Alexander Creek Streamside Restoration and Community Education

Project Reference Number UKE-F17-F-1264

Prepared for: Fish and Wildlife Compensation Program

FWCP Area: Columbia Region

Project Type: Habitat-Based Action; Ecosystem/Watershed Restoration/Enhancement

Prepared by: Lee-Anne Walker, Elk River Watershed Alliance www.elkriveralliance.ca

Prepared with financial support of the Fish and Wildlife Compensation Program on behalf of its program partners BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and public stakeholders.

Date: 31-03-2017

Executive Summary

Stream habitat restoration and community education were the two primary goals of the Elk River Alliance's *Alexander Creek Streamside Restoration and Community Education* project. After four years of community-based water monitoring on Alexander Creek, the Elk River Alliance (ERA) identified a section of Alexander Creek's bank as a priority area in need of slope stabilization. The 50-metre long by 3-metre high site was void of riparian vegetation as a result of anthropogenic disturbance, was much less stable than other reaches of the creek and provided little habitat value for terrestrial and aquatic wildlife.

In the fall of 2016, volunteers removed refuse from around the project site and planted 41 native riparian shrubs and trees on a 20-meter section of Alexander Creek's riverbank. Volunteers also harvested, bundled and soaked 600 live cuttings of dormant willows, dogwoods and cottonwood trees in preparation for the upcoming bioengineering work on a bank adjacent to the newly planted area.

While volunteers were harvesting live cuttings, the preliminary bioengineering installation placed footer logs in an excavated trench running parallel to the creek to stabilize the toe of the slope and to prevent undercutting of the bank. Trenches angled downstream were excavated for the placement of rootwads with boles attached. The boles were laid down with the rootwad resting on the footer logs, secured with boulders and then backfilled. Two benches were excavated across the length of the slope above the rootwads to install brush layers of live cuttings. Soil amendments were added to the live cuttings to boost their survival rate and coir matting was installed between the brush layers to prevent surface erosion and add integrity to the slope. The newly disturbed soil was seeded with a desirable native grass mixture and a rodent fence installed to protect the brush layers.

In the spring of 2017, an interpretive kiosk with two signs was installed just west of the Sparwood Gun Range site, which is only open to members. By placing the kiosk at just after the turnoff of Highway 3 up Alexander Creek Road, it reaches hunters, walk-and-wade fishers, and recreationalists using the area. ERA's community outreach for the project included newspaper articles, social media posts, presentations to community interest groups and the installation of interpretive signs near the project location.

This project was managed and delivered by the Elk River Watershed Alliance (ERA) with financial support from the Fish and Wildlife Compensation Program, Columbia Basin Trust, Recreational Fisheries Conservation Partnerships Program, Teck, Canfor, Sparwood and District Fish and Wildlife Association. The ERA wishes to acknowledge volunteers from ERA, Wildsight Elk Valley Branch and Sparwood Fish and Wildlife Association for their efforts and contributions to this project.

Table of Contents

List of Figures

List of Tables

1.0 Introduction

1.1 Organization Background

The Elk River Watershed Alliance (operating as Elk River Alliance or ERA) is a community-based water group that aims to connect people to the Elk River ensuring it is drinkable, fishable and swimmable for future generations. ERA's vision is a watershed where well-managed human activities result in healthy ecosystems and a robust economy. To realize this vision, ERA aims to 1) raise community awareness and understanding about our watershed; 2) facilitate community dialogue and engagement to better inform sustainable water decision-making; 3) monitor aquatic health in order to prioritize our collective effort in activities that steward, enhance and restore aquatic ecosystems; and 4) Promote safe and sustainable recreational use of the Elk River watershed.

The Elk River Alliance was fortunate to have a highly qualified, professional team for the Alexander Creek Streamside Restoration and Community Education project with many years of cumulative experience, all of which were integral to the project’s success. Executive Director, Lee-Anne Walker, with an MA Environment and Management from Royal Road University (2009), wrote her thesis on community based water governance and has been a professional environmental educator since 1981. Marsha Clarke, Restoration and Stewardship Project Manager, with a diploma in Environmental Assessment and Restoration from Lethbridge College (2014), worked as a reclamation technician on various bioengineering projects between 2005 and 2014 for Terra Erosion Control. Beth Millions, Environmental Program Coordinator, with an MSc in Environmental Science from the University of Lethbridge (2015) has developed and coordinated multiple environmental projects as part of her thesis and in her working career. Ayla Bennett, Water Monitoring and Education Program Manager, with a Bachelor of Science from the University of Calgary (2011), has been collecting water quality data on Alexander Creek since 2012, and played a vital role in identifying the restoration site. Mike Robinson (M. Sc., R.P. Bio) from Lotic Environmental has worked in the field of aquatic sciences for over ten years. Tegan Arnett (B. Sc., R.P. Bio), also with Lotic Environmental, has worked within the field of aquatic sciences since 2005.

1.2 Project Background

The ERA's community-based water monitoring program has been collecting baseline data on water quality and habitat health on Alexander Creek since 2012. The scientific protocols ERA uses include Streamkeepers, Sensitive Habitat Inventory Monitoring (SHIM) and Canadian Aquatic Biomonitoring Network (CABIN) protocols, twice a year during high flow (June) and low flow (between September and November). ERA has been collecting water quality data monthly between April and October in 2015 and 2016 with support from the Columbia Basin Water Quality Monitoring Network and follows a modified CABIN protocol.

Through ERA's monitoring efforts, a 50-meter section of eroding creek bank near the Sparwood & District Fish and Wildlife Association shooting range was identified as a potential restoration project site. The riparian zone provided little ecological function because the streambank was denuded of vegetation when the road to the nearby gun range was built. As stewards of the Elk River watershed, ERA proposed a plan to reclaim this site to achieve a healthy riparian ecosystem. ERA's vision was to use bioengineering techniques to stabilize the bank and re-vegetate the slope with native shrubs and trees resulting in erosion protection and habitat creation. Additionally, a site clean-up was planned to remove refuse, some of which was left behind long ago by an abandoned historic logging camp. As part of the Alexander Creek Restoration and Community Education project, ERA organized two volunteer events to engage local citizens who were interested in learning about bioengineering techniques and water stewardship. ERA also captivated the public's interest through various outreach portals including presentations for the Association of Professional Engineers and Geoscientists regional annual general meeting and Teck's Community of Interest partners, hosting a 2-day bioengineering workshop **(Figure 1)**, articles in the Free Press **(Appendix A)** and various social media posts.

Figure 1: Bioengineering workshop hosted by ERA at the College of the Rockies with Pierre Raymond of Terra Erosion Control in Spring 2016

This project is in alignment with the Upper Kootenay Ecosystem Enhancement Plan (UKEEP) for streams. UKEEP is a joint enhancement plan developed by the Columbia Basin Trust and Fish and Wildlife Compensation Program to help conserve, restore and enhance fish and wildlife by focusing on their habitats. The Elk River is identified in the plan as being a priority for action, and Alexander Creek is a major tributary to the Elk River. The two primary objectives of UKEEP for stream actions that this project aligns with are conserving productivity and diversity of stream ecosystems, and restoring and enhancing stream habitat and populations of Species of Interest, such as the Westslope cutthroat trout and bull trout.

2.0 Goals and Objectives

The primary goals of this project were to: stabilize and restore a 50-metre section of Alexander Creek's bank using bioengineering techniques with native riparian vegetation, and; educate the community on the importance of habitat restoration. Additional goals included removing refuse from around the work site and installing an interpretive kiosk to educate the public about ERA's watershed stewardship actions and particular volunteer opportunities. The specific objectives of this project were creek bank stability, erosion control, terrestrial and aquatic habitat improvement, increased biodiversity and increased awareness of anthropogenic impacts on water quality and aquatic health.

3.0 Study Area

The project site is located 0.21 kilometers 93° east (upstream) of the Highway 3 crossing of Alexander Creek near the Sparwood and District Fish and Wildlife Association shooting range. The latitude is 49.654871 and the longitude is -114.730320 **(Figures 2 & 3)**.

Figure 2: General area map of project site in relation to Corbin Road, Highway 3 and Summit Lake

Figure 3: Specific location map showing aerial view of the project site

Alexander Creek is a tributary of Michel Creek, which joins the Elk River in Sparwood. A fourth order stream, it flows west from the Continental Divide of the Rocky Mountains through the Montane Spruce biogeoclimatic zone (British Columbia Ministry of Forests, Lands and Natural Resource Operations, 2009). Upstream logging, cattle grazing and public motorized vehicle access along the forestry road impact the Alexander Creek watershed. Coal mining is proposed upstream.

4.0 Methods

4.1 Preliminary Work

A Change Approval and Notification (i.e. *Changes In and About a Stream*) application was submitted to the Government of British Columbia. ERA contacted the Archaeology Branch to gain access to the Remote Access to Archaeological Data Map, ensuring the excavation would not threaten any known archaeological sites. A BC One call was made in October to ensure the excavation area was clear of interference with underground facilities. ERA contractors devised a safety plan compete with a toolbox meeting form which addressed all potential safety concerns **(Appendix C)**. As the project took place on private land, ERA gained permission from the landowner, Teck and also the land occupants, Sparwood and District Fish and Wildlife Association, since they frequent the land to access their shooting range.

Throughout the summer, connections were made with Teck and Canfor to arrange for the acquisition of materials essential to the bank stabilization and fish habitat creation. Teck's donation of boulders and Canfor's donation of rootwad revetments and footer logs greatly reduced overall project costs to ERA. Teck hauled the rocks to the edge of their property but ERA was responsible for transporting the material to the site. Canfor was logging up Alexander Creek and arranged for the delivery of the rootwad revetments as part of their in-kind contribution to the project.

4.2 Baseline Assessment

On September 15th 2016, riparian health assessments, vegetation inventories, slope measurements and photo reference points were collected and recorded at the project site as a baseline assessment of the pre-project environmental conditions **(Figure 4)**. This baseline study provides ERA with a benchmark for future monitoring so changes in vegetation can be identified. A riparian health assessment was also completed nearby at an area representative of Alexander Creek's naturally occurring riparian conditions to be used for comparison **(Figure 5)**.

Figure 4: Biologists completing vegetation inventory along line transects

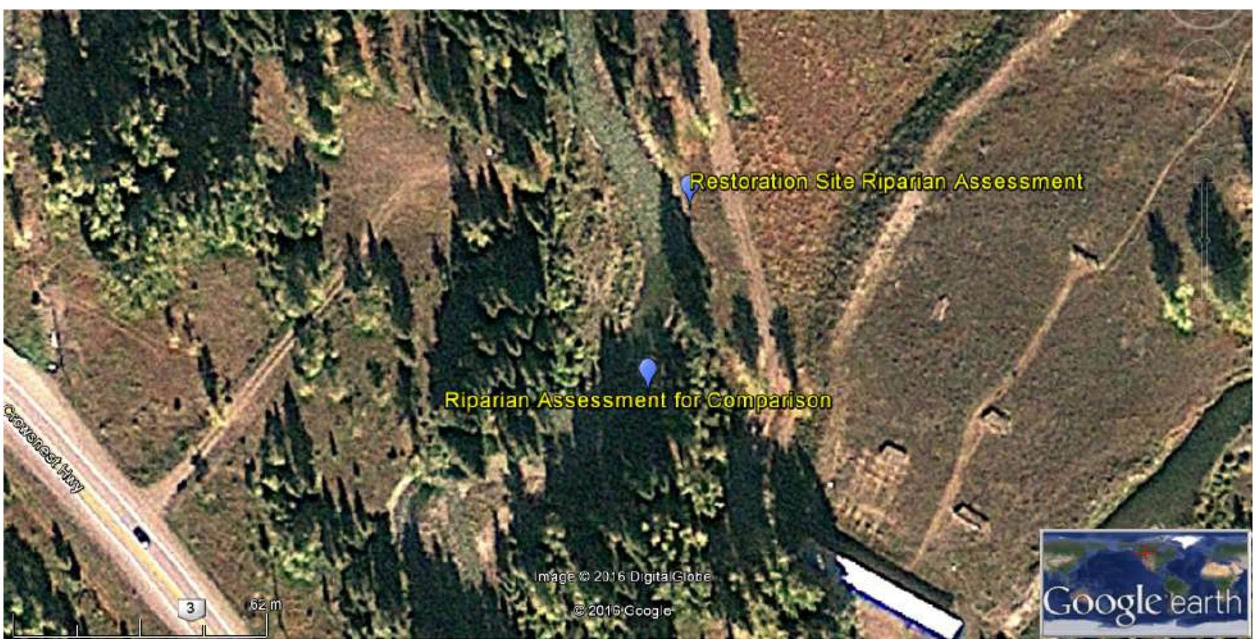

Figure 5: Site map showing riparian assessment locations

The riparian health assessment was done in accordance with the Riparian Health Assessment for Streams and Small Rivers developed by Cows and Fish (Fitch, Adams & Hale, 2009). The following aspects of riparian health were scored: vegetative cover of the floodplain and stream bank; invasive plant species canopy cover, density and distribution; disturbance-increaser undesirable herbaceous species; preferred trees and shrubs for browse and preferred trees and shrubs for use other than browse; standing decadent and dead woody material; streambank root mass protection; human caused bare ground; streambank alteration by human activity; reach structure alteration by human activity and stream channel incisement. Another riparian health assessment was completed 50 meters upstream of the restoration site for the purpose of comparing data. This spot was chosen because it is representative of more natural riparian ecosystems along Alexander Creek.

Three equidistant transects were marked in eight meter intervals along the top of the eroded slope running parallel to the river **(Figure 6)**. The line transects extended ten meters and ran perpendicular to the top of the bank. The first monitoring location is at latitude 49°39’17.6” N longitude 114°43’48.9”W. It is the monitoring point farthest upstream and is labeled “A” on the monitoring site map. The 10 meter line transect extended out from this point 69° northeast. The second point of reference, labeled “B”, is at latitude 49°39’17.8”N longitude 114°43’48.9”W. The line transect extended 77° northeast for 10 meters. Point C, the farthest point downstream, is at latitude 49°39’18.0”N longitude 114°43’49.0”W. The 10 meter line transect extended 62° northeast. Each individual plant touching the line was recorded. Three GPS coordinates were recorded at the west end of each transect as well as the degree in which the transect extends **(Figure 7)**. A photo was taken at each of the three points as a baseline for future monitoring. Also for future vegetative comparison, two photo reference points (PRP’s) were recorded. The first is at 49°39’18.3”N 114°43’49.2”W and the second PRP is at 49°39’17.4”N 114°43’48.8”W **(Figure 6)**.

Figure 6: Monitoring site map showing points A, B & C and photo reference points 1 & 2

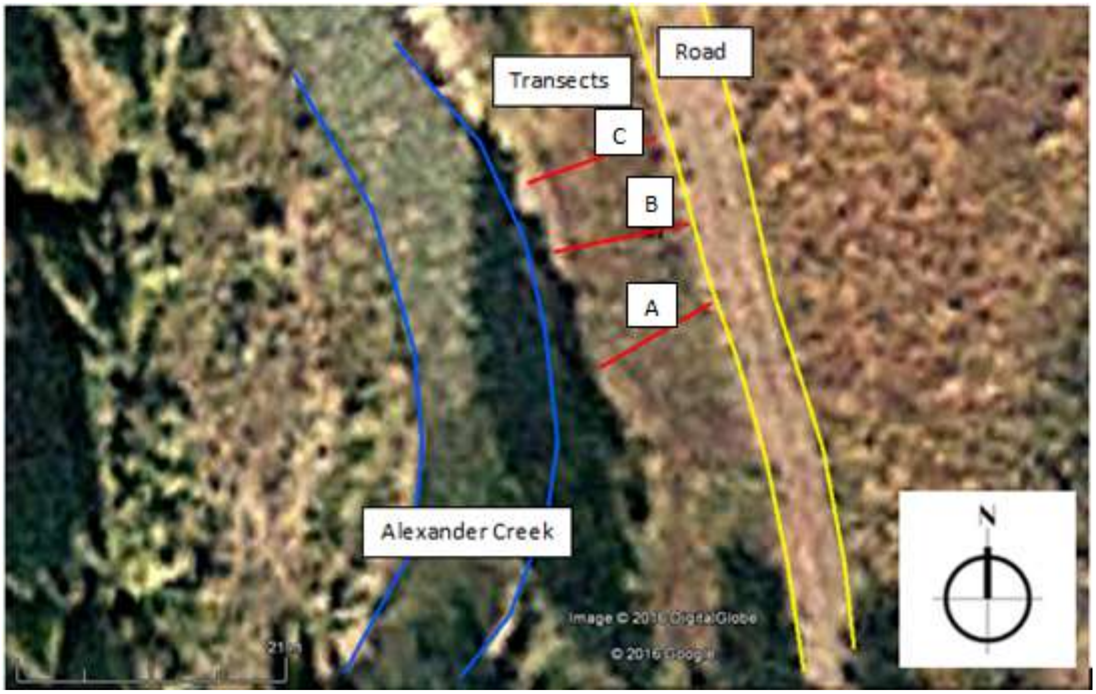

Figure 7: Location of monitoring transects in relation to the road to the SDFWA gun range and Alexander Creek

4.3 Streambank Stabilization and Enhancement

Lotic Environmental and ERA visited Alexander Creek on April 18, 2016 to determine a proposal for the bank stabilization and the addition of creek-side large woody debris. Lotic Environmental completed the design memorandum, which was the foundation for the bank stabilization activities that followed **(Appendix B)**.

The first stage of the plan involved recruiting volunteers for a site clean-up and to plant native vegetation; this occurred on October 22, 2016. A 20 m by 3 m section of the streambank was eroding into the stream but had a large mature tree nearby. As such, it was decided not to rework the slope of the bank in that location as it would disrupt the tree and potentially disturb the only mature vegetation currently stabilizing the slope. As such, native vegetation between one and five years of age was planted along the slope **(Figures 8 and 9)** and will, over time, take root and stabilize the slope. Soil, fertilizer, mycorrhizae and organic fertilizer were added to the roots of the plants and they were watered generously.

Figure 8: Volunteers collecting refuse and planting native riparian vegetation

Figure 9: Volunteers planting riparian plants on creek bank

The second stage involved reconstructing the 30 m by 3 m section of eroded bank upstream of the initial 20 m stretch. This was done to reduce the slope and involved bioengineering techniques that would stabilize the streambank. Prior to construction a siltation fence was installed along the shoreline to mitigate the addition of sediment to Alexander Creek from the construction activities (visible in **Figure 10**).

November 7, 2016 was the first day of the construction activities. Down to Earth Excavating was hired to place the rootwads, boulders and footer logs as well as dig the benches for the brush layer installment. A trench was dug to enable the placement of two 10 m footer logs at the toe of the slope **(Figure 10)**. Trenches were dug into the bank for the rootwad revetments which were placed on top of the footer logs at 2 meter intervals with the root ends nearest the creek and angled slightly upstream **(Figure 11)**. The rootwad revetments were each secured in place with 3 strategically placed boulders and then backfilled with soil **(Figure 12)**.

Figure 10: Excavator placing footer logs in trench

Figure 11: Excavator placing rootwads

Figure 12: Rootwads secured with boulders above footer logs

While construction was underway on site, seven volunteers participated in a second volunteer event near the Crowsnest Pass. The volunteers harvested 600 live cuttings of cottonwood, Red Osier dogwood and willow **(Figures 13 and 14)**. The branches were removed from the trunk of each cutting, and trunks were kept that had a diameter of less than 10 cm but more than 1.5 cm and a length of 1.2 m. Cuttings were bundled, wrapped in a tarp and placed in Island Lake to soak overnight **(Figure 15)**.

Figure 13: Volunteers harvesting live cuttings

Figure 14: Volunteers with bundles of cuttings

Figure 15: Volunteers about to soak the cuttings in Island Lake

Construction activities continued on November 8, 2016. In preparation for the day's activities, the cuttings were collected from Island Lake before dawn **(Figure 16)** and dipped in a 50% paint and 50% water mix to seal the ends to prevent moisture loss at the exposed tip **(Figure 17)**. A soil amendment was made by mixing peat, sunshine mix bales, Gia Green all-purpose fertilizer, mycorrhizae, humic acid, bone meal and worm castings **(Figure 18)**. Coir matting was cut to length **(Figure 19)**. At as low an elevation as possible, a bench was excavated for the first brush layer **(Figure 20)**. Along with soil amendments, 300 cuttings were placed in a row across the bank **(Figure 21)**. Jute matting was placed above the cuttings and then a layer of soil on top. The jute matting was folded up over the backfill and ran along the bottom of the next row of brush layers to provide structural integrity to the slope. The coir matting over exposed soil will provide soil stability between the brush layers **(Figure 22)**. The addition of another 300 cuttings and soil amendments made up the top brush layer. Soil was placed on top and the remainder of the jute matting tied into the bank above the top brush layer **(Figure 23)**. Of the 600 cuttings installed in the brush layers, 50% were willow, 40% were cottonwood and 10% Red Osier dogwood. The remaining unused footer logs and rootwads were placed above the creek bank near the planted riparian vegetation, which was sprayed with a deer deterrent **(Figure 24)**. A rodent fence was installed to prevent damage to the cuttings **(Figure 25)** and all exposed mineral soil was seeded **(Figure 26)**.

Figure 16: Retrieving cuttings from Island Lake (Alberta border) early in the morning

Figure 17: Dipping the bundles of cuttings into the latex paint solution

Figure 18: Mixing the soil amendments.

Figure 19: Cutting the coir matting to length

Figure 20: Excavated bench for first brush layer

Figure 21: Placing cuttings on the bench

Figure 22: Coir matting securing soil between brush layers

Figure 23: Completed bank stabilization and slope re-contouring

Figure 24: Deer repellent was sprayed on planted vegetation

Figure 25: Rodent fence installation

Figure 26: Grass seed was spread over disturbed soil

4.4 Education and Outreach

ERA developed an interpretive plan for watershed-wide community outreach and education. For the interpretive signs, a graphic designer was hired to write the sign text and design the layout. The content includes Alexander Creek water quality data collected by ERA, which provides rationale for the restoration activities as well as threats and challenges to water quality and stream ecosystems. A local contractor was hired to build the kiosk and the Sparwood and District Fish and Wildlife Association will install the interpretive signs in the spring of 2017. Other public outreach activities included a bioengineering workshop, project updates on ERA's Facebook page and website, a submitted article in the Free Press, and presentations to the Teck Community of Interest partners and the Association of Professional Engineers and Geoscientists.

5.0 Results and Outcomes

5.1 Streambank Enhancement Results

Nine volunteers were engaged in the first volunteer event on October 22, 2016. From this event three truckloads of garbage and large metal pieces were removed from the project area **(Figure 27)**. Volunteers also planted 5 Prickly rose (*Rosa acicularis*), 5 Wood's rose (*Rosa woodsia*), 5 Saskatoons (*Amelanchier alnifolia*), 5 Chokecherry (*Prunus virginiana*), 4 Wolf willow (*Eleagnus commutate*), 4 Trembling aspen (*Populus tremuloides*), 2 Water birch (Betula oxxidentalis), 4 Red Osier dogwood (Cornus stolonifera), 5 Balsam poplar (*Populus balsamifera*) and 2 willows species (*Salix*). This vegetation was used to restore a 20 m by 3 m section of eroding streambank **(Figure 28)**.

Figure 27: Some of the 2 truckloads of trash removed from the project site by volunteers.

Figure 28: Volunteers prepare native vegetation to be planted along 20 m of eroded slope

Seven volunteers participated in the second volunteer event on November 7, 2016. The volunteers harvested a total of 600 live cuttings of cottonwood, Red Osier dogwood and willow.

The 600 cuttings were then used to create 2 brush layers to stabilize the streambank. Two footer logs, nine rootwads and a total of 27 large rocks a minimum of 1 m^2 were further used to reinforce the streambank. This will restore a 30 m by 3 m area of eroded streambank **(Figure 29).**

Figure 29: Completed streambank stabilization project a restoring 30 m stretch of eroded bank

5.2 Baseline Assessment Results

The vegetation inventory revealed nine plant species **(Table 1 & Figure 30)**: four in transect A **(Figure 31)**, five in transect B **(Figure 32)** and four in transect C **(Figure 33)**. Of the nine species, the following three are listed as either noxious or invasive by the Invasive Species Council of BC (Invasive Species Council of British Columbia [ISCBC], 2014): spotted knapweed is defined as provincially noxious, oxeye daisy is defined as regionally noxious, and Goatsbeard is an unregulated invasive plant of concern (ISCBC, 2014). The creek bank slope below point A was 82°, the creek bank slope below point B was 55° and the slope of the bank below point C was 48°. Smooth brome, an exotic species (Electronic Atlas of the Flora of British Columbia [EAFBC], 2013) was the most abundant grass and made up about 66% of the total vegetation inventory. Kentucky bluegrass, also an exotic species (EAFBC, 2013) makes up about 16% of the vegetation. Yellow salsify, common mullein, alfalfa, oxeye daisy, and spotted knapweed are all exotic (EAFBC, 2013) and made up another 15% of the vegetation. Prairie pepper-grass and Prairie rose, the two native species (EAFBC, 2013) found on site make up the remaining 3% of the inventoried vegetation. A total of nine species of plants were recorded, 97% of which were exotic species and 3% of which were native. Photos were taken for the PRP's at either end of the restoration site looking in **(Figures 34 & 35)**.

Table 1: Vegetation types found along three transects pre-restoration

Plant		Transect			Total
Scientific Name	**Common Name**	**A**	**B**	**C**	
Verbascum thapsus	Common mullein	1			1
Bromus inermis	Smooth brome	61		20	81
Poa pratensis	Kentucky bluegrass	2		18	20
Tragopogon dubius	Yellow salsify	2			2
Medicago sativa	Alfalfa		1		1
Chrysanthemum leucanthemum	Oxeye daisy		5	1	6
Centaurea stoebe	Spotted knapweed		2	6	8
Lepidium densiflorum	Prairie pepper grass		3		3
Rosa woodsii	Prairie rose		1		1

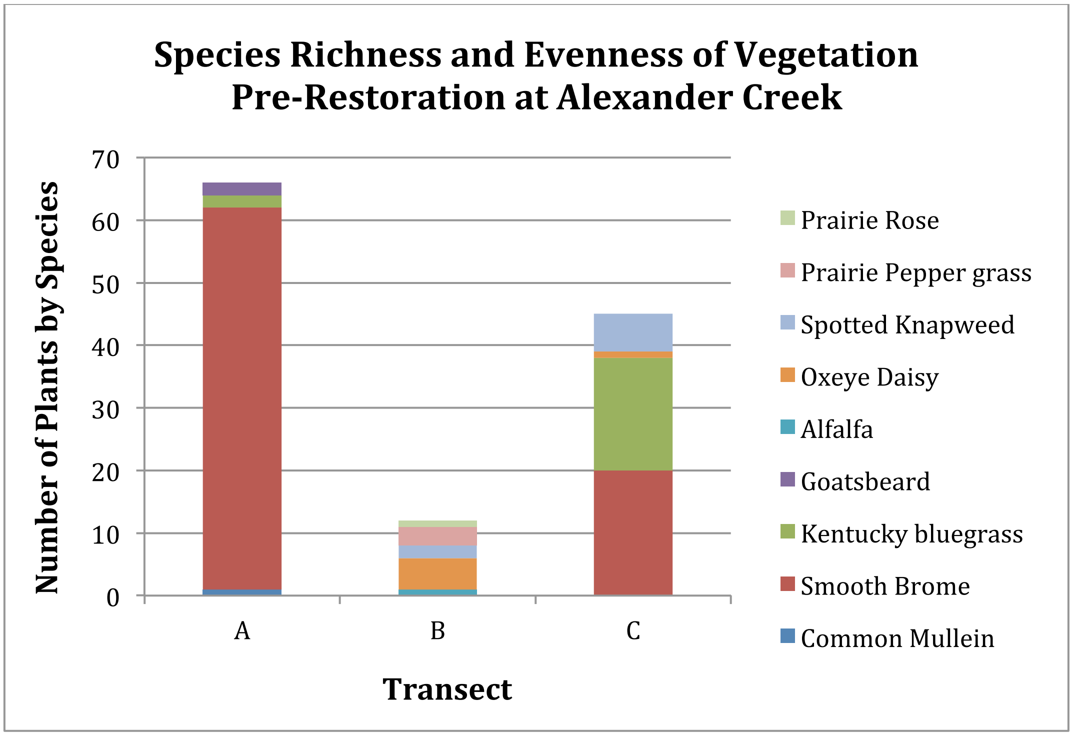

Figure 30: Column chart showing species distribution along three transects pre-restoration


Figure 31: Birds eye view of vegetation at monitoring point A

Figure 32: Birds eye view of vegetation at monitoring point B

Figure 33: Birds eye view of vegetation at monitoring site C

.

Figure 34: Photo reference point 1 before prescription

Figure 35: Photo reference point 2 before prescription

Results from the riparian health assessment for the restoration site landed in the *unhealthy* category with a score of 11%. The vegetative cover of the riparian area was very sparse with mostly cobbles and sand **(Figure 36)**. Undesirable species present included spotted knapweed, oxeye daisy and common mullein **(Figure 37)**. There was no tree or shrub establishment. There were decadent forbs and grass, but no dead woody material. There was no streambank root mass protection and the bank was heavily eroding. Structural alterations by human activity include levelling and the removal of riparian vegetation due to the construction of a nearby road.

The riparian assessment of a more natural section of creek bank, which was done for comparison, scored 65%, which indicates the site is *healthy with problems*. The vegetative cover was 80% and there were a few sporadically occurring individual invasive plants: Timothy grass, common mullein and oxeye daisy. The preferred tree and shrub establishment was mostly mature willow and alder, both of which had been slightly browsed. The standing decadent and dead woody material was evenly distributed and the streambank had bare mineral soil exposed with 50% root mass protection. Less than 1% of the study area showed signs of alteration by human activity. The stream channel showed minimal channel incisement.

Figure 36: Lack of creek-side vegetation noted during riparian assessment prior to prescription

Figure 37: Undesirable vegetative species recorded during riparian assessment

6.0 Discussion

By incorporating bio-technical slope stabilization techniques, the restoration work accomplished at Alexander Creek will enhance the surrounding aquatic and terrestrial habitat as the cuttings grow and mature. Riparian vegetation increases natural biodiversity providing food and habitat for microorganisms and animals. As the new vegetation establishes, organic matter will accumulate, adding nutrients to the soil and substrate to the river from which aquatic organisms will benefit. Riparian vegetation further benefits fish by creating shade to maintain cool water temperatures.

The rootwad revetments anchored to the shore will result in a more complex flow of pools and riffles and may stabilize critical spawning gravel beds. Large woody debris traps and collects organic matter and encourages the growth of periphyton providing food for aquatic insects and invertebrates as well as slows the velocity and therefore encourages a pool-riffle sequence (Fitch et al. 2009).

Live cuttings collected in a dormant stage retain a large reserve of carbohydrates to supply new growth. This enables the cuttings to produce generous vegetation quickly during the active growth period. Within the first year, invertebrates will benefit from the new leaf litter from the brush layers and the riverbank will become more stable as the root mass develops. The new vegetative growth will create food, cover and breeding areas for small mammals, birds, amphibians and invertebrates. Red-osier dogwood has a high browse value for ungulates and creates thickets for wildlife including squirrels, butterflies, birds, butterfly larvae and bees. Willows are also browsed by large and small mammals and used as shelter by many birds. Cottonwood trees can grow up to 6 feet/year, which will contribute to landscape connectivity. By planting brush layers with cottonwood cuttings that will grow into mature trees, this project will increase the numbers of cottonwood ecosystems in southeastern BC, an ecosystem identified by the BC Ministry of Environment, Lands and Parks as endangered (Egan, Cadrin & Cannings, 1997).

This project will increase the health and populations of blue listed Westslope cutthroat, bull trout, great blue heron, and grizzly bear as well as benefit many other vulnerable species that depend on riparian ecosystems. The ecosystem, over time, will function more like it did historically as nature takes its role in the recovery process. With new riparian habitat, aquifers will recharge, flow energy will dissipate, future flood damage will be reduced, water quality will improve and biodiversity will return. This restoration project will mitigate some of the linear disturbance and fragmentation that has occurred in the Alexander Creek watershed.

Engaging community volunteers in the Alexander Creek restoration project enabled participants to gain awareness of the threats and challenges to water quality and stream ecosystems. ERA's public outreach will extend to travelers and anglers through the installation of interpretive signs in a kiosk that educate residents and visitors about the current condition of Alexander Creek by interpreting community-based water quality data collected by ERA between 2012-2016. By sharing this information, we expect community members will better understand the importance of the restoration project and will be more inclined to participate in the on-going stewardship of Alexander Creek. Community-based water monitoring guided by the ERA at high and low flows on Alexander Creek increases citizen water literacy and motivates the public to protect and restore aquatic habitat while participating in sustainable watershed management decisions. These actions promote healthy river ecosystems benefiting fish and wildlife for years to come. Additional public communications include posts on the ERA website and Facebook page, submitted articles to the Free Press **(Appendix A)**, and information shared through presentations with the Teck Community of Interest and at working group meetings of the Elk Valley Cumulative Effects Management Framework (CEMF).

7.0 Recommendations

This project received substantial interest and support from volunteers as they enjoyed learning about bioengineering techniques while contributing to a meaningful, local watershed enhancement project. This information may be helpful to other organizations planning a bioengineering project as substantial savings can be made from accepting volunteer labour. It was also a great opportunity to build ERA's relationship with the Sparwood Fish and Wildlife Association who lease the site from Teck for their gun range and partnered with the implementation of the project.

Continued monitoring of the project will help to identify potential issues early on. Before the native grass seed has had a chance to establish, the exposed soil will be vulnerable to spring rains and splash erosion. For this reason, reseeding in spring is recommended. The rodent fence should be inspected to ensure it remains secure around the cuttings. Planting more riparian vegetation in spring is recommended to ensure maximum growth and stabilization. Future monitoring is critical to evaluate whether the project goals are being met. For similar future projects it may be helpful to apply for a seed grant to better determine the project costs including those associated with obtaining permits and archaeological assessments.

8.0 Acknowledgements

This project was managed and delivered by the Elk River Watershed Alliance (ERA) with financial support from the Fish and Wildlife Compensation Program, Columbia Basin Trust, Recreational Fisheries Conservation Partnerships Program, Teck, Canfor, Sparwood and District Fish and Wildlife Association. The ERA wishes to acknowledge volunteers from ERA, Wildsight Elk Valley Branch and Sparwood Fish and Wildlife Association for their efforts and contributions to this project.

9.0 References

British Columbia Ministry of Forests, Lands and Natural Resource Operations. Research Branch. (2009). *Ecosystems of British Columbia:Biogeoclimatic ecosystem classification program*. Retrieved from https://www.for.gov.bc.ca/hre/becweb/resources/classificationreports/provincial/index.html

Egan, B., Cadrin, C., & Cannings, S. (1997). *Cottonwood riparian ecosystems of the southern interior.* Retrieved from http://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/species-ecosystems-at-risk/brochures/cottonwood_riparian_ecosystems_southern_interior.pdf

Electronic Atlas of the Flora of British Columbia. (2013). *Search for species pages*. Retrieved from http://ibis.geog.ubc.ca/biodiversity/eflora/

Fitch, L., Adams B.W., & Hale, G. (2009). *Caring for the Green Zone: Riparian assessment for streams and small rivers* (2nd ed.). Lethbridge, AB: Cows and Fish Program.

Invasive Species Council of British Columbia. (2014). *List of regulated plants in BC*. Retrieved from http://bcinvasives.ca/invasive-species/about/regulated-invasive-species-in-bc/list-of-regulated-invasive-plants-in-bc

Appendix A

Volunteers stabilize stream banks

Submitted

The weather might have been cool and wet this fall, but that didn't stop the Elk River Alliance and their amazing volunteers from joining forces to work on a couple of stream bank restoration projects. Thanks to the world of ecological restoration, it is possible to stabilize and rehabilitate an eroded bank by using plants instead of conventional methods, such as riprap. A major benefit of using plants as opposed to conventional bank stabilization methods is that they add to the longterm health of the aquatic ecosystem by providing shelter, habitat and adding nutrients to the stream.

Stream banks can be bioengineered by placing live plant material in the side of the bank and allowing the material to grow. Many plant species, such as willows and cottonwoods, can be grown from cuttings into full, healthy plants.

This means that shoots can be harvested and planted in the fall while they are dormant and then in the spring, when it warms up and the snow melts, they will start to bud and grow roots and shoots. These roots will continue to grow into the eroded soil over the next several years and will stabilize the ground.

Elk River Alliance volunteers help with riparian work.
Submitted photo

This is exactly what volunteers did to help a stream bank on Lizard Creek! The site had failed in 2013 and the ERA had previously banded together with concerned citizens and park users to restore the site. The slope was well on its way to becoming stabilized, but to reduce the erosion that was still occurring they came around for a second pass. More cottonwood and willow cuttings were harvested and planted into the bank between the existing rows. By this time next year, these new cuttings will already be stabilizing the soil.

Another way that stream banks can be stabilized is by planting young plants that will continue to grow in them. This technique is more costly, but can be equally effective if care is taken to give the plants their best shot with lots of water and soil amendments.

At the other stabilization site on Alexander Creek, volunteers removed invasive plants that commonly grow in disturbed areas and then planted native riparian vegetation along the eroding stream bank. Native plant species like cottonwood, trembling aspen, willow, and red osier dogwood were used due to their fast growth rate and aggressive root development. These were planted in an area where a well-established tree already exists, so attempts to stabilize the bank without disturbing the mature tree were taken.

The project will continue further upstream in November where more cuttings will be placed into the soil to stabilize the bank. Volunteers are needed on November 7th to help take these cuttings. Further, root wads and footer logs will be placed in the stream to deflect the water's energy as it comes around the bend. In addition, they will also provide fish habitat in the stream.

ERA would like to thank their amazing sponsors and funders who made these projects possible. They are: Lotic Environmental, Teck, Fish and Wildlife Compensation Program, Sparwood and District Fish and Wildlife Association, Columbia Basin Trust, Recreational Fisheries Conservation Partnerships Program and Canfor.

Anyone interested in learning more about these projects and volunteering on November 7th should message beth@elkriveralliance.ca with their inquiries.

Appendix B

LOTIC ENVIRONMENTAL
SPECIALISTS IN FRESHWATER ECOSYSTEMS

Lotic Environmental Ltd
2193 Mazur Road
Cranbrook BC, V1C 6V9
P. 250.421.7802

Elk River Alliance
PO Box 537
Fernie BC
V0B 1M0

April 22, 2016

Lotic Project #16ERAF01

Attn. Ms. Marsha Clark

Subject: Alexander Creek Bank Stabilization – Design Memorandum

Lotic Environmental Ltd. visited the Alexander Creek site with the Elk River Alliance (ERA) on April 18, 2016 to view a potential bank stabilization project that the ERA was interested in pursuing. The site was located upstream of the Highway 3 crossing of Alexander Creek, near the Sparwood Rod and Gun Club shooting range. The site was an eroding bank on an outside meander of the right downstream bank (Figure 1).

The site showed extensive erosion over 30-40 m in length and a 3 m high bank. The right bank lacked riparian vegetation beyond grasses, which exacerbated the erosion issue. Many invasive weed plant species were also present. Overwidening of the channel was apparent over the length of the site. Because of the previous disturbance in the way of riparian clearing, this site was considered to be an anthropogenic issue resulting in the site not functioning naturally in terms of erosion rates or habitat value. A survey of adjacent, vegetated meander bends supported this claim that the banks of Alexander Creek in this reach are generally more stable than this proposed site.

Figure 1. Downstream view of treatment area.

The recommended rehabilitation objective is to provide temporary bank protection to allow the area enough time to regenerate riparian vegetation in the form of shrubs and trees, thus providing long-term stability. The design concept is to use rootwad revetments to stabilize the toe of slope and use a combination of a vegetated geogrid (i.e., brush layers with coconut coir) and plantings to promote revegetation on the upslope areas. In doing so, a vegetated floodplain bench will be created on the outside bend, further reducing the rates of erosion.

The project would begin by excavating the bank to create a 4 m wide work area at an elevation near water level at the time of construction. Three, 10 m long footer logs will be placed in the alignment of toe of right bank. The footer logs will be placed into an excavated trench such that the top of the log will be flush with the streambed elevation. Footer logs would ideally be cedar or larch and be a minimum 0.5 m diameter at breast height (dbh). Fir are also acceptable. Footer logs would not have any rootwad attached.

Rootwad revetments (tree boles with roots attached) are then placed at approximately 2 m spacing on top of the footer logs (Figure 2). Rootwads are placed with the rootwad on the stream side of the footer log and the boles laid back towards the bank at a 40° angle downstream (i.e., the rootwad is further upstream). Rootwads are approximately 4 m long and are also ideally cedar or larch. Large (1 m^3) rocks are then placed on either side of the rootwad behind the footer log and at the furthest end into the bank. No cable ballasting is proposed. Tree tops can be overlay on the rootwads with the tips directed downstream for habitat complexing. The entire area is then backfilled to the desired floodplain bench elevation. Several areas were noted on Alexander Creek that can be surveyed to determine this elevation.

Figure 2. Example of rootwad and footer log construction before backfilling.

The bank upslope of the floodplain bench will then be resloped to a desired angle. A vegetated geogrid design will be used to install two brush layers with coconut coir jute interwoven between the two layers (Figure 3). Crews will first collect cuttings that are 1 m in length and approximately 1-2 cm in diameter. Live cuttings should be woody plant material often taken from first or second year growth of species that will root from cuttings. Typical native species used for live cuttings that are found in this area are willow and cottonwood. Cuttings are cut and soaked prior to construction.

Geogrid construction begins with an excavator shaping the bank, by pulling the slope back to a more stable angle (1:1.5). Two successive horizontal benches are cut parallel to the stream where cuttings will be set in. Benches are to be spaced 1 m apart, with the first located at the floodplain bench elevation. Coconut jute is placed on the benches. Cuttings are then placed down such that no more than 0.1 m of the cuttings are to be exposed. The jute is folded back over the cuttings and the bench is covered with approximately 0.10 m of topsoil. The jute is the extended up the face of the slope to the next bench, where the process is repeated. The jute is intended to prevent minor surface erosion and to hold soil and seed until grasses establish. Live stakes can be used to hold down the jute and to provide vegetation cover. The entire area is then seeded with an applicable grass seed mix.

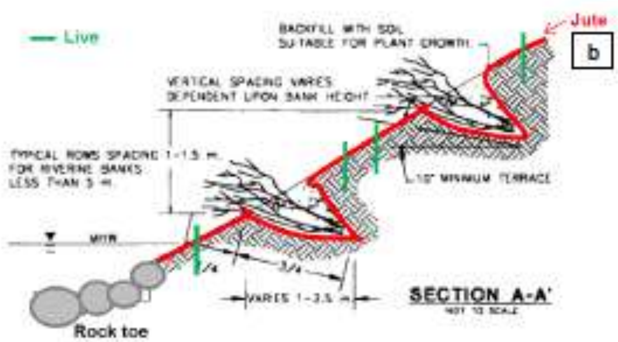

Figure 3. a) Vegetated geogrid under construction; b) Cross-sectional view of vegetated geogrid with rock toe (modified from Slaney and Zaldokas 1997[1]).

[1] Slaney, P.A. and D. Zaldokas. 1997. Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No.9. Ministry of Environment, Lands and Parks and Ministry of Forests. Victoria, BC, Canada.

The design discussed is conceptual at this time and is based on preliminary data collected during the single site visit. Designs and materials estimates will become more refined as further site information is collected. At this stage, the following materials quantities are anticipated:

Quantity	Description
3	10 m footer logs
15	rootwads
45	rock (m^3)
750	cuttings
150	coconut jute (m^2)
25	seed (kg)

The following cost-estimate is based on the design described in this report. It assumes four days for construction time, one excavator and operator for four days, and one construction supervisor for four days. It also assumes the ERA will provide labourers. A 20% contingency was included given the conceptual nature of this design. Cost savings can be realized if rock and wood can be locally sourced and provided to the project free of charge.

Cost	Item
$ 7,050	Bank protection subtotal
$ 1,450	Revegetation subtotal
$ 11,440	Equipment and wages subtotal
$ 19,940	Project subtotal
$ 3,988	20% Contingency
$ 23,928	**Project Total**

We thank you for the opportunity to provide this conceptual design. Please do not hesitate to contact us with any questions.

Sincerely,

Mike Robinson, MSc, RPBio
Senior Aquatic Ecologist