas.

7.0 LITERATURE CITED

Lichvar, R.W., M. Butterwick, N.C. Melvin, and W.N. Kirchner. 2014. *The National Wetland Plant List. 2014 Update of Wetland Ratings*. Phytoneuron 2014-41:1-42.

Montana Department of Agriculture. *Montana Noxious Weed List*. July 2015. Accessed November 2015 at: http://agr.mt.gov/agr/Programs/Weeds/PDF/2015WeedList.pdf.

Appendix A

Project Site Photos

MDT Stream Mitigation Monitoring
Clark Fork River
Granite County, Montana

PHOTO INFORMATION

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: 2013 and 2015 Monitoring Events

CONFLUENCE

Photo 1
Description: View upstream looking at revetment.
Taken in 2013

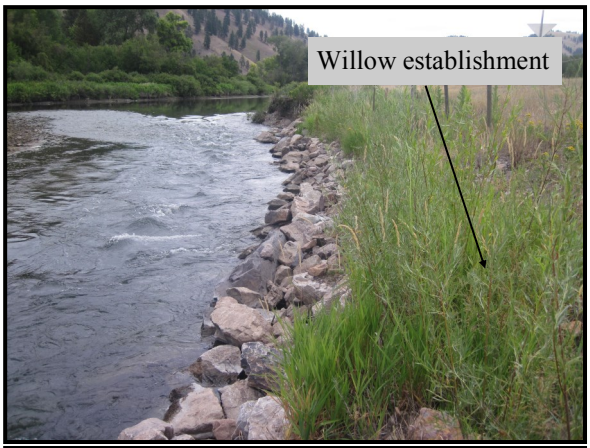

Photo 1
Description: View upstream looking at revetment.
Taken in 2015

Photo 2
Description: Toe of revetment looking upstream.
Taken in 2013

Photo 2
Description: Toe of revetment looking upstream.
Taken in 2015

Photo 3
Description: Middle of revetment looking upstream.
Taken in 2013

Photo 3
Description: Middle of revetment looking upstream.
Taken in 2015

PHOTO INFORMATION

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: 2013 and 2015 Monitoring Events

CONFLUENCE

Photo 4
Description: Willow growth at top of revetment.
Taken in 2013

Photo 4
Description: Willow growth at top of revetment.
Taken in 2015

Photo 5
Description: Highway embankment / access area.
Taken in 2013

Photo 5
Description: Weedy streambank/work area.
Taken in 2015

Photo 6
Description: Sandbar willow growth and bare ground.
Taken in 2013

Photo 6
Description: Sandbar willow growth and bare ground.
Taken in 2015

PHOTO INFORMATION

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: 2013 and 2015 Monitoring Events

CONFLUENCE

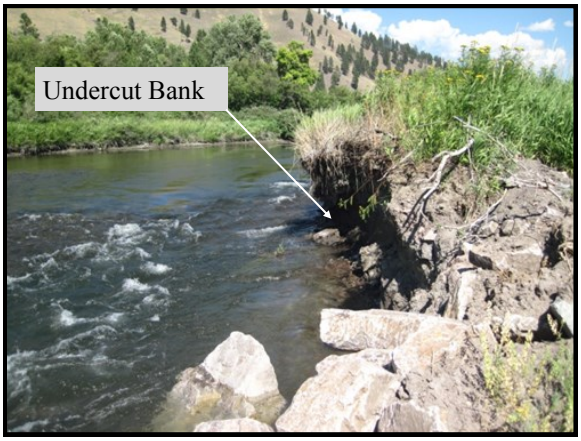

Photo 7
Description: Eroding streambank at upstream extent.
Taken in 2013

Photo 7
Description: Eroding streambank at upstream extent.
Taken in 2015

Photo 8
Description: Middle of revetment looking downstream.
Taken in 2013

Photo 8
Description: Middle of revetment looking down-stream. **Taken in 2015**

Photo 9
Description: Looking downstream at revetment.
Taken in 2013

Photo 9
Description: Looking downstream at revetment.
Taken in 2015

PHOTO INFORMATION

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: 2013 and 2015 Monitoring Events

CONFLUENCE

Photo 10
Description: Close-up of sandbar willow growth.
Taken in 2013

Photo 10
Description: Close-up of sandbar willow growth.
Taken in 2015

Photo 11
Description: Upstream extent of rip-rapped stream-bank. **Taken in 2013**

Photo 11
Description: Upstream extent of rip-rapped stream-bank. **Taken in 2015**

Photo 12
Description: Highway embankment adjacent to bank.
Taken in 2013

Photo 12
Description: Highway embankment adjacent to bank.
Taken in 2015

PHOTO INFORMATION

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: 2013 and 2015 Monitoring Events

CONFLUENCE

Photo 13
Description: Looking downstream at revetment
Taken in 2013

Photo 13
Description: Looking downstream at revetment.
Taken in 2015

Additional Photo
Description: **Dead willows in revetment**
Taken in 2015

Additional Photo
Description: **Willow growing in revetment**
Taken in 2015