western water
ASSOCIATES
Consultants in Hydrogeology and Water Resources Management

Veg Pro Flood Management Plan
Coldstream Creek in Coldstream, BC

Prepared for:

Veg Pro International

Prepared by:

Western Water Associates Ltd.
106 – 5145 26th St
Vernon, BC
V1T-8G4

October 18, 2018

WWAL Project 18-067-01

western water ASSOCIATES
Consultants in Hydrogeology and Water Resources Management

October 23, 2018

Jonathan Blais
Western Regional Director
Veg Pro International

Via Phone: 250-215-9707
Via Email: jblais@vegpro.com

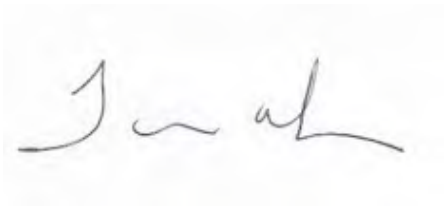
Re: Flood Management Plan for Veg Pro International in Coldstream, BC

Western Water Associates Ltd. (WWAL) is pleased to provide this Flood Management Plan (FMP) to support Section 11 *Water Sustainability Act* Approval and Notification applications to allow for flood management solutions to be implemented at the Veg Pro International location in Coldstream, BC.

Please address any questions about the following FMP to the undersigned,

WESTERN WATER ASSOCIATES LTD.

Gina Le Bel B.Sc. B.I.T.
Junior Biologist



Reviewed by

Trina Koch B.Sc. R.P.Bio.
Senior Biologist, partner.

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1. BACKGROUND

Veg Pro International (Veg Pro) has retained Western Water Associates Ltd. (WWAL), to complete a Flood Management Plan (FMP) to support development of permanent flood management infrastructure at their location in Coldstream, BC (Figure 1). Works will include installation of new berms, repairs to existing berms, and the removal of select downed pacific willow (*Salix lucida*) debris jams and concrete debris in Coldstream Creek.

This FMP supports two *Water Sustainability Act* (WSA) Section 11 Applications, one Notification and one Approval, for the installation and repair of berms and removal of pacific willow tree debris jams. Figures are attached as Appendix A, Photographs as Appendix B, Engineering Design Plans as Appendix C and Silt Curtain and Silt Fence Detail as Appendix D.

1.1 Stakeholder Kick-off Meeting

Those who were interested in contributing to the FMP were invited to a kick off meeting on June 20, 2018 at the WWAL office. The attendees were Jonathan Blais of Veg Pro, Michael Baker and Mike Reiley of the District of Coldstream, Ted Osborn of Coldstream Ranch, Renee Clark and Keiko Parker of the Regional District of North Okanagan (RDNO), Alan Bates of Streamworks, Gina Le Bel and Trina Koch of WWAL, and Lee Hesketh of the Farmland-Riparian Interface Stewardship Program. While viewing drone footage, taken by Mr. Blais, the group discussed the flood problems from the spring of 2018 and contributed suggestions for possible infrastructure solutions on the Veg Pro site. Suggestions included settling basins, a man-made wetland, the addition of a flap gate to the railway culvert, grading the fields to encourage downward flow, berms and ditches, and increasing the culvert capacity at Highway 6 and under Ricardo Road. The group agreed on next steps for the project which included contacting the CN railway, the completion of a field visit by Gina, Trina and Alan, the collection of historical flow data for the creek, contacting Alastair from the RDNO for LIDAR mapping, and investigation into funding from the Environmental Farm Plan.

1.2 Meeting with CN Railway Contact

Mark Bergey of CN railway met with Jonathan Blais on site at Veg Pro on June 27, 2018. Mark emphasized the 75-foot (~23 m) right of way on both the north and south sides of the rail line and that any works done within the easement can be adjusted or removed by the railway if the infrastructure does not suit their purposes. The hydrologist from CN wants to keep water away from the track. Mark also communicated interest in having a CN representative present in the field during works. CN agreed to share the easement boundaries along Veg Pro property to assist Veg Pro as they move forward with their FMP.

2. REGULATORY REQUIREMENTS

The following regulatory requirements have been considered in the development of this flood management plan:

- *B.C. Environmental Management Act*
- *Spill Reporting Regulation*
- *B.C. Fish Protection Act*
- *B.C. Water Sustainability Act*

- *B.C. Wildlife Act*
- *BC Weed Control Act*
- *Canada Fisheries Act (Riparian Area Regulation)*
- *Canada Migratory Birds Convention Act*
- *Canada Species at Risk Act*
- *Canada Wildlife Act*

3. ROLES AND RESPONSIBILITIES

This project includes the following agencies and individuals with primary responsibility for delivering services towards the completion of the proposed project:

3.1 Infrastructure Management

Veg Pro International
Jonathan Blais
ph: 250-2159707
e: jblais@vegpro.com

3.2 Engineering of Berms

Streamworks Consulting Inc.
Alan Bates P.Eng.
ph: 250-832-5880
e: streamworks@telus.net

3.3 Environmental Permitting and Monitoring

Western Water Associates Ltd.
Trina Koch R.P.Bio., Senior Biologist, (Lead Qualified Environmental Professional (QEP))
ph: 250-309-2806
e: Trina@westernwater.ca

Gina Le Bel B.I.T., Junior Biologist
Ph: 250-540-0108
e: gina@westernwater.ca

4. BIOPHYSICAL ASSESSMENT

On July 9, 2018, WWAL's Senior Biologist, Trina Koch R.P.Bio., and Junior Biologist, Gina Le Bel B.I.T., completed an assessment of the sections of interest on Coldstream Creek on the Veg Pro property from Ricardo Road to the location where Coldstream Creek crosses to the south side of Highway 6 (Figure 1). On August 24, 2018 Gina Le Bel and Al Bates revisited the site to survey the creek and identify the specific locations for debris removal. Below we provide a summary of our results using information from the site investigation, provincial databases, historical reporting and online mapping applications.

4.1 Coldstream Creek

Coldstream Creek is a significant tributary to Kalamalka Lake and is used for irrigation water, drinking water, and valuable aquatic habitat for aquatic species. It flows south from its headwaters in Silver Star

Provincial Park down through Noble Canyon near Highway 6, west through Lavington and Coldstream before entering Kalamalka Lake. Coldstream Creek is one of the principal tributaries of Kalamalka Lake and forms the eastern segment of the Vernon Creek watershed above the (regulated) Kalamalka Lake outlet. The Coldstream Creek watershed has an area of approximately 20,600 hectares and supplies 80% of the surface water input into Kalamalka Lake below its connection to Wood Lake.

Historical impacts to the creek's water quality include natural erosion, timber harvest, recreation and cattle grazing upstream of Noble Canyon and extensive agriculture and residential development in the valley bottom. Although designated as a Community Watershed upstream of Noble Canyon, use of Coldstream Creek for domestic supply ceased in 1996 after severe storms degraded water quality (MoE 2015).

4.2 Vegetation

The Veg Pro property is located within the Interior Douglas Fir (IDF) biogeoclimatic zone, very dry hot Okanagan (IDF xh1) sub variant (BC Government 2017). The IDF zone is characterized by long hot summers and forests of Douglas fir and Ponderosa pine with dry, relatively open understories.

Riparian species within the proposed works area includes those typical of this zone as well as some invasive species. The riparian area at this location is an endangered ecosystem: black cottonwood – Douglas fir/ common snowberry – red osier dogwood (*Populus trichocarpa – Pseudotsuga menziesii/ Symphoricarpos albus – Cornus*) (MOE 2018c). Many species were documented during the site visits and are listed in Tables 1 and 2.

Table1. Native Vegetation Species Present in the Assessed Area

Common Name	Scientific Name
Blue Wild Rye	*Elymus glaucus*
Black Cottonwood	*Populus trichocarpa*
Common Snowberry	*Symphoricarpos albus*
red Osier Dogwood	*Cornus sericea*
Pacific Willow	*Salix lucida*
Scrub Birch	*Betula nana*
Water Birch	*Betula occidentalis*
Choke Cherries	*Prunus virginiana*
Black Hawthorn	*Crataegus douglasii*
Prickly Rose	*Rosa acicularis*
Saskatoon Berry	*Amelanchier alnifolia*
Common Horsetail	*Equisetum arvense*

Table2. Invasive Vegetation Species Present in the Assessed Area

Common Name	Scientific Name
Canadian Thistle	*Cirsium arvense*
Forget-Me-Not	*Myosotis spp.*
Creeping Buttercup	*Ranunculus repens*
Reed Canary Grass	*Phalaris arundinacea*

Common Name	Scientific Name
Red Clover	*Trifolium pratense*
White Sweet Clover	*Melilotus albus*
Wild Mustard	*Sinapsis arvensis*
Columnar Grass	*Miscanthus spp.*
Common burdock	*Arctium minus*
Chicory	*Cichorium intybus*
Goat's-beard	*Tragopogon dubius*
Bladder campion	*Silene vulgaris*
Woolly mullein	*Verbascum thapsus*
Oxeye daisy	*Leucanthemum vulgare*
Houndstooth	*Cynoglossum officinale*
Nightshade	*Solanum* spp.

Two habitat types were observed during the site visit; cleared grassland habitat, and forested riparian habitat. The grassy, open, unfarmed area is south of the CN rail line and north of the riparian area. It is comprised mostly of varying combinations of grasses and invasive weeds. The ground varies depending on the location from dry to flooded.

The riparian habitat along the creek is typical of the IDF zone as well as consistent with species present in the endangered black cottonwood Douglas fir/ common snowberry – red osier dogwood ecosystem. Tree species composition along the creek was fairly consistent with 50% black cottonwood, 30% pacific willow, 10% black hawthorn and 10% Douglas fir. The riparian area understory consisted of Saskatoon berry, scrub birch, water birch, common snowberry and red osier dogwood. Invasive species represented a minimal percentage of the total vegetation biomass in the riparian area.

4.3 Wildlife

A variety of wildlife have the potential to inhabit the Coldstream Creek worksite. During the site visit a pacific tree frog (*Pseudacris regilla*) and ungulate tracks were observed. Bird calls from a variety of species could also be heard during the visit. The mature black cottonwood and pacific willow have the potential to provide cover for cascade mantled ground squirrel (*Callospermophilus saturatus*), marten (*Martes* sp.), great basin pocket mouse (*Perognathus parvus*), southern red-backed vole (*Myodes gapperi*), fisher (*Martes pennanti*), porcupine (*Erethizon dorsatum*), American badger (*Taxidea taxus*) and browse for larger mammals including coyote (*Canis latrans*), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), and black bear (*Ursus americanus*) (Lloyd et al. 1990).

Seeds and foliage provide food and/or nesting sites for many bird species, such as the black beaked woodpecker (*Picoides arcticus*), blue grouse (*Dendragapus obscurus*), bald eagle (*Haliaeetus leucocephalus*), canyon wren (*Catherpes mexicanus*), and a variety of owls (Lloyd et al. 1990).

The banks on both sides of Coldstream Creek have the potential to provide habitat for tiger salamander (*Ambystoma tigrinum*), painted turtle (*Chrysemys picta*), Ensatina salamander (*Ensatina eschscholtzii*), and big brown bat (*Epesicus fusus*) (Lloyd et al. 1990).

The grassy area on the northern side of Coldstream Creek has the potential to provide hunting grounds for the gopher snake (*Pituophis catenifer*), rubber boa (*Charina bottae*), western rattlesnake (*Crotalus oreganus*), and night snake (*Hypsiglena torquata*). (Lloyd et al. 1990).

4.4 Fish Habitat

WWAL assessed fish habitat using RIC protocol (RIC 1998). Substrate, leaf litter, woody debris, cover and salmonid spawning potential were considered. Creek bed substrate consisted most often of 60% gravel, 10% rounded pebbles (1 cm – 3 cm diameter) and 20% fine, however at some locations larger angular cobble was also present (Photograph 2). Overhanging vegetation with the potential to provide leaf litter and shade during high water is present in the form of black cottonwood, pacific willow, and Douglas fir. Many sections of the assessed creek sections have large rafted, woody debris collected along the creek banks as well as spanning across the creek.

Rainbow trout (*Onchorhynchus mykiss*) and kokanee (*Onchorhynchus nerka)* have been documented within Coldstream Creek (MOE 2018b).

The creek habitat in the assessed section of Coldstream Creek is quality fish habitat, however in 1995 the Ministry of Environment (MOE) identified two barriers to fish flow in Coldstream Creek downstream of the assessed reach (MoE 2018b). A cascade and a dam were identified as barriers to fish flow at the location identified in Figure 2. These barriers make it difficult, if not impossible, for fish to reach the assessed stretch of Coldstream Creek. This information means even though the fish habitat is of good quality in this reach, it is unlikely any fish can reach this area to use it.

4.5 Species at Risk

According to the Conservation Data Centre (CDC) both a species at risk and ecosystem at risk are mapped on Veg Pro property: the species at risk, the red-listed American Badger (*Taxidea taxus*), and the endangered ecosystem Black cottonwood – Douglas-fir/ common snowberry – red osier dogwood (MoE 2018c). Although, not present on Veg Pro's property the following listed species have been mapped less than 10 kms from the site by the CDC: the western screech owl (*Megascops kennicottii*), gopher snake (*Pituophis catenifer*), painted turtle (*Chrysemys picta*) and Swainson's hawk (*Buteo swainsoni*).

Species at risk with the potential to inhabit forested riparian areas on the worksite within the IDF zone, RDNO and Okanagan Shuswap forest district are listed in Table3. These include three red-listed[1] species; Swainson's Hawk, yellow-breasted chat (*Icteria virens*), and barn owl (*Tyto alba*) and fourteen blue-listed species (MoE 2018a). Of the red listed species, one is considered endangered[2] under the Committee on the Status of Endangered Species in Canada (COSEWIC) and under the Species at Risk Act (SARA): the yellow-breasted chat. Of the blue-listed species, the barn swallow (*Hirundo rustica*), Lewis's woodpecker *(Melanerpes lewis*), western rattlesnake (*Crotalus oreganus*), western screech-owl (*Megascops kennicottii macfarlanei*), and gopher snake (*Pituophhis catenifer deserticola*) are considered threatened[2] under

[1] Red-listed: Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation.

[2] Red-listed: Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation. Blue-listed, includes

COSEWIC and SARA. The mature black cottonwood in the riparian habitat have the potential to provide ideal habitat for Swainson's hawk, Lewis woodpecker (*Melanerpes lewis*) and the olive sided flycatcher (*Contopus cooperi*) (MOE 2018c). The dry grass area could provide hunting grounds for the gopher snake and western rattle snake (MoE 2018d).

Table3. Species at Risk with the Potential to Inhabit the Project Site

Scientific Name	English Name	BC List	Class (English)	COSEWIC	SARA
Ardea herodias herodias	Great Blue Heron, *herodias* subspecies	Blue	bird		
Buteo swainsoni	Swainson's Hawk	Red	bird		
Chrysemys picta pop. 2	Painted Turtle - Intermountain - Rocky Mountain Population	Blue	turtle	SC	SC
Contopus cooperi	Olive-sided Flycatcher	Blue	bird	SC	T
Corynorhinus townsendii	Townsend's Big-eared Bat	Blue	mammal		
Crotalus oreganus	Western Rattlesnake	Blue	reptiles	T	T
Gulo gulo luscus	Wolverine, *luscus* subspecies	Blue	mammal	SC	SC
Hirundo rustica	Barn Swallow	Blue	bird	T	T
Icteria virens	Yellow-breasted Chat	Red	bird	E	E
Megascops kennicottii macfarlanei	Western Screech-Owl, *macfarlanei* subspecies	Blue	bird	T	T
Melanerpes lewis	Lewis's Woodpecker	Blue	bird	T	T
Myotis ciliolabrum	Western Small-footed Myotis	Blue	mammal		
Pekania pennanti	Fisher	Blue	mammal		
Pituophis catenifer deserticola	Gopher Snake, *deserticola* subspecies	Blue	reptile	T	T
Plestiodon skiltonianus	Western Skink	Blue	reptile	SC	SC
Tyto alba	Barn Owl	Red	bird	T	T
Ursus arctos	Grizzly Bear	Blue	mammal	SC	SC

5. PROPOSED PROJECT WORKS

Proposed project works include the reparation and installation of berms on both the north and south sides of Coldstream Creek on the subject property and the removal of select debris jams. The works will follow engineering plans from Streamworks for the differing height and width of the berms along each reach as well as follow the guidance for the exact locations for debris removal.

Work on the berms is proposed during low water conditions between October of 2018 and the early Spring of 2019, prior to freshet. The removal of the log jams will occur in the early Spring of 2019 during

any indigenous species or subspecies considered to be of Special Concern. Schedule 1 The Species at Risk Act (SARA) establishes Schedule 1, as the official list of wildlife species at risk. It classifies those species as being either extirpated, endangered, threatened, or a special concern. E-Endangered A wildlife species facing imminent extirpation or extinction. T-Threatened, A species facing imminent extirpation or extinction. SC-Special Concern A species of special concern because of characteristics that make it is particularly sensitive to human activities or natural events.

low water. Engineering Design Plans are attached as Appendix C. Figure 3 provides an overview of proposed berm sections and the exact locations of the debris removal. A description of proposed development in each of these areas is provided below.

5.1 Reparation and Construction of Berms

As indicated in Figure 3 there are sections along Coldstream Creek that have existing berms and areas that will require the construction of new berms. Varying amounts of material will be required along the creek to ensure the berms are tall enough to protect the fields from a 200-year flood with the typical freeboard allowance of 0.3m. Material will be moved by machines and built up as specified in the engineering drawings. The berms will range from 0.5 to 1.5 m tall and will be at a minimum 3 m wide. New material will be placed outside of the treed riparian area for the berms. The amount of material required will depend on the location of each berm. After the completion of the berms a combination of Douglas maple (*Acer glabrum*), balsam poplar (*Populus balsamifera*), and Douglas fir (*Pseudotsuga menziesii*) will be planted along the top of the berms. No riparian vegetation will be removed, and silt fencing will be in place where there is a risk of sediments from the movement of materials entering the creek.

5.2 Pacific Willow and Concrete Debris Jam Removal

Works below the top of bank in Coldstream Creek, at five locations identified in Figure 3, will involve the removal of debris jams consisting of deadfall, downed pacific willow, other human garbage and concrete. Debris Jams 1-4 are comprised of deadfall, pacific willow and garbage. Debris Jam 5 consists of old concrete irrigation infrastructure that has filled with sediment and debris. Due to the damming impact of these debris jams the works will restore proper flow of Coldstream Creek during freshet.

The debris jams are proposed to be removed during low water conditions in early Spring of 2019 and will require the use of machinery in the creek. Debris will only be removed at the identified locations and no critical wildlife trees or endangered trees from the black cottonwood ecosystem will be removed. A silt curtain will be placed downstream of each Debris Jam removal site (Appendix D). An Environmental Monitor (EM) will be onsite during instream works, who will monitor upstream and downstream turbidity. If turbidity increases more than 8 NTU compared to background readings, the EM will direct crew to stop the work, adjust the silt curtain and let sediment settle to within an acceptable turbidity range before commencing. Further environmental mitigation strategies are provided in Section 7.

6. POTENTIAL ENVIRONMENTAL IMPACTS

Overall, birds and fish are most at risk of being impacted by the proposed project works. Potential environmental impacts include the following:

- Destruction of habitat or damage to wildlife, nests or plant species at risk;
- Destruction of habitat used by raptors and migratory birds;
- Sediment, entering the creek resulting in reduced fish habitat (downstream of the fish barrier) and water quality;
- Fuel or other toxic substances from heavy machinery entering the soil or water;
- Destruction or damage to overhanging vegetation that provide shade and leaf litter into the foreshore.

7. ENVIRONMENTAL MITIGATION

Our environmental mitigation strategies comply with *Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia* (MWLAP 2004) and *Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia* (MOE 2013).

Mitigation includes six main categories; Timing and Wildlife Management, Air Quality, Sediment Control, Environmental Monitoring, Spill Response, and Revegetation and Site Restoration.

7.1 Timing and Wildlife Management

Project works are proposed from October 20, 2018 to March 30, 2019. The raptor works window is between August 15 and January 30. The berm construction will be within this window, however the debris removal from Coldstream Creek will be outside the window. Mitigation for works outside the raptor works window will include the completion of a raptor nest survey by the environmental monitor (EM) the day before works begin.

None of the works for this project will be within the fish timing window for Coldstream Creek (August 7 – September 12), however the barriers to fish flow likely mean there will be few to no fish present any time of year. Works in the creek will only occur during very low water conditions in early spring to ensure the impacts to Coldstream Creek's fish habitat are minimal.

All works for this project will be completed within the migratory bird window of August 1 to March 31.

7.2 Air Quality

All machinery and equipment should be in excellent working order and engine air filters should be clean and functioning well. Works should be completed as quickly as possible to reduce the CO_2 emissions.

7.3 Sediment Control

Silt fencing will be placed to isolate the works area during both the berm construction and debris removal phases. Silt fencing will be used to keep sediments from entering the creek during the transport of material and compacting for the berms. Additionally, silt curtains will be used within Coldstream Creek to isolate work areas during the four debris jam removals.

The EM will provide guidance on instream worksite isolation including placement of the silt fencing and fish observation before any activities below the top of bank commence. Upstream and downstream turbidity will be monitored by the EM to ensure the work site is properly isolated. If turbidity increases more than 8 NTU compared to background readings, the EM will direct crew to stop the work, adjust the silt curtain and let sediment settle to within an acceptable turbidity range before commencing. Silt fence and curtain detail is included as Appendix D.

Weather will be monitored throughout the planned work period. Work will not be completed during heavy rain events (more than 5mm/day).

7.4 Environmental Monitoring

A copy of this document and all appropriate plans, drawings and permits will be forwarded to all contractors and be reviewed at a kick off meeting before the project begins.

The EM should be onsite full-time during instream works and monitor regularly during works within the riparian zone. It is Veg Pro's responsibility to inform the EM when instream work is planned.

The EM has authority to modify and/or halt any construction activity if deemed necessary for the protection of fish and wildlife populations or their habitats.

Within 60 days of completion of the project an Environmental Monitoring Report will be submitted to Veg Pro.

7.5 Spill Response

Ensure equipment and machinery are in good operating condition (power washed), free of leaks, excess oil, and grease. No equipment re-fueling, or servicing should be undertaken within 30m of any watercourse or surface water drainage.

Ensure all hydraulic machinery uses environmentally sensitive hydraulic fluids that are non-toxic to aquatic life and that are readily or inherently biodegradable.

Keep a spill containment kit readily accessible onsite in the event of a release of a deleterious substance to the environment. Train onsite staff in its use. Immediately report any spill of a substance that is toxic, polluting, or deleterious to aquatic life should be reported to the Provincial Emergency Program 24-hour phone line at **1-800-663-3456**.

7.6 Revegetation and Site Restoration

Equipment, supplies, debris and all construction materials should be removed from the site once work is complete.

Drought-tolerant, native species have been chosen for the buffers along the new and repaired berm sections to limit the spread of invasive weeds. A combination of Douglas maple, balsam poplar, and Douglas fir will be planted along the new berm.

Planting should occur in the Fall of 2019 and ideally during cool and wet conditions.

7.7 Conclusions

This EMP has utilized onsite observations from May 16, July 9, and August 24, 2018. It summarizes the project, possible impacts, and environmental mitigation to reduce/minimize the potential impacts. Potential impacts to the biophysical features along the reach of Coldstream Creek on Veg Pro's property will be minimized if mitigation strategies in Section 7 are followed.

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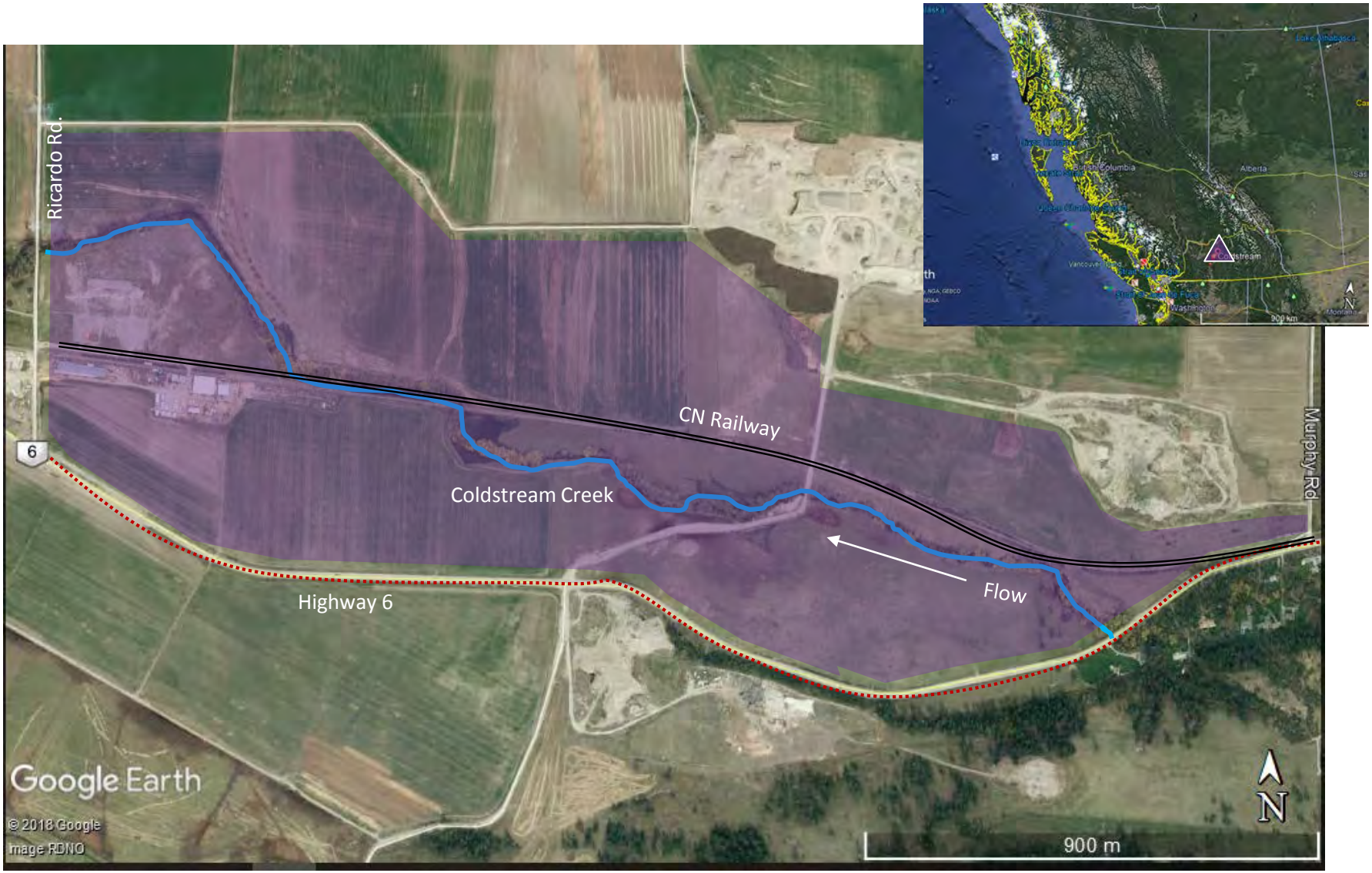
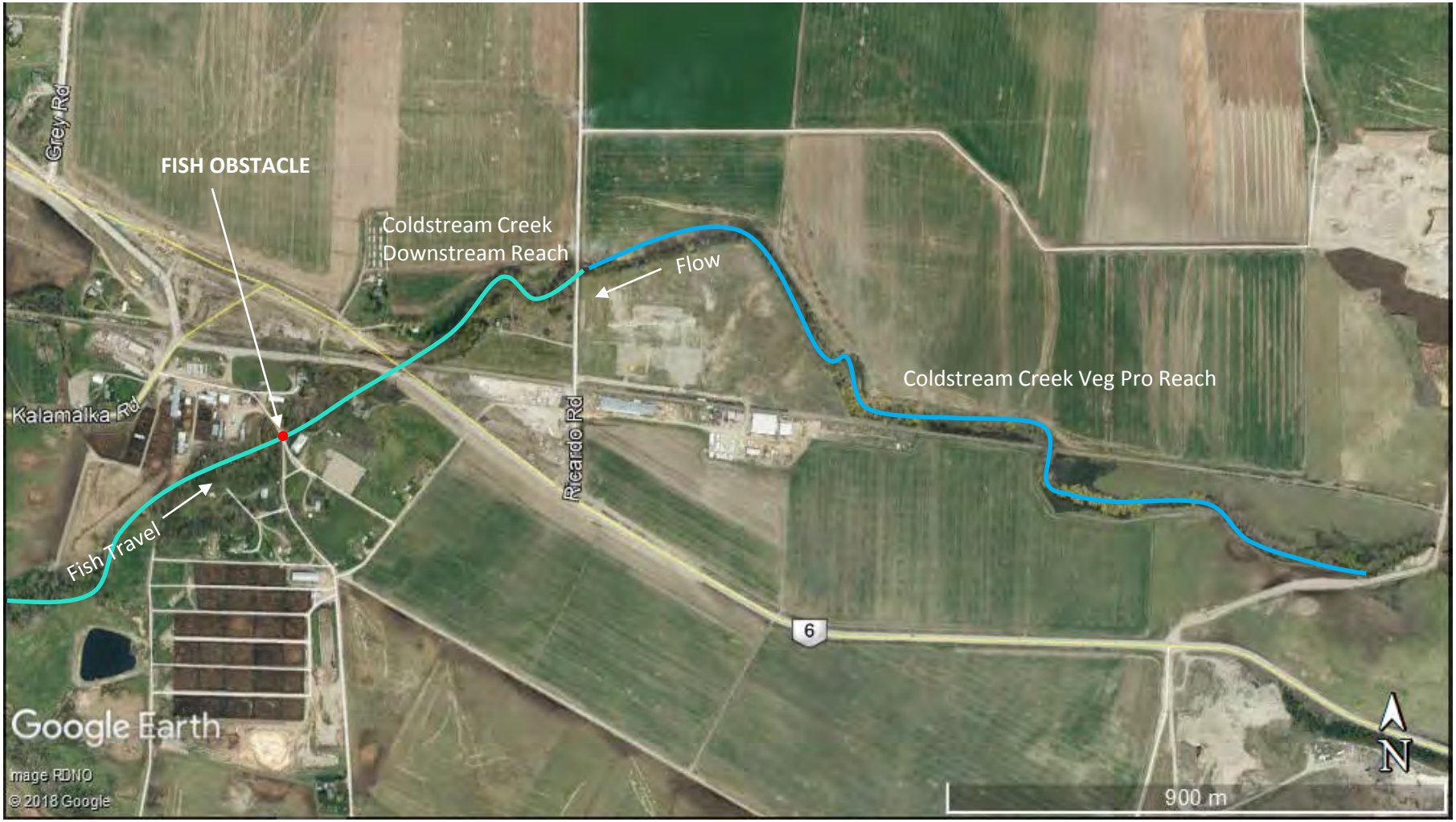
APPENDIX A

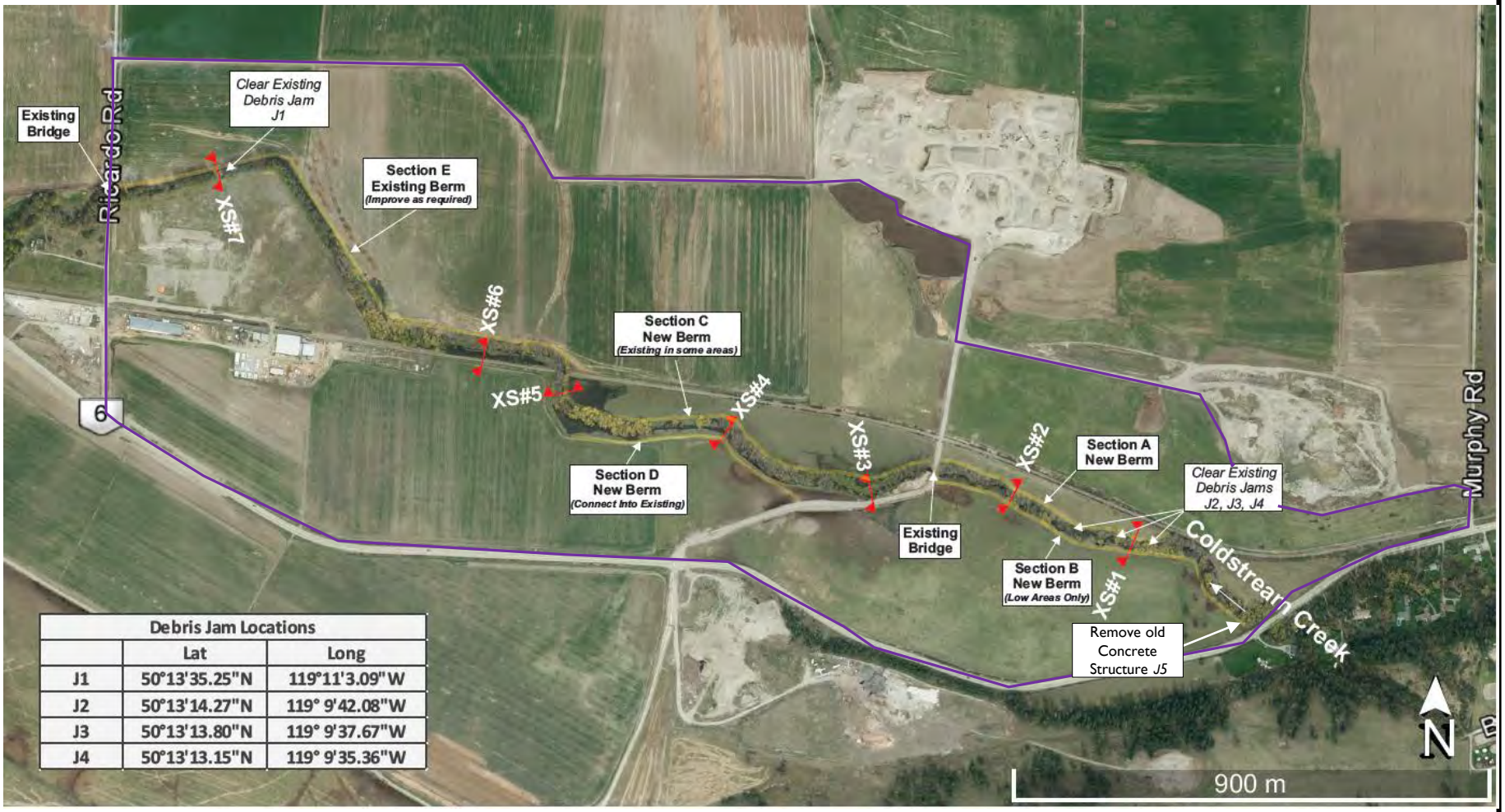
Figures



Veg Pro Flood Management Plan	TITLE **Figure 1:** Project Location			
western water ASSOCIATES LTD	DRAWN GL	DATE August 2018	PROJECT NO. 18-067-01	
	CHECKED TK	Location Figure	TOPOGRAPGY	
	REVIEWED DG		SOURCE. Google Maps	



Veg Pro Flood Management Plan	TITLE **Figure 2:** Fish Obstacle Dam/ Cascade Location			
western water ASSOCIATES LTD	DRAWN GL	DATE August 2018	PROJECT NO. 18-067-01	
	CHECKED TK	Coldstream Creek	TOPOGRAPGY	
	REVIEWED DG		SOURCE. Google Maps	



Debris Jam Locations		
	Lat	Long
J1	50°13'35.25"N	119°11'3.09"W
J2	50°13'14.27"N	119° 9'42.08"W
J3	50°13'13.80"N	119° 9'37.67"W
J4	50°13'13.15"N	119° 9'35.36"W

Veg Pro Flood Management Plan

TITLE **Figure 3:** Berm and Debris Jam Locations

western water ASSOCIATES LTD

DRAWN	GL	DATE August 2018	PROJECT NO. 18-067-01
CHECKED	TK	Coldstream Creek	TOPOGRAPGY
REVIEWED	DG		SOURCE. Streamworks

APPENDIX B
Photographs

Photograph 1. Native trees along Coldstream Creek including black cottonwood (*Populus trichocarpa*) and pacific willow (*Salix lucida*) (July 9, 2018)

Photograph 2. The photographs below illustrate the variation in Coldstream Creek's substrate from angular cobble to small gravels and fines (July 9, 2018)

Photograph 3. Large woody debris and overhanging vegetation along Coldstream Creek (July 9, 2018)

Photograph 4. Log jam in Coldstream Creek inhibiting flow (July 9, 2018)

Photograph 5. Flooded area in the field north of the rail line (July 9, 2018)

Photograph 6. Man-made channel fed by the culvert under the rail line (July 9, 2018)

Photograph 7. Black cottonwood along Coldstream Creek (July 9, 2018)

Photograph 8. Proposes berm location, outside the treed riparian area (July 9, 2018)

Photograph 9. Existing berm (July 9, 2018)

Photograph 10. Log jam in Coldstream Creek inhibiting flow (July 9, 2018)

Photograph 11. Woody debris in Coldstream Creek (July 9, 2018)

Photograph 12. Log jam in Coldstream Creek inhibiting flow (July 9, 2018)

Photograph 13. Field flooding along the south side of the rail line, north side of the creek (May 16, 2018)

Photograph 14. Flooding along Coldstream Creek that Veg Pro would like to eliminate with berms and debris jam removal (May 16, 2018)

Photograph 15. Concrete infastructure to be removed from Coldstream Creek as it has filled with sediment and is blocking creek flow (July 9, 2015)

Photo credit: Johnathan Blais

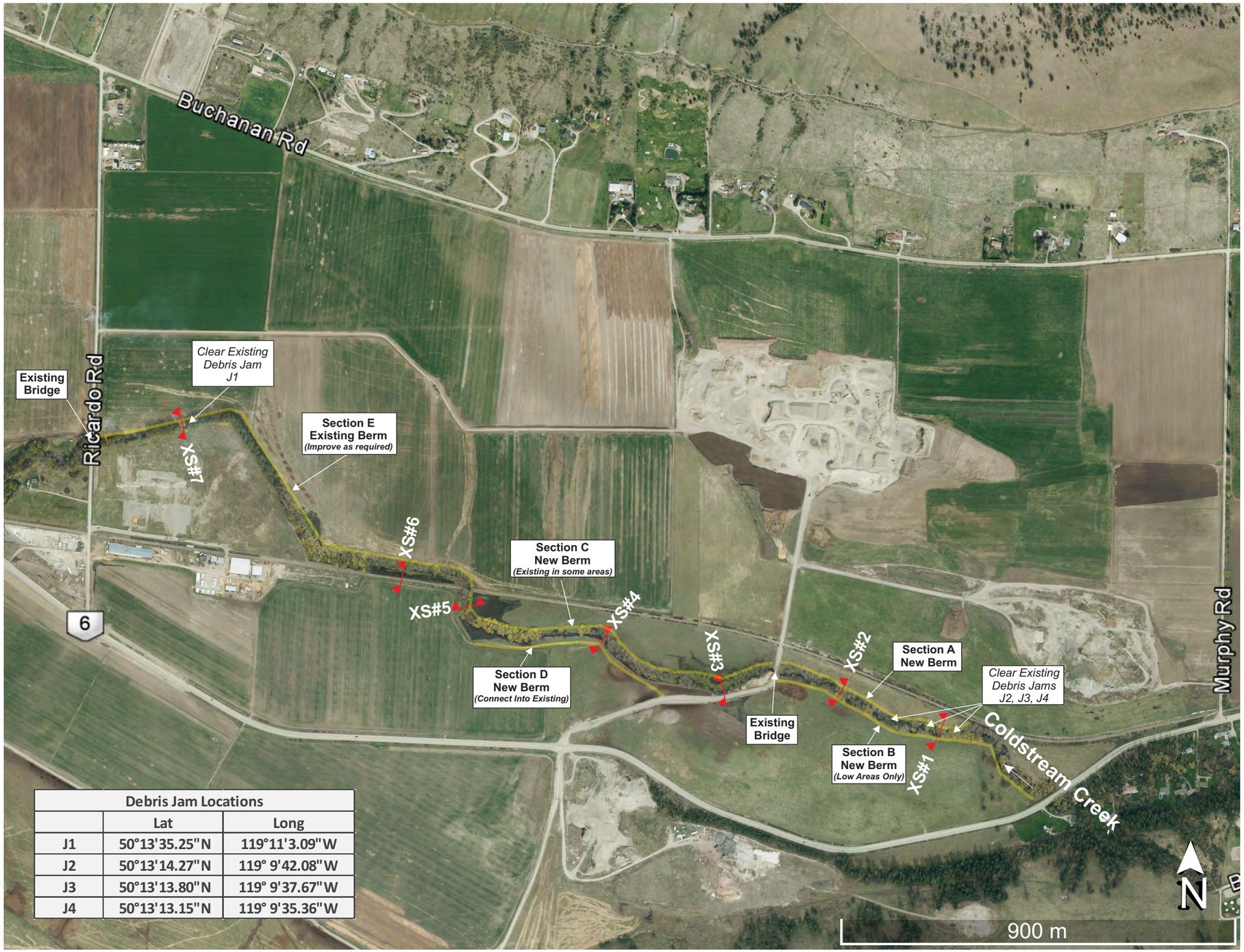
Photograph 16. Old concrete irrigation infrastructure to be removed from Coldstream Creek as it is inhibiting creek flow (July 9, 2015)

Photo credit: Johnathan Blais

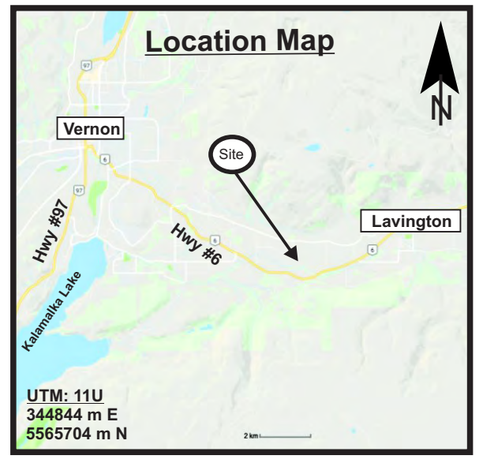
APPENDIX C

Engineer Design Plans

Figure 1: Site Plan - XSection Locations and Proposed Improvements - Coldstream Creek



Debris Jam Locations		
	Lat	Long
J1	50°13'35.25"N	119°11'3.09"W
J2	50°13'14.27"N	119° 9'42.08"W
J3	50°13'13.80"N	119° 9'37.67"W
J4	50°13'13.15"N	119° 9'35.36"W



Flood Frequency Estimates For Coldstream Creek

Return Period (Years)	Estimated Design Discharge (m^3/s)
2	4.0
5	6.0
10	8.0
20	10.0
50	12.0
100	13.5
200	15.0

Estimated capacity of the Highway #6 culvert upstream of the project site: 9 m^3/s

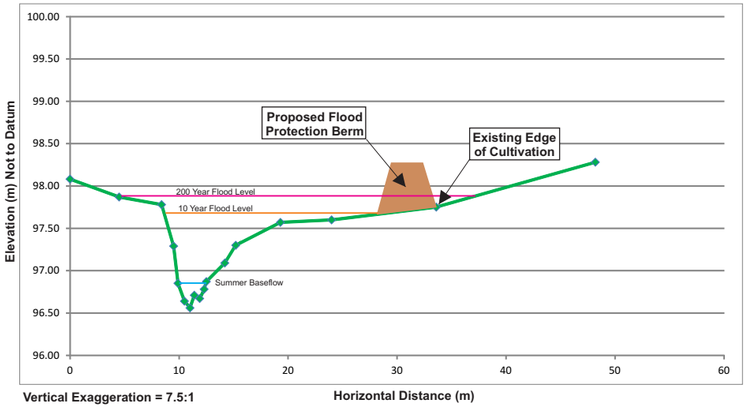
VegPro Flood Mitigation Plan
Coldstream Creek, Coldstream BC

Design By:	Date:
AGB	Sep 18, 2018
Revision No: 1	Drawing No: 2018-0918-1

Streamworks Consulting Inc.

Figure 2A: Surveyed Channel Sections and Proposed Improvements - Coldstream Creek

See Figure 1 for XSection Locations
See Figure 2C for Typical Berm Design



XSection #1

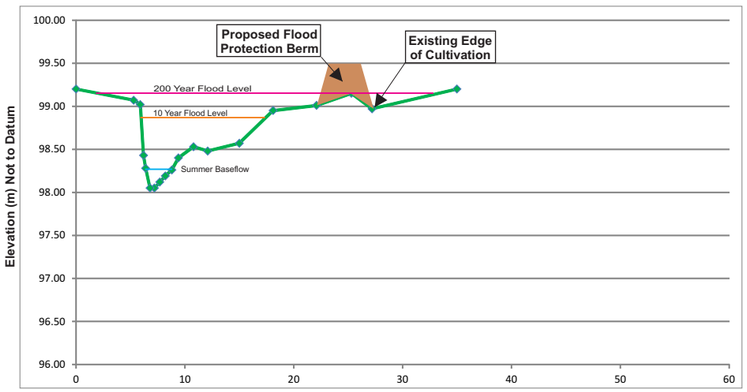
Proposed Berm on Right (north) Bank
(Section A - See Figure 1 and 2C)
Approximate Height of Berm = 0.6m
Freeboard = 0.3m
Approximate Elevation of Berm = 1.2m
(above baseflow water level).
Approximate Offset from Top of Bank = 14m
Preserved Floodplain Width = 25m

A similar berm may be considered on
the Left (South) bank to match the elevation
of the Right bank (equivalent freeboard).
(Section B - See Figure 1)
No floodplain encroachment.

Looking across XS#1 from the right (north) bank.

Looking upstream along the channel from XS#1.

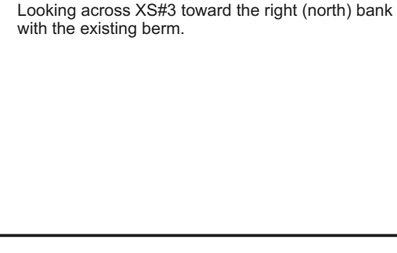
Looking upstream along right bank flood channel above XS#1.



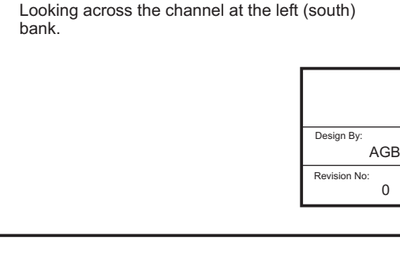
XSection #2

Proposed Berm on Right (north) Bank
(Section A - See Figure 1 and 2C)
Approximate Height of Berm = 0.5m
Freeboard = 0.3m
Approximate Elevation of Berm = 1.2m
(above baseflow water level).
Approximate Offset from Top of Bank = 4m
Preserved Floodplain Width = 18m

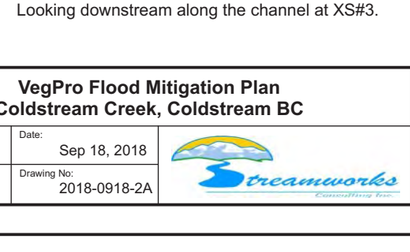
A similar berm may be considered on
the Left (South) bank to match the elevation
of the Right bank (equivalent freeboard).
(Section B - See Figure 1)
No floodplain encroachment.



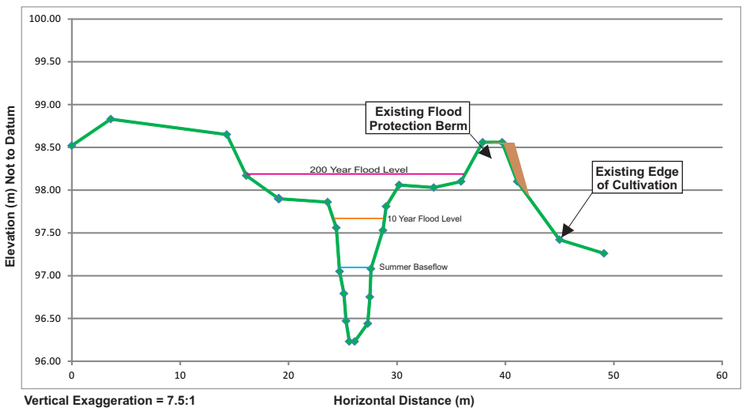
Looking across XS#2 toward the right (north) bank.



Looking downstream along the channel across XS#2.



Looking across the channel at the left (south) bank.



XSection #3

Existing Berm on Right (north) Bank
(Section C - See Figure 1)
Improve existing berm as required.
Approximate Height of Berm = 0.5m
Freeboard = 0.35m
Approximate Elevation of Berm = 1.5m
(above baseflow water level).
Approximate Offset from Top of Bank = 6m
Preserved Floodplain Width = 20m

No berm required on the Left (South) bank.

Looking across XS#3 toward the right (north) bank with the existing berm.

Looking across the channel at the left (south) bank.

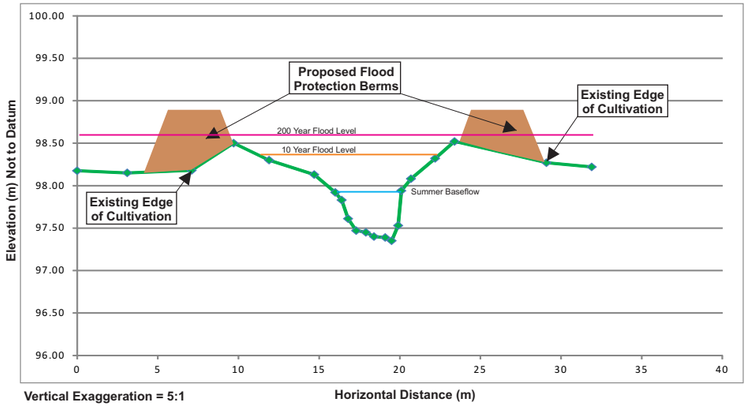
Looking downstream along the channel at XS#3.

VegPro Flood Mitigation Plan
Coldstream Creek, Coldstream BC

Design By:	Date:	
AGB	Sep 18, 2018	Streamworks Consulting Inc.
Revision No: 0	Drawing No: 2018-0918-2A	

Figure 2B: Surveyed Channel Sections and Proposed Improvements - Coldstream Creek

See Figure 1 for XSection Locations
See Figure 2C for Typical Berm Design



XSection #4

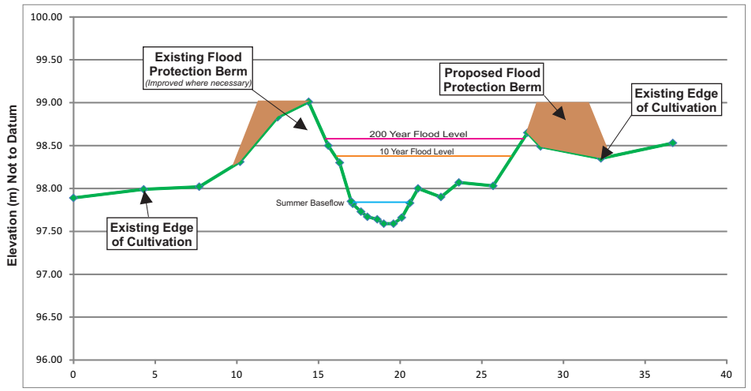
Proposed Berm on Right (north) Bank
(Section C - See Figure 1)
Improve existing berm in some areas.
Approximate Height of Berm = 0.6m
Freeboard = 0.3m
Approximate Elevation of Berm = 1.0m
(above baseflow water level).
Approximate Offset from Top of Bank = 1m
Preserved Floodplain Width = 14m
Some Loss of Flood Relief

Proposed Berm on Left (south) Bank
(Section D - See Figure 1)
Some existing berm, connect into existing berm at upstream end.
Approximate Height of Berm = 0.7m
Freeboard = 0.3m
Approximate Elevation of Berm = 1.0m
(above baseflow water level).
Approximate Offset from Top of Bank = 0m
Preserved Floodplain Width = 14m
Some Loss of Flood Relief

Looking across XS#4 from the right (north) bank.

Looking upstream along the channel toward XS#4.

Looking downstream along the channel toward XS#4.



XSection #5

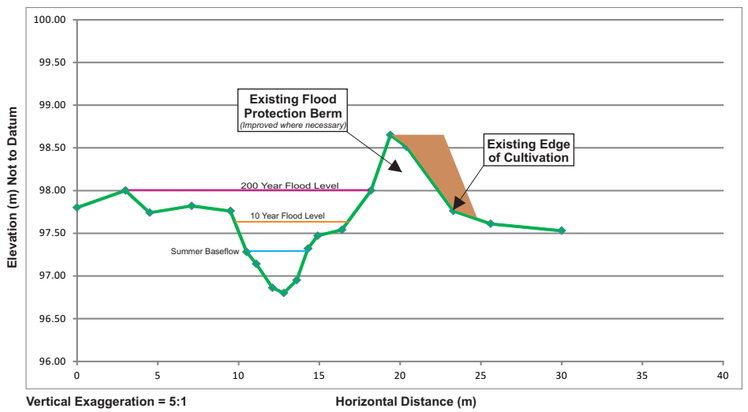
Proposed Berm on Right (north) Bank
(Section C - See Figure 1)
Approximate Height of Berm = 0.6m
Freeboard = 0.4m
Approximate Elevation of Berm = 1.2m
(above baseflow water level).
Approximate Offset from Top of Bank = 7m
Preserved Floodplain Width = 13m

Existing berm on the Left (South) bank may be improved/augmented where necessary to ensure an equivalent height and proper function.

Looking across XS#5 toward the left (south) bank and the existing berm.

Looking downstream along the channel across XS#5.

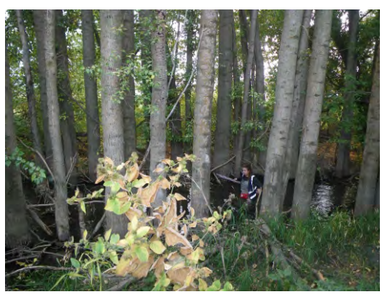
Looking upstream along the channel across XS#5.



XSection #6

Existing Berm on Right (north) Bank
(Section E - See Figure 1)
Approximate Height of Berm = 1.0m
Freeboard = 0.6m
Approximate Elevation of Berm = 1.35m
(above baseflow water level).
Approximate Offset from Top of Bank = 4.5m
Preserved Floodplain Width = 15m

No berm required on the Left (South) bank (flood limited by railway grade).



Looking across XS#6 toward the left (south) bank from the existing berm.

Looking downstream along the channel at XS#6.

Looking upstream along the channel from XS#6.

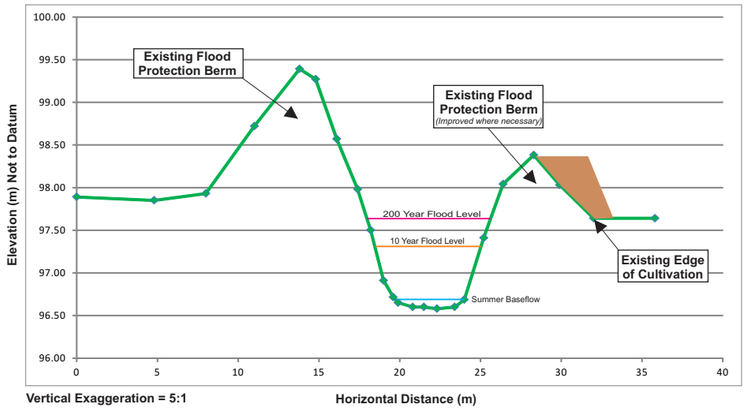
VegPro Flood Mitigation Plan
Coldstream Creek, Coldstream BC

Design By: AGB	Date: Sep 18, 2018
Revision No: 0	Drawing No: 2018-0918-2B

Streamworks Consulting Inc.

Figure 2C: Surveyed Channel Sections and Proposed Improvements - Coldstream Creek

See Figure 1 for XSection Locations
See Figure 2C for Typical Berm Design



XSection #7

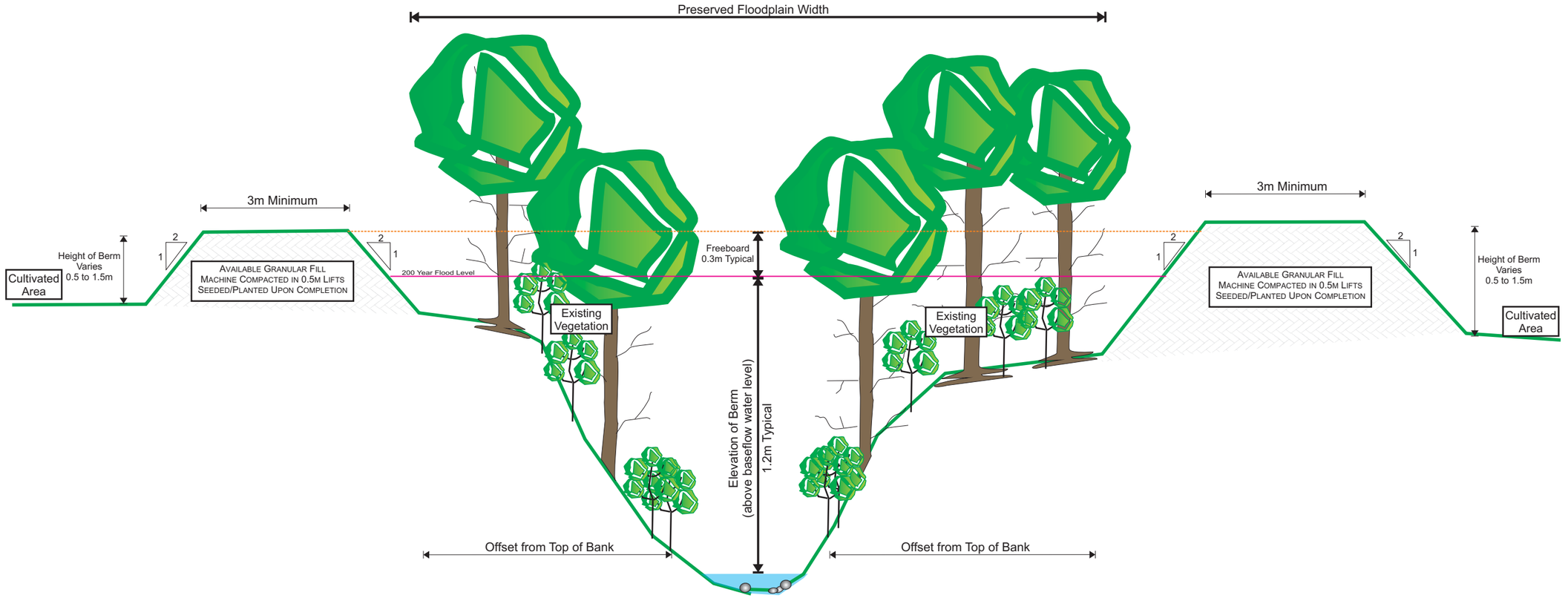
Existing Berm on Right (north) Bank
(Section E - See Figure 1)
Existing berm improve where necessary
Approximate Height of Berm = 0.75m
Freeboard = 0.7m
Approximate Elevation of Berm = 1.7m
(above baseflow water level).
Approximate Offset from Top of Bank = 3m
Preserved Floodplain Width = 10m

Existing Berm on Left (south) Bank
Approximate Height of Berm = 1.5m
Freeboard = 1.7m
Approximate Elevation of Berm = 2.7m
(above baseflow water level).
Approximate Offset from Top of Bank = 3m
Preserved Floodplain Width = 10m

Looking across XS#7 toward the left (south) bank from the existing berm.

Survey instrument on top of existing berm at XS#7.

Looking upstream along the channel toward XS#7.



Typical Completed Channel Cross-Section with Berms

Not to Scale - Vertically Exaggerated

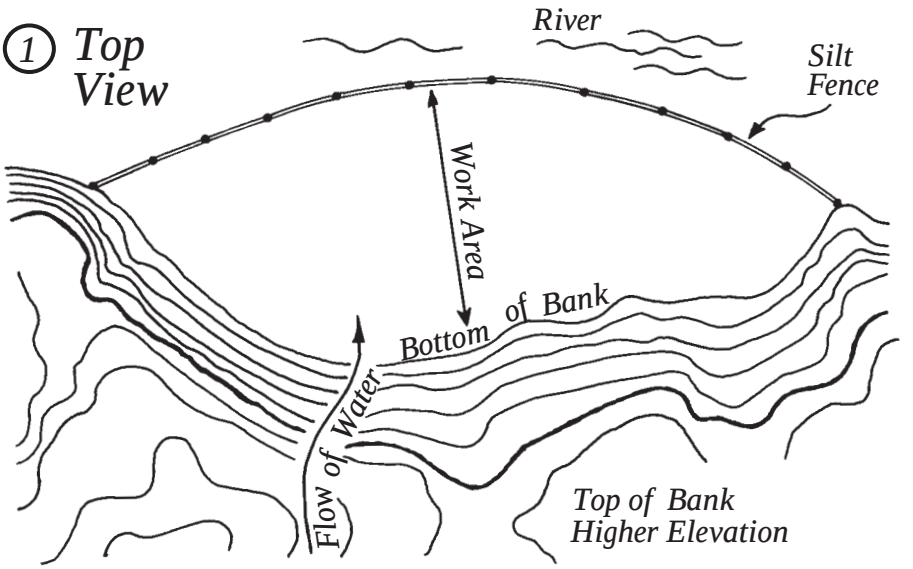
VegPro Flood Mitigation Plan Coldstream Creek, Coldstream BC		
Design By: AGB	Date: Sep 18, 2018	Streamworks Consulting Inc.
Revision No: 0	Drawing No: 2018-0918-2C	

APPENDIX D

Silt Fence and Silt Curtain Details

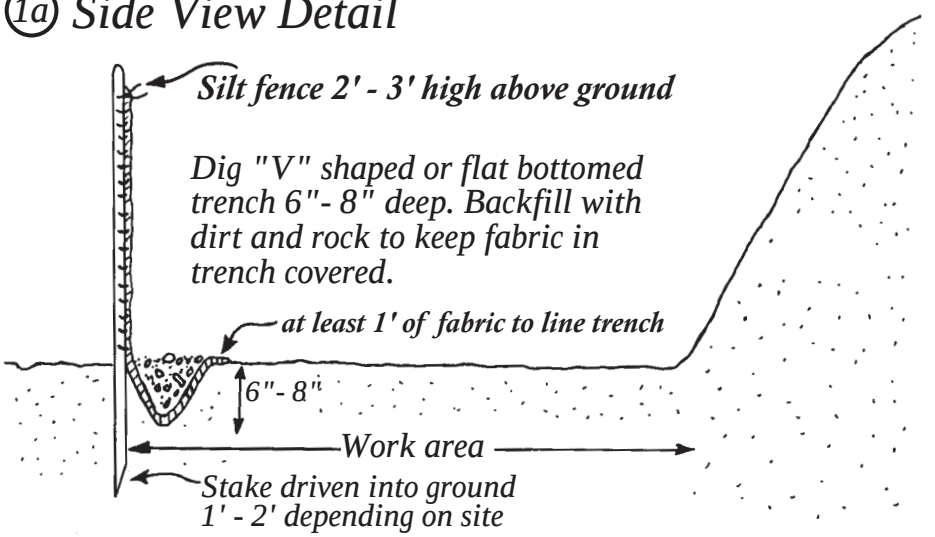
Silt Fence Installation *Step-by-Step*

① Top View



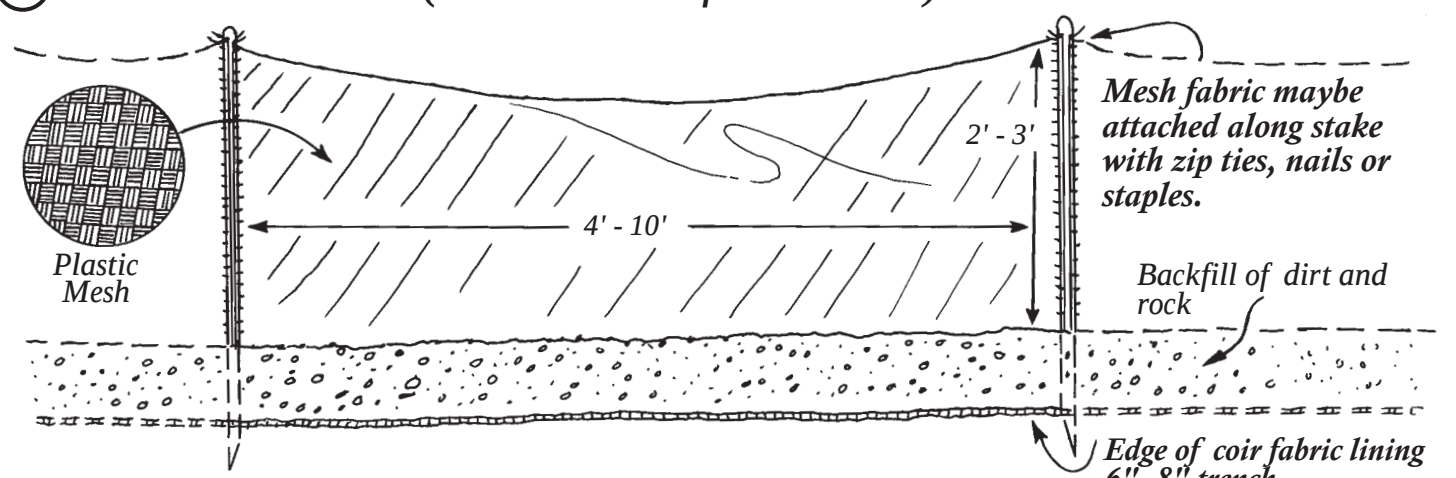
Prepare a stormwater pollution prevention plan. Set up silt fences according to terrain, soil and run-off consideration. Prevent soil migration by decreasing soil exposure, steep unvegetated slopes and construction time. Revegetate as soon as possible in the SAME SEASON.

①a Side View Detail



Moniter integrity of installed silt fence and remove sediment before it reaches 1/3 the height of the silt fence. It is especially important to moniter during and after rain and break-up events.

①b Front View Detail (One Section of Silt Fence)



Leave silt fence in place until vegetation is established and sediment is stabilized.

Silt (Sediment) Fence Installation

When installing a silt fence, first choose the appropriate place to set up a silt fence by considering site terrain and slope, water flow and projected soil disturbance during construction.

Set the silt fence perpendicular to the slope of the land, curving the fence inward towards slope.

Place the silt fence spaced away from the toe-of-slope, leaving enough room to accumulate sediment and to perform work.

Dig a six to eight-inch trench (either V shaped or flat-bottomed) directly up-slope or upstream of the silt fence. On the downstream edge, drive in wood stakes, rebar or steel stakes at least 1 foot down into the sediment. The stakes or rebar should be long enough to accommodate the trench depth and height of the silt fence fabric.

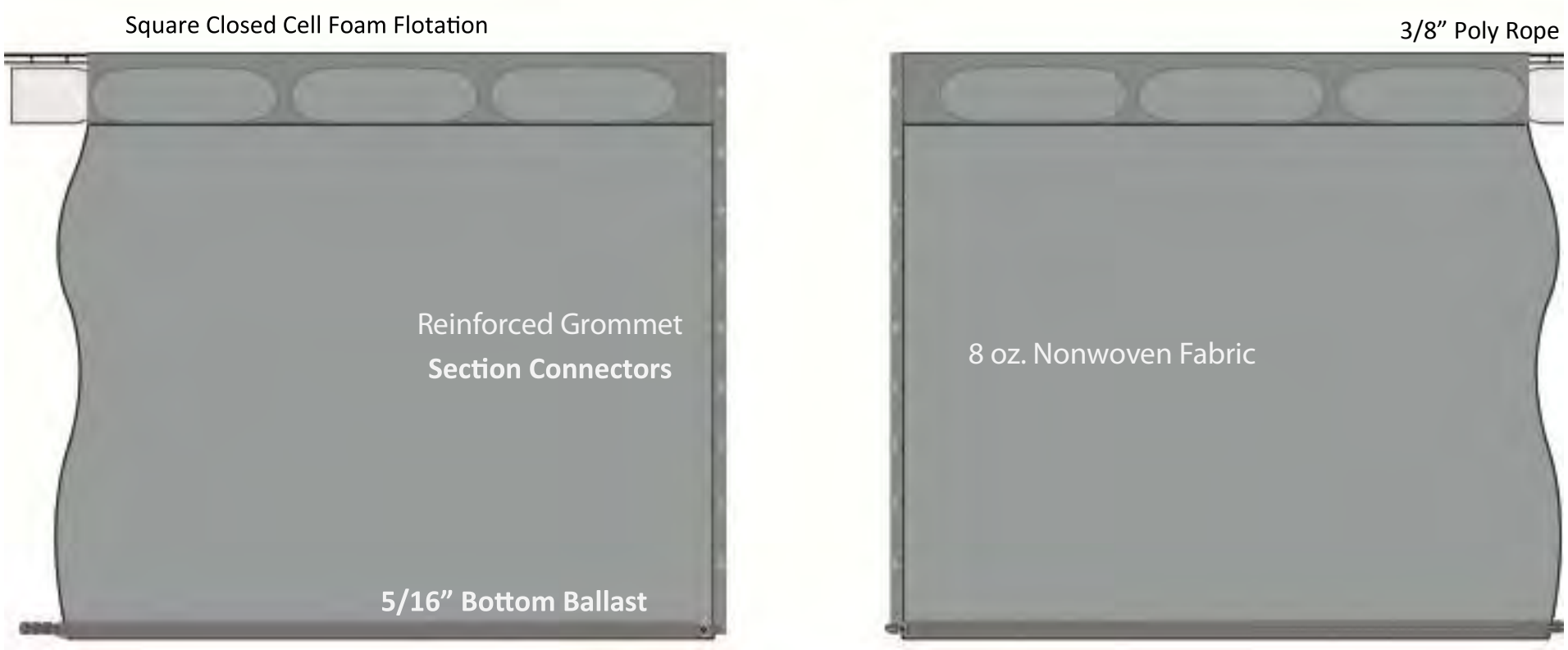
Run a continuous length of fabric along the inside of the stakes and secure with nails,
staples or zip ties allowing at least 1 foot to line the trench. Extend termination points uphill one full panel length.

Use continuous fabric piece for the silt fence. If one is unavailable and a joint is necessary, overlap the fabric at least the width of one stake spacing and secure in place using a wooden lath, staples, zip ties or nails.

Cover the trench with backfilled and compacted soil, gravel or rock.

Maintain the fence by checking the fabric for damage, failure of fence to withhold sediment, and damage to posts. Install additional back-up silt fence if needed.

APPENDIX D: Silt Curtain Detail
Veg Pro Flood Management Plan UU?J /6+.67-0/



Drawing for illustrative purposes only. Not to scale.

GEI WORKS
772.646.0597
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Type 1 Geo Turbidity Curtain

Scale:	Drawing:	Revision:	Date:	By:
Not to Scale	G9180-1	1		

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Groundwater Supply Development and Management

Source Water Assessment and Protection

Well Monitoring & Maintenance

Environmental & Water Quality Monitoring

Storm & Wastewater Disposal to Ground

Groundwater Modeling

Aquifer Test Design and Analysis

Geothermal / Geoexchange Systems

Policy and Guideline Development

Applied Research

Rural Subdivision Services

Environmental Assessment & Permitting