Project number: 4435-029
Document number: V3729
Version: 3
Date: September 4, 2014

MILE 122.7 DERAILMENT – COAL RECOVERY REPORT FOR SILVER CREEK AND BURNABY LAKE

Prepared for:

Canadian National Railway Company

13477 – 116th Avenue
Surrey, BC V3R 6W4
Luanne Patterson

Prepared by:

#1308, 1030 West Georgia St.
Vancouver, BC V6E 2Y3

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DISCLAIMER

This report is rendered solely for the use of the Canadian National Railway Company (CN) in connection with the Silver Creek derailment site stabilization program and Burnaby Lake coal recovery project. No person may rely on it for any other purpose without Triton Environmental Consultants Ltd.'s prior written approval. Should a third party use this report without Triton's approval, they may not rely upon it. Triton accepts no responsibility for loss or damages suffered by any third party as a result of decisions made or actions taken based on this report.

The objective of this report is to summarize environmental monitoring activities for the Silver Creek derailment site stabilization and coal recovery programs in Burnaby Lake and Lower Silver Creek for CN.

This report is based on facts and professional opinions. We have attempted to identify and consider relevant facts and documents pertaining to the scope of work, at the time during which we conducted this analysis. However, our opinions may change if new information is available or if information we have relied on is altered.

We applied accepted professional practices and standards in developing and interpreting data obtained by our field measurement, sampling and observation. While we used accepted professional practices in interpreting data provided by CN or third party sources we did not verify the accuracy of data provided by CN or third party sources.

This report should be considered as a whole and selecting only portions of the report for use may create a misleading view of our opinions.

1.0 Introduction

Triton Environmental Consultants Ltd. (Triton) was retained by the Canadian National Railway Company (CN) to provide environmental services following a Canadian Pacific (CP) train derailment at Mile 122.7 on CN's Yale Subdivision in Burnaby, BC (Figure 1). The derailment occurred on January 11, 2014, releasing metallurgical coal from three rail cars into and adjacent to Silver Creek. Triton provided support during the initial emergency response and subsequent track restoration at the derailment site. Triton also conducted coal deposition surveys for recovery planning and, ultimately, provided technical support during coal recovery in Silver Creek and Burnaby Lake. This report provides background information on Silver Creek and Burnaby Lake, as well as a summary of the coal deposition surveys and environmental monitoring conducted during the track restoration and coal recovery programs.

1.1 Silver Creek Bank Restoration and Culvert Cleaning

Once the derailed cars were recovered, field inspections of Silver Creek were conducted by CN and Triton personnel. CN Engineering, Bridges & Structures determined bank armouring / slope stabilization and culvert cleanout would be required to restore conveyance at the Silver Creek crossing and ensure track stability moving forward. Construction and site restoration planning was completed by CN, Sonny's Excavating, Northwest Hydraulic Consultants and Triton. The construction program was undertaken between January 20 and February 10, 2014 and is described in Section 3.0 of this document.

1.2 Pre Coal Recovery Deposition Surveys

In January 2014 Triton conducted deposition assessments in Silver Creek, Burnaby Lake and the Brunette River to quantify coal deposition and assess the feasibility of coal recovery[1] (Appendix 1 Photos). The total estimated coal deposition in the three water bodies (Silver Creek, Burnaby Lake and Brunette River) was approximately 81.6 m^3. Based on the nature of coal deposition (e.g. depth and areal extent) and available recovery methods (hand removal, vac-truck & selective dredging) the group determined it was feasible to recover approximately 81.4 m^3 or 99.75% of the deposited coal.

The results of the Silver Creek deposition assessment identified roughly 5.5 m^3 of deposited coal (based on measurements collected at approximately 40 locations in the channel). The main areas of deposition occurred at the derailment site and near the confluence with Burnaby Lake. The thickness of the deposits ranged from surface staining (<1 mm) to a maximum observed thickness of 500 mm. Coal particulate ranged in size from fines (<1 mm) to large gravel sized pieces (50 – 70 mm). Most deposits were homogenous in particle size[2].

The Burnaby Lake deposition assessment indicated approximately 76 m^3 of coal was deposited on and around the existing alluvial fan of Silver Creek at the confluence with Burnaby Lake. The alluvial fan, which begins at the confluence, is approximately 20 m wide and 60 m long with typical depths of 20 – 50 cm. Coal particulate (20 – 50 mm) was generally confined to the

[1] Triton, January 25th, 2014. Mile 122.7 Derailment – Burnaby Lake Coal Deposition Recovery Plan.
[2] See Mile 122.7 Derailment – Silver Creek Impact Assessment. Triton, January 22nd, 2014.

western (upstream) end of the fan where the Silver Creek mainstem enters Burnaby Lake on the west side of a vegetated bar. Mixed coal fines and smaller particles (10 – 20 mm) were generally confined to the secondary channel on the east side of the vegetated bar, and on the shallower portion of the bar extending downstream of the confluence. The depth of coal varied across the alluvial fan, with the thickest deposits (average depth of 500 mm) observed at the outer edge of the fan along the main channel. Deposition on the downstream portion of the fan consisted of a layer of fine particles typically 50 mm deep. A thin layer (3 – 10 mm deep) of deposition was observed off shore from the alluvial fan (approximately 20 m from shore). A dusting of coal (1 mm deep) also extended downstream of the alluvial fan on the north side Burnaby Lake outlet channel towards Cariboo Dam.

The results of the Brunette River deposition assessment between the Cariboo Dam and the confluence with Fraser River identified approximately 0.12 m^3 of coal deposited at 23 sites along the surveyed length (Triton 2014c). Given the limited volume of material (0.12 m^3) relative to the wide area of dispersal (698 m^2); coal recovery was not recommended. The anticipated disturbance from accessing multiple, widely distributed sites to remove thin layers of coal (typically ≤ 3 mm) was considered to be more disruptive than leaving the coal in place.

1.3 Coal Recovery Program

A coal recovery plan for Burnaby Lake and Silver Creek was developed in cooperation with regulatory agencies, local and regional governments, CN, Quantum Murray Remediation Services (Quantum), Triton, Summit Environmental (Summit) and EBB Environmental Consulting (EBB). Coal recovery was undertaken between March 4 and April 2, 2014. Deposits in Burnaby Lake, lower Silver Creek and the off channel habitat located immediately south of the Cariboo Business Park Driveway were cleared using a vac-truck system (Figure 2). Coal was removed by hand in the Silver Creek mainstem and in the CN right-of-way (ROW) during the January / February stabilization work. An estimated total of 142.8 tonnes of mixed coal, organic and mineral fines was removed as part of the coal recovery program. A more detailed description of the recovery program is provided in Sections 4, 5 and 6 of this document.

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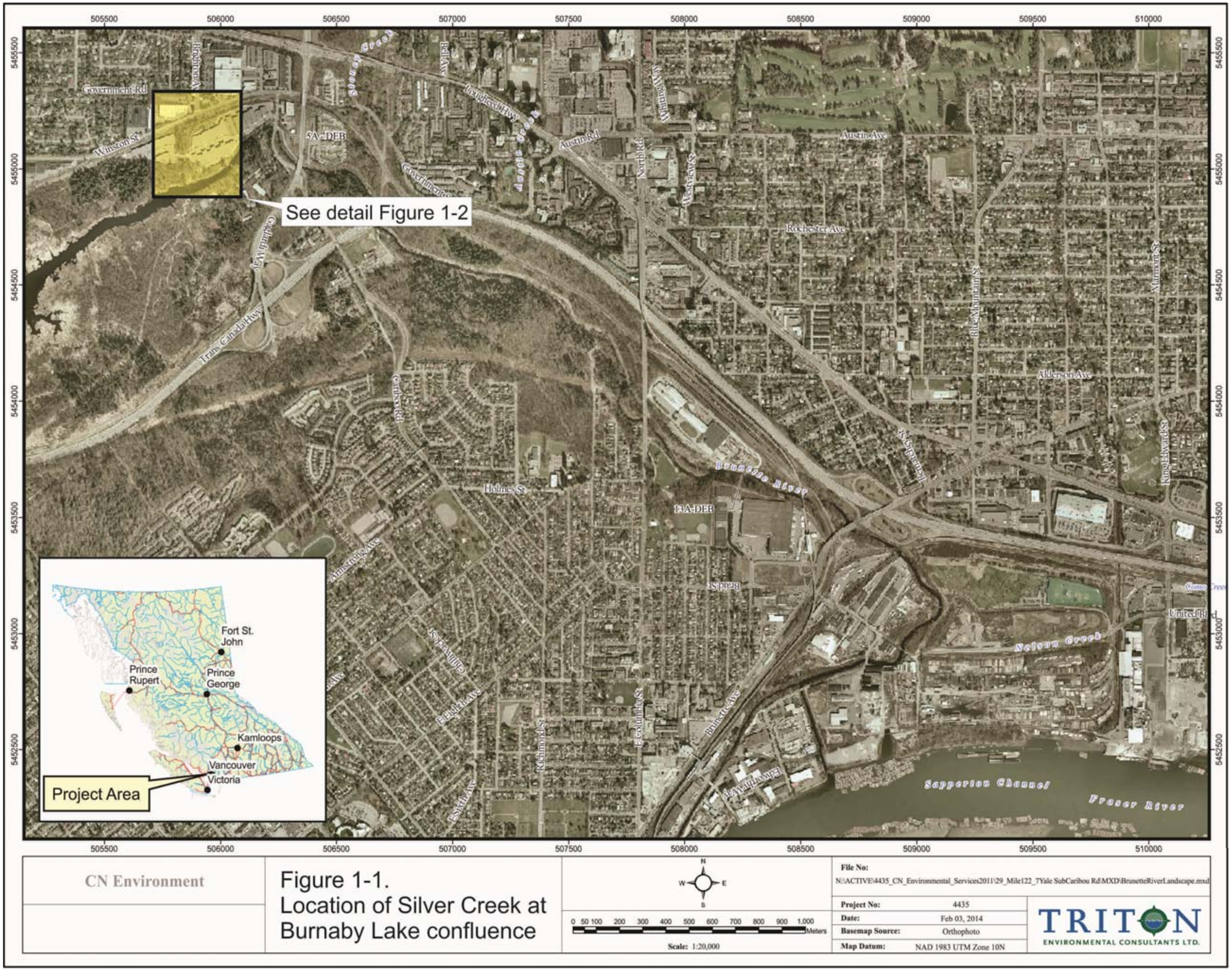
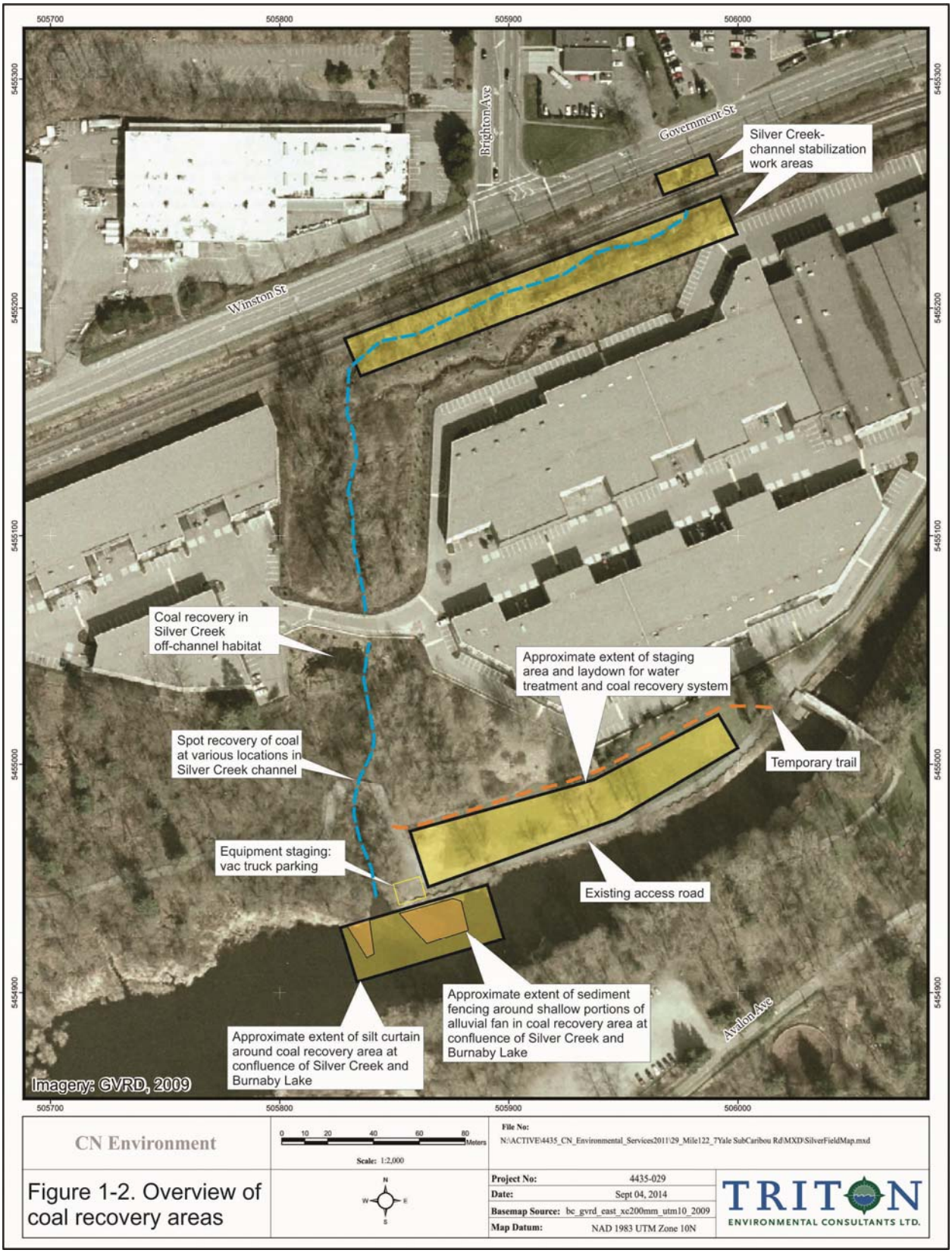


Figure 1-1.
Location of Silver Creek at Burnaby Lake confluence


505700
505800
505900
506000
5455300
5455200
5455100
5455000
5454900
Brighton Ave
Government St
Winston St
Avalon Ave
Silver Creek-channel stabilization work areas
Coal recovery in Silver Creek off-channel habitat
Approximate extent of staging area and laydown for water treatment and coal recovery system
Spot recovery of coal at various locations in Silver Creek channel
Temporary trail
Equipment staging: vac truck parking
Existing access road
Approximate extent of sediment fencing around shallow portions of alluvial fan in coal recovery area at confluence of Silver Creek and Burnaby Lake
Approximate extent of silt curtain around coal recovery area at confluence of Silver Creek and Burnaby Lake
Imagery: GVRD, 2009
CN Environment
0 10 20 40 60 80 Meters
Scale: 1:2,000
File No:
N:\ACTIVE\4435_CN_Environmental_Services2011\29_Mile122_7Yale SubCaribou Rd\MXD\SilverFieldMap.mxd
Figure 1-2. Overview of coal recovery areas
N
W
E
S
Project No: 4435-029
Date: Sept 04, 2014
Basemap Source: bc_gvrd_east_xc200mm_utm10_2009
Map Datum: NAD 1983 UTM Zone 10N
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2.0 Background Information

2.1 Fish and Fish Habitat

2.1.1 Silver Creek

Silver Creek (local name) is a non-gazetted stream entering the CN ROW via three (3) municipal storm water pipes at Government Street. The watercourse does not appear on National Topographic Survey (NTS) maps, or provincial Terrain Resource Information Management (TRIM) maps, or the watershed code availability maps.

A stream survey from the confluence with Burnaby Lake to Government Street conducted on January 16, 2014 indicated an average channel width of 4.06 m and an average wetted width of 3.22 m. Mean wetted depth at low water ranged from 0.05 to 0.26 m. The majority of the channel was categorized as riffle or glide habitat. Pools with residual depths >0.3 m were infrequent. Substrate was dominated by small cobble (SC) and large gravel (LG), with areas of extensive sand deposition along with exposed clay seams. Spawning habitat was classified as moderate over the entire length of channel surveyed. Available cover was ranked as low (L) to moderate (M), and was provided mainly by undercut bank (U) and accumulations of large and small woody debris (LWD and SWD), with some over stream vegetation (OV). Habitat conditions within the CN ROW were similar to the downstream reach described above, with the exception of reduced overstream vegetation.

Coho Salmon (*Oncorhynchus kisutch*), Cutthroat Trout (*O. clarkii*), and Lamprey (*Lampetra sp.*) were salvaged in Silver Creek ahead of the January and February works in the ROW (Section 3.1). Triton reported Threespine Stickleback (*Gasterosteus aculeatus*) in Silver Creek in 2007 (iMAP, 2014), and we understand Chum Salmon (*O. keta*) were observed spawning in Silver Creek in the fall of 2013 (pers. comm. Burnaby Streamkeepers Program).

2.1.2 Burnaby Lake

Burnaby Lake (watershed code (WSC) 100-020100) has a perimeter of approximately 5.3 km and covers an area of approximately 33.3 hectares with a maximum depth of 3 m (FISS, 2014). Fish species documented in Burnaby Lake, the Brunette River, Still Creek, Eagle Creek, Massey Creek and Beecher Creek upstream of the Cariboo Dam are summarized in Table 2-1 (iMAP, February 2014).

Table 2-1. Fish species present in Brunette River, Burnaby Lake and Still Creek, Eagle Creek, Massey Creek and Beecher Creek

Fish species	Scientific name
Brassy Minnow	*Hybognathus hankinsoni*
Brown Catfish	*Ameiurus nebulosus*
Carp	*Cyprinus carpio*
Chinook Salmon	*Oncorhynchus tshawytscha*
Coastal Cutthroat Trout	*O.clarkii*
Coho Salmon	*O. kisutch*
Lamprey	*Lampetra sp.*
Northern Pikeminnow	*Ptychocheilus oregonensis*
Peamouth Chub	*Mylocheilus caurinus*
Perch	*Perca sp.*
Prickly Sculpin	*Cottus asper*
Nooksack dace (1)	*Rhinichthys cataractae*
Rainbow Trout	*O. mykiss*
Redside Shiner	*Richardsonius balteatus*
Sucker	*Catostomus sp.*
Threespine Stickleback	*Gasterosteus aculeatus*
Yellow perch	*Perca flavescens*

1) record shown for Massey Creek / Robert Burnaby Creek (upstream of Cariboo Dam) in the iMAP database but not shown in the FISS database (searched February 2014)

The shallow lake margins around Burnaby Lake support abundant aquatic vegetation around the perimeter. Some of the aquatic or semi aquatic species of vegetation reported to occur in Burnaby Lake are listed in Table 2-2 (City of Burnaby, 2002).

Table 2-2. Aquatic vegetation in Burnaby Lake

Species	Scientific name
Yellow pond lily	*Nuphar lutea*
White water lily	*Nymphaea alba*
Yellow Iris	*Iris pseudacorus*
Cattail	*Typha latifolia*
Bulrush	*Scirpus micrcarpus*
Purple Loosestrife	*Lythrum salicaria*
Grasses/Sedges	Multiple species
Willow/mixed wet shrubs	Multiple species

Near the Silver Creek confluence the typical wetted width of Burnaby Lake is ≤50 m. However, a review of historical air photos available online (i.e. BurnabyMap and Google Earth) indicates the visible open channel (free of dense aquatic vegetation cover) is ≤15 m during low flow conditions in summer when aquatic vegetation is more prevalent. A survey of the area around the confluence conducted during dive and snorkel surveys indicated maximum mid channel depths near the work area ranging from approximately 1.5 to 1.8 m. The survey also indicated mid channel substrate near the upstream (western) end of the alluvial fan is comprised primarily of coarse gravel, whereas fine organic sediments dominate the surface layer of substrate mid channel, near the downstream (eastern) end of the alluvial fan.

The Cariboo Dam provides a supplemental hydrologic control for the lake and is operated by Metro Vancouver for flood control (e.g., to control storm water run-off), and environmental enhancement purposes (e.g. controlled releases downstream for fish and increased water levels for nesting birds in summer)[3]. Fish species which are reported to be present in Burnaby Lake are summarized above in Table 2-1.

2.2 Listed Plant and Wildlife Species

Provincially and/or federally listed species in Burnaby Lake Park are listed below in Table 2-3 (City of Burnaby, May 2002; Conservation Data Centre, accessed August 2014).

Table 2-3. Listed wildlife species documented in and around Burnaby Lake

Species	Scientific name	Status
Red-legged Frog	*Rana aurora*	Blue
Western Painted Turtle	*Chrysemys picta bellii*	Red
Western Pond Turtle	*Actinemys marmorata*	Red
Western Grebe	*Aechmophorus occidentalis*	Red
Double-crested Cormorant	*Phalacrocorax auritus*	Blue
Great Blue Heron	*Ardea herodias*	Blue *(fannini)*
American Bittern	*Botaurus lentiginosus*	Blue
Green Heron	*Butorides virescens*	Blue
Short-billed Dowitcher	*Limnodromus griseus*	Blue
Peregrine Falcon	*Falco peregrinus*	Blue *(pealei)*
Band-tailed Pigeon	*Patagioenas fasciata*	Blue
Purple Martin	*Progne subis*	Blue
Snowshoe Hare	*Lepus americanus*	Red *(washingtonii)*
Long-tailed Weasel	*Mustela frenata*	Red *(altifrontalis)*
Blue Dasher	*Pachydiplax longipennis*	Blue
False Pimpernel	*Lindernia dubia* var. *anagallidea*	Blue

[3] Greater Vancouver Regional District, February 2001. Brunette Basin Watershed Plan.

Other reptiles and amphibians known to occur, or with some potential to occur in the project area include:

- Red-eared Slider *(Trachemys scripta elegans)*
- Midland Painted Turtle, (*Chrysemys picta marginata)*
- Bullfrog (*Lithobates catesbeianus)*
- Green Frog *(Lithobates clamitans)*
- Long Toed Salamander (*Ambystoma macrodactylum*)
- Northwestern Salamander *(Ambystoma gracile)*
- Western Toad (*Anaxyrus boreas*)

2.3 Western Painted Turtle Overwintering and Nesting Habitat

Western Painted Turtle overwintering habitat occurs near the coal recovery area at the Silver Creek and Burnaby Lake confluence. An artificially created/maintained nesting beach is located upslope of the coal recovery area. The turtle nesting beach is located next to a pedestrian trail circling Burnaby Lake and is on the east side of the confluence with Silver Creek and Burnaby Lake. The beach is approximately 118 m^2 in size and the substrate was classified as predominantly loamy sand based on criteria described in the United States Department of Agriculture Soil Survey Manual (SSDS, 1993). The nesting beach is relativity flat along the north end and begins to gently slope (up to 20 degrees) within 5 m of the shoreline. For detailed information on the turtle salvage and management of turtle habitat see Section 4.2.

3.0 Silver Creek – Derailment Site Stabilization

The channel and bank restoration works were designed by CN in consultation with Northwest Hydraulic Consultants Ltd (NHC) and the works were completed by Sonny's Excavating. Triton provided environmental monitoring services throughout construction (January 16 to February 10, 2014). The following tasks were completed in the CN ROW:

- The culverts at the Silver Creek crossing were dewatered and accumulated sediment was removed. A 2" high pressure water hose pushed material into an excavated sump, where it was collected by an excavator and removed from the channel (Appendix 2, Photos 1-6).
- Selected Danger Trees[4] and other trees located in areas of beaver activity in the CN ROW (23 specimens in total) were either removed or topped (Appendix 2, Photo 7). Hazard trees removed as part of the stabilization work were replaced with additional tree and tall shrub planting conducted as follows:
  - 12 Lodgepole Pine *(Pinus contorta)*, pot size #3;
  - 12 Sitka Spruce *(Picea sitchensis)*, pot size #3;
  - 12 Western red-cedar *(Thuja plicata)*, pot size #3;
  - 20 Hardhack *(Spiraea douglasii)*, pot size #2;
  - 30 Nootka Rose *(Rosa nutkana)*, pot size #2;
  - 25 Red Elderberry *(Sambucus racemosa)*, pot size #2;
  - 75 Red-osier Dogwood *(Cornus stolonifera)*, pot size #1;
  - 25 Snowberry *(Symphoricarpos albus)*, pot size #1; and,
  - 30 Thimbleberry *(Rubus parviflorus)*, pot size #2.
- Trees that fell across the stream or close to the tracks were removed from site. Trees felled on the south bank, away from the tracks, were left on site as habitat features. *Note: in August 2014, new leaf growth was observed on multiple topped deciduous specimens in the ROW.*
- Roughly 125 m of stream bank was armoured using ≤1 m diameter riprap over two sections of channel: (1) from the City's outfall to approximately 100 m downstream, and (2) a roughly 40 m long stretch where Silver Creek veers south away from the tracks (Appendix 2, Photos 8-30).
- The remnants of the failed beaver dam and dam building material were removed from the site, and accumulated fine sediments below the culverts (from past deposition events) were removed (under dry conditions).
- A knoll located 100 m downstream of the culvert outfall was removed. This knoll was identified as a channel constriction and potential point of failure during the initial post spill investigation and was removed under dry conditions using an excavator[5] (Appendix 2, Photo 31)

[4] Danger Trees identified by a Certified Danger Tree Assessor from Triton.

[5] Davey Tree Expert Co. was retained to remove the trees prior to knoll removal.

- Coal particles were opportunistically removed in working areas, with a combination of machine and hand removal efforts. This material was removed from the ROW for offsite disposal (Appendix 2, Photo 32).
- Two rock weirs (approximately 0.5 m tall, 6 m long and 2 m wide) were constructed in Silver Creek, including one weir upstream of the point where Silver Creek veers south away from the ROW and one below the culvert outlet pool. The weirs were installed to control water levels, reduce the likelihood of bank or channel erosion, and to encourage the creation and enhancement of fish habitat through backwatering and pool formation (Appendix 2, Photo 33).
- Rootwads and large woody debris (LWD) from the tree removal were incorporated into the bank protection/stabilization work to enhance fish habitat conditions (Appendix 2, Photo 34 and 35).
- Gravels (5 – 35 mm) were imported and used to line the channel from the rail crossing to approximately 100 m downstream of the crossing (Appendix 2, Photo 36).
- Composted soil grout[6] was sprayed onto the bank protection beginning at the City's storm sewer outfall and up to approximately 40 m downstream of the culverts to fill void spaces in support of re-vegetation. The grout included a grass and native woody plant seed mix (Appendix 3). CN is monitoring the re-growth and if the native shrub seed does not develop in the riprap area then re-planting will be conducted in the fall of 2014.
- Replanting with native stock was conducted adjacent to the City's storm sewer outfall into the Silver Creek channel and CN's ROW (approximate area of 425 m^2).

3.1 Construction Mitigation Measures

Construction mitigation measures and environmental monitoring tasks completed in support of the project included but were not limited to the following (Appendix 2 Photos):

- Instream works were completed in the dry with work area isolation accomplished using poly and sand bag dams and a combination of 6" and 3" pumps. Instream works were discontinued as needed when rain events occurred.
- At any given time, the isolated, dewatered work areas were limited in size to minimize overall channel disturbance.
- Extra pumps were available on site in case of equipment failure or rain events.
- An environmental monitor was onsite full time during instream works and conducted aquatic life salvages in each new isolation area (Table 3-1).
- Turbidity was monitored during construction and results showed construction work did not affect turbidity although turbidity spikes were observed originating from storm water during rain events(Appendix 4, and Appendix 2, Photos 7–10).
- Loose straw was spread onto exposed soils adjacent to Silver Creek as needed to prevent rain-splash erosion and sedimentation.

[6] Prepared and installed by DENBOW.

- Planting was conducted in disturbed areas as described above.
- Hazardous materials (fuels and oils) were stored in secondary containment and any refueling of equipment occurred at least 50 m from any watercourse.
- All equipment was visually inspected for leaks or excess grease or oil, and were all equipped with spill kits.
- The work area was clearly delineated to minimize the limits of disturbance.
- Garbage was removed from site on a daily basis for good housekeeping and to prevent impacts on local wildlife.

Channel and bank stabilization works and selective tree removal / topping in the CN ROW were evaluated by DFO through the Request for Review Process[7]. Fish salvages were completed under existing fish collection permits held by Triton (XR 8 2014 and SU13-85705).

Table 3-1. Summary of fish salvaged during Silver Creek derailment site stabilization

Date	Species	Fry	Juvenile	Adult	Total
16-Jan	Coastal Cutthroat Trout	0	24	1	25
16-Jan	Coho Salmon	30	0	0	30
16-Jan	Lamprey (General)	0	3	0	3
18-Jan	Coastal Cutthroat Trout	0	17	0	17
18-Jan	Coho Salmon	53	0	0	53
18-Jan	Lamprey (General)	0	13	0	13
19-Jan	Coastal Cutthroat Trout	0	8	0	8
19-Jan	Coho Salmon	12	0	0	12
19-Jan	Lamprey (General)	0	7	0	7
20-Jan	Coastal Cutthroat Trout	0	7	0	7
20-Jan	Coho Salmon	8	0	0	8
20-Jan	Lamprey (General)	0	1	0	1
21-Jan	Coho Salmon	6	0	0	6
22-Jan	Coastal Cutthroat Trout	0	2	0	2
22-Jan	Coho Salmon	4	0	0	4
23-Jan	Coastal Cutthroat Trout	0	8	0	8
23-Jan	Coho Salmon	14	0	0	14
23-Jan	Lamprey (General)	0	3	0	3
26-Jan	Coho Salmon	1	0	0	1
28-Jan	Coastal Cutthroat Trout	0	10	0	10
28-Jan	Coho Salmon	20	0	0	20
30-Jan	Coastal Cutthroat Trout	0	2	0	2
30-Jan	Coho Salmon	6	0	0	6
30-Jan	Lamprey (General)	0	2	0	2
02-Feb	Coastal Cutthroat Trout	0	16	0	16
02-Feb	Coho Salmon	62	0	0	62
02-Feb	Lamprey (General)	0	3	0	3
	Total	**216**	**126**	**1**	**343**

[7] A total of three (3) submissions were made to DFO as restoration plans for the ROW were finalized. In all cases, DFO indicated an Authorization was not required, as serious harm could be avoided

4.0 Coal Recovery in Burnaby Lake and Lower Silver Creek

Coal recovery from Burnaby Lake and lower Silver Creek was conducted by Quantum on the basis of work plans developed in consultation with federal and provincial regulatory agencies, and regional and local government agencies. Triton, Summit, and EBB, conducted turtle, amphibian and fish salvages ahead of and during the coal recovery program[8]. Triton also provided environmental monitoring and site restoration services for the project. The following list identifies some of the project-specific information sources reviewed to develop the site and task specific mitigation measures implemented during coal recovery (Appendix 5 Photos):

- Triton (January 2014) Mile 122.7 Derailment – Assessments of coal deposition in Burnaby Lake and Silver Creek;
- Triton (February 204) Mile 122.7 Derailment – Coal recovery plan for Silver Creek, Burnaby Lake and Brunette River;
- Ministry of Forests, Land and Natural Resource Operations (MFLNRO) (Kym Welstead) (February 2014) Response to Burnaby coal derailment - deposition & recovery plan;
- Quantum Murray (February 2014) Coal Recovery Work Plan;
- MFLNRO (Liz Freyman) (February 2014) Response to final coal recovery plan and EMP;
- Metro Vancouver (Greg Maximuk), and City of Burnaby (Christine Ensing) (February 2014) Response to coal recovery plan – meeting notes draft;
- Ministry of Environment-South Coast Region (February 2014) re: Burnaby Lake Coal Deposition Recovery Plan Review;
- CN Environment (Feb 2014) Response to Painted turtle comments raised by MFLNRO (Kym Welstead);
- Fisheries and Oceans Canada (14-HPAC-00141) (Feb 2014) Subject: Serious harm to fish can be avoided or mitigated (in response to CN's Request for Review of the coal recovery program at and around the confluence of Burnaby Lake and Silver Creek);
- Wildlife Act permit SU-1493104 issued for Western Painted Turtle, Midland Painted Turtle and Red-eared Slider salvage;
- Wildlife Act permit SU-1493104 issued for Northern Red-legged Frog, Western Toad, Northwestern Salamander, and Long Toed Salamander;
- Wildlife Act Permit SU13-85705 issued to Triton Environmental Consultants Ltd. for fish salvage in South Coast Region – all waters;

[8] For detailed turtle salvage information see the Burnaby Lake Coal Recovery – Turtle Salvage report (Summit 2014).

- License Number XR 8 2014 – Scientific License issued to Triton Environmental under section 4 of the Fisheries Act for Brunette River and tributaries including Silver Creek; and,

- City of Burnaby Comments on the January 25, 2014 Memorandum RE: Mile 122.7 Derailment – Burnaby Lake Coal Deposition Recovery Plan, by Triton Environmental Consultants Ltd.

4.1 Burnaby Lake Coal Recovery Schedule

Coal recovery in Burnaby Lake was completed between March 4 and April 2. This timeframe was selected on the basis of the following considerations:

- The seasonal life cycle of the Western Painted Turtle[9] includes breeding activity between March and July, with nest construction in June and July, followed by a 60 to 80 day incubation period;

    - MFLNRO indicated coal recovery and site restoration must be completed before May (identified as the start of the turtle nesting season); and,

- Fry emergence timing and the onset of nesting bird activity, particularly early nesting raptors (e.g. selected owl species).

Based on these considerations, CN completed the coal recovery program for Silver Creek and Burnaby Lake in March and early April 2014. Equipment mobilization and staging at Burnaby Lake started on February 26 and ended on March 3, 2014 (Appendix 5, Photos 1-9). Coal recovery began on March 4 and was completed by April 2, 2014. Demobilization and site restoration was completed by April 11, 2014.

4.2 Turtle Salvage

The turtle salvage was conducted from February 28 to April 2, 2014 under CN's *General Wildlife Act* Permit SU-1493104. The initial primary salvage was completed by a three to seven person crew led by turtle specialist Nicole Basaraba, M.Sc., P.Ag., from Summit Environmental and additional personnel from Triton and EBB Consulting. After March 4, supplementary turtle salvage was conducted by Triton personnel. The salvage emphasized raking the nesting beach, sifting sediments in the recovery area, (prior to coal being removed); as well as diver survey(s) and the use of dip nets, seine nets and traps in deeper areas (Appendix 5, Photos 10-14). Information about turtle salvage techniques and turtle activity monitoring is summarized below and additional information is included in the report titled *Burnaby Lake Coal Recovery – Turtle Salvage /Restoration, Yale Subdivision* (Summit 2014; Appendix 6).

[9] BC's Coast Region: Species & Ecosystems of Conservation Concern Western Painted Turtle – Pacific Coast Population (Chrysemys picta pop.1) Global: G5TNR Provincial S2: COSEWIC: SC E, BC List: Red (Adamah Consultants &Brent Matsuda, 2012)

4.2.1 Nesting Beach Salvage

Prior to coal recovery, the turtle nesting beach was covered with a 200 cm by 200 cm grid constructed using string and small wooden stakes. The grid was used as a visual reference to help organize search efforts. Each grid was carefully raked and screened to a depth of ≤20 cm in search of neonate turtles and their nests. Turtles were expected within 10 - 15 cm of the surface; however searches were conducted to 20 cm depth to ensure no nests were missed. A compacted layer of substrate was encountered in selected areas of the beach between 10 cm and 15 cm depth, and this layer prevented deeper salvage efforts only in those areas.

4.2.2 Shoreline Salvage

After the nesting beach salvage was completed, efforts were made to isolate the coal recovery area. During the initial stages of this process, a diver searched deeper waters (i.e. ≥1 m) for turtles and attempted to secure a silt curtain to the bottom of the lake. However, the area could not be fully isolated with the silt curtain because high flows from Silver Creek, in conjunction with dam operations, destabilized the curtain. Shallow portions of the coal recovery area (e.g. the alluvial fan) were isolated using silt fencing in efforts to minimize impacts to the area from the high flow of Silver Creek into Burnaby Lake.

The first area isolated was directly in front of the turtle nesting beach. This area was hand-searched for turtles of all age classes by raking sediment to the shoreline or into piles. Deeper areas were searched using a seine net to dredge the top layer of the isolated area, and again with four people in a line swathing the area with dip nets to detect turtles or turtle movement. Two basking logs in the coal recovery area were removed during this time using an excavator. They were later pressure washed and replaced under supervision of the EM during site restoration. The second and third areas were then isolated using silt fence (the second area was located to the west of the outlet of Silver Creek and Burnaby Lake and the third was to the east of the outlet of Silver Creek bordered along the second area). Hand searches were conducted for turtles of all age classes by raking sediment up to the shoreline or into piles. The deeper areas were searched using a seine net to dredge the top layer of the isolated area. Finally, the areas were swathed by three people in a line using dip nets to search for turtles or turtle movement. The same isolation areas were salvaged for amphibians and fish.

Once the isolated areas were cleared of aquatic life, Quantum used the vacuum truck system to suck coal and water into drying bins on site, where water was decanted through the water treatment system (see Section 4.3.2). The dried material was then disposed of offsite. Initially, the vacuum was outfitted with a metal screen to protect any undetected turtles from the vacuum system; however, initial attempts with this method prevented successful recovery of the coal and the screen had to be removed at various times, until a modified screen was later attached (see Section 4.3). To help mitigate impacts, Quantum staff maneuvered the vacuum end slowly through the piles of substrate that had been previous sifted through for turtles.

4.2.3 Offshore Salvage

When coal removal began in the deep water sections, the environmental monitor typically conducted a minimum of two passes of the work area using a 15 m long x 3 m deep, 60 mm

mesh seine net ahead of any coal recovery. No turtles or other animals were captured by seining and this method was discontinued after the first 6 days of deep water recovery. At that time, divers had begun working further away from the alluvial fan, and based on previous seining results it was determined either no turtles were present in the area or the seining was not an effective technique. Coal removal was also closely controlled in the water by the divers, who worked the equipment by hand to maximize coal recovery and ensure no adult turtles were removed inadvertently. No turtles were encountered or observed during the deep water coal recovery by divers.

4.2.4 Turtle Activity Monitoring

Three hoop traps were set from March 3 to March 28, south of the coal recovery area to determine whether adult and juvenile turtles were moving nearby in Burnaby Lake. These traps were baited with sardines (in soya oil) and checked at intervals of 4 to 12 hours. Traps were deployed for a total 1,080 trap hours. In addition, the environmental monitor conducted surveys of the shoreline to search for basking turtles. No basking turtles were observed until March 31, during sunny conditions. One turtle (species unknown) was seen basking on a log approximately 20 m upstream of the work area. On April 1 (again under sunny conditions), two turtles were observed basking on the shoreline, one (species unknown) approximately 50 m downstream of the recovery area, and a second turtle (identified in the field as a painted turtle or a hybrid) approximately 115 m downstream. On the last day of coal removal (April 2), when conditions were even warmer (and sunny), eight turtles were observed at one time at various locations between 20 and 120 m from the work area.

4.2.5 Salvage Results

One hundred and five (105) live neonate turtles in 11 locations were detected at the nesting beach. One additional neonate was found in an isolated coal recovery area directly adjacent to the turtle nesting beach and one neonate was recovered walking along the shoreline. Eleven (11) of the 19 suspected nests were viable with live neonates detected. Most of the nests were found under an open canopy, within 3 m of the shoreline on a west-southwest-facing slope with approximately 20-degree slope. All captured turtles were delivered to Species at Risk Biologist Kym Welstead to confirm species and collect measurements, as per CN's work plan and General Wildlife Permit (SU14-93104). A total of 61 turtles were identified by MFLNRO staff as either Midland Painted Turtles (an invasive species in BC) or as hybrids of Western Painted and Midland Painted Turtles. The remaining 46 turtles appeared to be Western Painted Turtles; however, 41 of these identifications are pending genetic confirmation of the species. All individuals identified as Midland Painted Turtles or hybrids (61 total), and all other turtles that were in grave condition (3 of the 46 tentatively identified Western Painted Turtles) were sent to be euthanized, as requested by the Species At Risk Biologist (K. Welstead) and as per CN's General Wildlife Permit.

4.3 Coal Recovery Methods

Coal deposits were removed in Burnaby Lake and Silver Creek, downstream of the pedestrian footbridge, by vac truck suction dredging, supported by hand recovery. Suction hoses were fitted with screening device(s) to prevent turtles from being sucked into the recovery system and to

reduce clogging. The first screen was constructed of aluminum and fitted directly to the end of the hose. The screen had a 2 cm by 2 cm grid size. The second screen was also constructed of aluminum, and was shaped like a standard tapered vacuum head with a long handle (Appendix 5, Photos 15-16). This second screen had an approximately 4 cm by 8 cm grid size. The third screen was constructed of wire and fitted directly to the end of the hose. The grid pattern of the screen was approximately 3 cm by 3 cm.

The dredgeate was removed from the working areas to a series of onsite collection bins attached to a water treatment system (see Section 4.3.2 for detail). Prior to coal recovery, a staked grid was installed in near shore and offshore working areas to delineate areas of coal recovery. Daily coal recovery progress was monitored by calculating the number of individual squares in the grid cleaned over the course of the day. Each square was cleaned by a two person crew, and each square was dredged a minimum of two times, until at least 90% of the visible coal was removed. In deeper areas divers were used to operate the suction dredge and specifically target areas of deposition for coal recovery (Appendix 5, Photos 17-22).

4.3.1 Work Area Isolation

The in-lake work area was isolated with a silt curtain and sediment fencing to contain disturbance in the water column (Appendix 5, Photo 23). Additional measures to further partition the work area, and to contain or isolate smaller daily work areas was implemented as needed and included the use of sand bags, and other geotextile barriers. A 6" electric pump was installed near the footbridge in Silver Creek to divert at least a portion of flow around the work area. Aquatic life salvages were conducted as necessary to remove turtles, amphibians and fish from daily working areas.

4.3.2 Water Treatment System

An overview of the treatment system used for on-site treatment of water from the coal recovery operation is shown in Figure 4-1. The vac truck excavation/suction system discharged coal and water into a series of modified collection bins for dewatering[10]. The dewatering bins included a combination of metal screens and non-woven geotextile cloth for straining coal and other debris from the water. Water was typically discharged continuously to one screening container until the container was partially full of coal and sediment. Water was then discharged to a second container while the previous container was emptied and coal was removed for off-site holding and assessment at Quantum until the final disposal location and method had been determined.

The strained water was removed from the bins by pumping and pushed through a pH adjustment system. From there the water flowed through tubes housing chitosan flocculent belts. Flocculent treated water then settled through a series of tanks before being processed by mechanical filtration. The mechanical filtration system included an automated sand filter to remove particulates larger than 20 microns. The sand filter was followed by bag filters that removed

[10] The coal and water slurry was vacuumed off the lake bed and discharged into three (3) drying bins for product separation. The water was pumped from these bins to a treatment system including (in order of components): 100 micron bag filter, pH adjustment box (1), chitosan flocculent belts (2), four – 5,000 gallon settling tanks, sand filter system (20 micron) additional bag filter (5 microns) and two series of carbon vessels (total of four) and pH adjustment (2). The treated water was discharged into Burnaby Lake approximately 100 m upstream of the Cariboo Dam

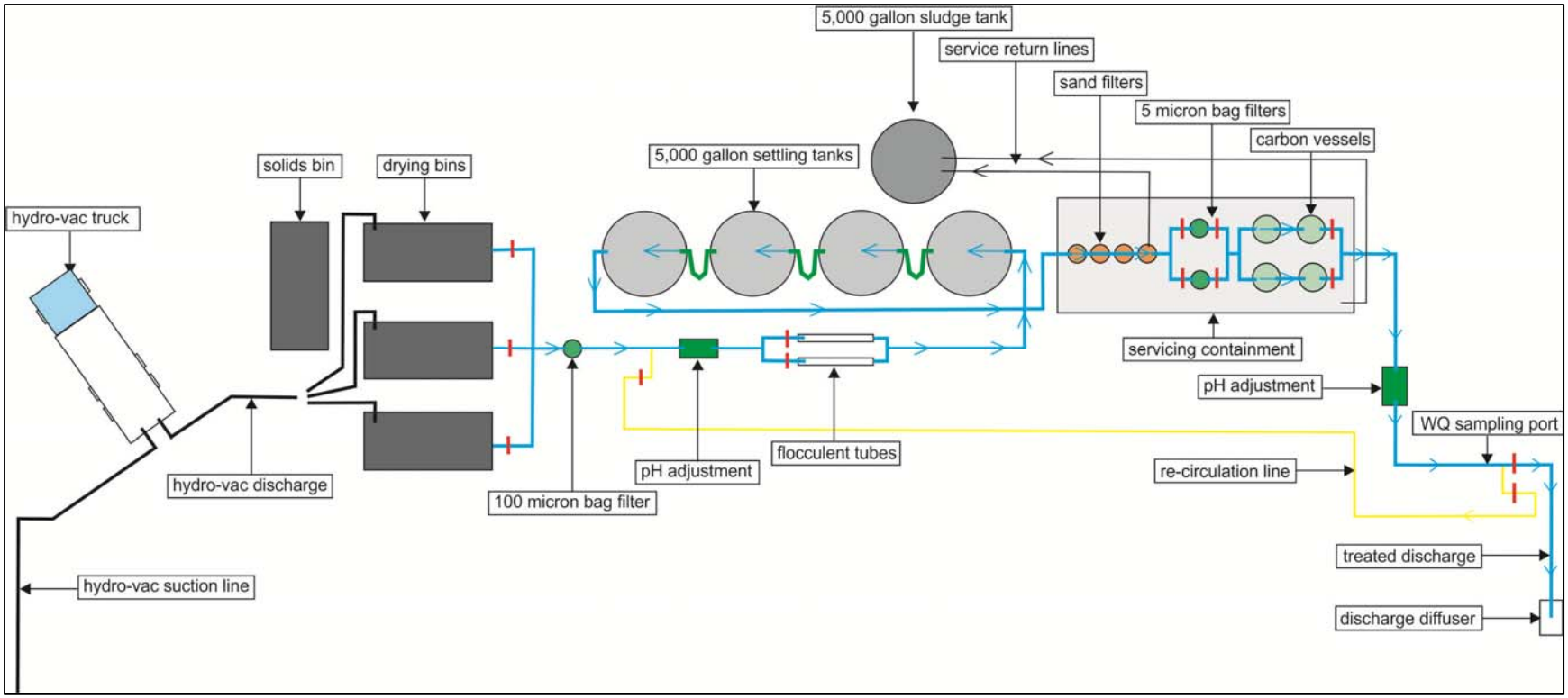

Figure 4-1. Schematic detailing the water treatment system used in the Burnaby Lake coal recovery project

particulates down to 5 microns. Finally the water was polished using four carbon vessels in series and parallel format.

A sampling port after the final vessel in the water treatment system allowed for monitoring of discharge water quality, and flow through the system was measured with a flow meter at the discharge location. If at any time water quality measurements indicated treatment objectives were not being achieved, the discharge valve was closed and water was recirculated back through the treatment system. When water quality measurements confirmed water quality objectives were being achieved water was discharged directly to Burnaby Lake. The discharge pipe was surrounded by a silt curtain in the water, and wood forms and filter fabric were used to dissipate the energy of the discharge to limit disturbance of sediment in the lake bottom (Appendix 5, Photo 24).

4.4 Coal Recovery Mitigation Measures

The recovery program had some potential to impact fish and other aquatic life (e.g. turtles or amphibians) from physical removal or exposure to suspended particulates. Foot access for recovery work and removal of deposits had some potential to mobilize fines and cause temporary increases in turbidity or impacts on riparian vegetation (through trampling). Both foot access and coal removal had some potential to impact buried eggs or alevins in the Silver Creek substrate, as well as hibernating turtles in the bottom sediments of Burnaby Lake, and neonate turtles at the turtle nesting beach. While best efforts were made to remove as much deposited material as possible; coal removal was balanced with mitigation measures or avoidance to minimize impacts to existing habitat (e.g. underlying organic layers) and aquatic life.

Coal deposits on the alluvial fan of Silver Creek were below the water level, although the depth of deposition and particle size of the deposits varied by location. Depth of deposition ranged from 3 mm to 500 mm on the fan, and particle size ranged from 1 mm to 50 mm. Offshore of the alluvial fan thin layers of coal were deposited at depths of up to 1.8 m. Given the volume of coal to be removed, and the potential for re-suspending particulates in the water column, work area isolation was implemented to contain the increased turbidity of water disturbed during coal recovery.

The turtle nesting beach was salvaged ahead of any coal recovery, to prevent potential impacts on buried turtles associated with foot and equipment access and in case of spills. For more information on the turtle salvage and management of turtle habitat see the *Burnaby Lake Coal Recovery Turtle Salvage/Restoration Report, Yale Subdivision* (Summit 2014; Appendix 6). Aquatic life salvages were conducted down slope of the nesting beach to remove animals from the work area, both to minimize exposure to turbid conditions and minimize the potential for removal during suction dredging. The work areas were salvaged for aquatic life on an ongoing basis (e.g. daily) during coal recovery.

Mitigation measures implemented during the recovery program included the following:

Nesting beach

- The turtle nesting beach was carefully raked/screened to a depth of 20 cm (8”) to look for neonate/ hatchling turtles prior to equipment traversing out on the beach.

- The nesting beach was covered with geotextile and sediment fencing to minimize the potential for inadvertent contamination of the nesting substrate with organic material (Appendix 5, Photos 25-27).

- A containment structure on the nesting beach was built using geotextile, poly, and plywood to distribute the weight of the vac trucks and minimize compaction.

Water quality protection

- Inshore work areas on the alluvial fan were isolated with sediment fence to contain disturbance in the water column. Additional measures to further partition the work area, and to contain or isolate daily work area were implemented as needed and included the use of sand bags, and additional geotextile barriers. A 6" electric pump was also installed near the footbridge in Silver Creek to divert at least a portion of flow around the work area. Coal recovery operations (i.e. dredging) generally created a negative pressure situation inside the isolated work area so that sediment laden water was contained within the silt fence barriers.

- The offshore working area was first isolated with a double-walled silt curtain to contain sediments mobilized during the recovery. However, elevated flows in Burnaby Lake destabilized the curtain and the recovery team moved to a sediment fence and sand bag system in the shallow areas (< 1 m deep).

- In the deeper areas (≥ 1 m but < 1.8 m) the suction hose was positioned such that it was facing into the flow to minimize sediment suspension in the water column.

- Turbidity levels and other water quality parameters were closely monitored by the EM at *in situ* monitoring stations, which were adjusted daily to be as close as possible to the actual work area. In addition, water quality logging stations (Sondes) were established upstream and downstream of the work area. Water quality measurements from the receiving environment and the treatment system demonstrated general compliance with BC (provincial) and Canadian Council of Ministers of the Environment (CCME; federal) Protection of Aquatic Life (PAL) water quality guidelines[11]. Water quality data collected during the coal recovery program was summarized in a separate report prepared by CN (CN 2014; *Summary of in situ and Analytical Water Quality Data Collected as Part of the Burnaby Lake Coal Recovery Program*).

Flow diversion

- In an attempt to reduce the potential for sediment dispersal by water flowing through the work area, partial flows from Silver Creek were diverted around the work area with a 6" submersible pump installed inside a suitable fish screen near the Silver Creek footbridge. This pump was primarily used to reduce velocities during high flows.

[11] Water quality notes from *Summary of in situ and Analytical Water Quality Data Collected as Part of the Burnaby Lake Coal Recovery Program:* pH > 9.0 was recorded in treated discharge on system initialization, but did not result in pH > 9.0 in the receiving environment; the induced turbidity >8 NTU during typical coal recovery working hours (08:00 to 17:00) in Burnaby Lake, relative to background turbidity in Burnaby Lake ranged from 8.2 NTU to 38.4 NTU. These exceedances were temporary and ranged in duration from <0.5 hours to 3 hours, but typically lasted for ≤ 1 hour

Aquatic life salvage

- Once the work area isolation(s) had been installed a salvage was conducted to capture and remove fish and other aquatic life from the work area (See Section 4.5 for capture data).
    - The initial aquatic life salvage encompassed the entire work area, and subsequent daily salvages targeted specific areas where work was proposed for the day.
- Aquatic life salvages were conducted by environmental professionals experienced in capturing and handling aquatic life, and salvage crews followed the Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia (Biolinx and Wind, 2004).
    - Summit Environmental was retained by CN to lead the turtle salvage program, with assistance from Triton and EBB Consulting (who also led the amphibian salvage).
    - The fish salvage was be led by Triton with support from EBB Consulting during amphibian salvage portions of the project.
    - All reptiles (turtles) were held and transferred to Kym Welstead (MFLNRO) for confirmation of identification and subsequent disposition.
- All fish and native amphibians were temporarily held in buckets of well aerated water before being enumerated and relocated at least 100 m west of the work zone or above the isolation net in Silver Creek.
- A dive survey was conducted along in the work area to look and feel for turtles that may be hibernating in the soft sediments at the edge of the alluvial fan.
    - Sediment and vegetation within 2 m of the shoreline or the two (2) basking platforms was hand salvaged and raked to look and feel for turtles that may be hibernating in the sediment.
    - Sediment and vegetation (including riparian vegetation) within 2 m of the shoreline was hand salvaged to look and feel for turtles that may be hibernating in the sediment or among vegetation.
    - The salvage focused on daily work areas as well as in-shore areas at the mouth of Silver Creek where vegetation and LWD provided cover for fish and better conditions for capture.
    - Aquatic life capture methods included (but were not necessarily limited to) minnow traps, hoop traps, beach seining, pole seining, dip netting, and hand salvage.
    - The final phase of the salvage was completed by electrofishing through the work area in order to capture/ remove as many organisms as possible.
    - A fyke net with 3 mm mesh netting was also installed in Silver Creek downstream of the footbridge to isolate the work area and prevent fish from migrating into the work zone from Silver Creek (Appendix 5, Photo 28).

Water quality treatment and monitoring

- Discharge water and coal were screened through an upland containment treatment system to remove suspended solids.

- Discharge water quality was monitored through periodic measurements of water quality to ensure compliance with applicable water quality guidelines. This included a combination of strategies including the use of hand held meters[12], three (3) (YSI Model 556 multi-probe system (MPS) - 6920-V2 Sondes (Figure 4-2) and analytical sample collection.

- *In situ* data collection focused on temperature, turbidity, conductivity and pH, although dissolved oxygen (DO), salinity and ORP were also measured and recorded.

- Analytical data collection focused on:
  - Alkalinity (speciated);
  - Chloride;
  - Hardness;
  - Extractable Petroleum Hydrocarbons (EPH);
  - Nutrients (NH_3, NO_3, NO_2, C);
  - pH;
  - Polycyclic Aromatic Hydrocarbons (PAH);
  - Sulphate;
  - Sulphide;
  - Total and dissolved metals;
  - Total dissolved solids (TDS);
  - Total suspended solids (TSS); and,
  - Turbidity.

Temperature was monitored as part of the Western Painted Turtle and amphibian salvage programs[13]. Turbidity, conductivity and pH were monitored to evaluate treatment system performance. The *in situ* and analytical water quality data were compiled and summarized in CN's April 2014 submissions to Environment Canada. As indicated above, these data indicated general compliance with available CCME guidelines and BC Approved / Working Water Quality Guidelines for the protection of aquatic life[14].

[12] YSI Professional Plus, Hanna Instruments – Model HI 98129, LaMotte 2020we Turbidimeter

[13] Temperatures impact turtle activity and amphibian breeding activity (i.e. increased activity at temperatures consistently >5°C)

[14] Polycyclic Aromatic Hydrocarbons (PAH) were not detected in the treated discharge. Total lead in the treated discharge exceeded the CCME guideline once but did not exceed the provincial lead guideline. Total cadmium in the treated discharge exceeded the provincial guideline value once, but was below the concurrent background in Burnaby Lake and below the CCME guideline. Finally, total copper in the treated discharge exceeded the CCME guideline once, but levels were also below background in Burnaby Lake and the provincial guideline level.

Environmental Monitoring

Triton measured *in situ* water quality parameters (e.g., turbidity, pH)[15] from the downstream end of the water treatment system and near the discharge point back to Burnaby Lake. The frequency of monitoring varied depending on the status of the coal recovery efforts and the duration the system had been operating for the day (e.g. monitoring was more frequent during early stages of the treatment program and decreased over time once system effectiveness had been established). At a minimum the EM endeavoured to collect measurements at a variety of sites every two hours. These measurements were compared to background measurements upstream of the work area in Silver Creek. If water quality objectives (e.g. provincial and federal water quality guidelines) were not being achieved, Triton worked with Quantum to re-circulate water as necessary as well as identify and implement system adjustments. Throughout the coal recovery project the water treatment system functioned as intended and discharge was compliant with applicable water quality guidelines. *In situ* data collected by Triton was augmented with data collected from three (3) Sonde stations[16] distributed at locations upstream and downstream of coal recovery areas (Figure 4-2).

Throughout the project the EM worked with Quantum to evaluate the effectiveness of the coal recovery. This evaluation included visual assessments, photo documentation, and the ongoing collection of core samples to evaluate shallow and deep water coal recovery. This information was tracked on a daily basis and used to plan and direct subsequent coal recovery work (Appendix 5, Photos 29-31). Upon completion of the coal recovery program a survey of the alluvial fan was conducted to compare remaining deposits with those identified during the initial deposition assessment. The final survey identified only trace amounts of coal and confirmed the goal of >90% recovery had been achieved.

4.5 Aquatic Life Salvage Results

Aquatic life salvaged from Burnaby Lake and lower Silver Creek during the coal recovery program is summarized in Table 4-1.

Table 4-1. Summary of aquatic salvage results during the coal recovery program

Species	Scientific name	Number of individuals salvaged
Bullfrog	*Lithobates catesbeianus*	4
Coho Salmon	*O. kisutch*	1
Lamprey	*Lampetra sp.*	2
Long-toed Salamander	*Ambystoma macrodactylum*	1
Midland Painted Turtle or hybrids	*Chrysemys picta marginata*	61
Northwestern Salamander	*Ambystoma gracile*	2
Prickly Sculpin	*Cottus asper*	1
Threespine Stickleback	*Gasterosteus aculeatus*	57
Western Painted Turtle*	*Chrysemys picta bellii*	46

*Turtle species still pending confirmation from genetic tests being performed by MFLNRO

[15] YSI Professional Plus, Hanna Instruments – Model HI 98129, LaMotte 2020we Turbidimeter)

[16] Model 556 multi probe system (MPS) - 6920-V2 Sonde)

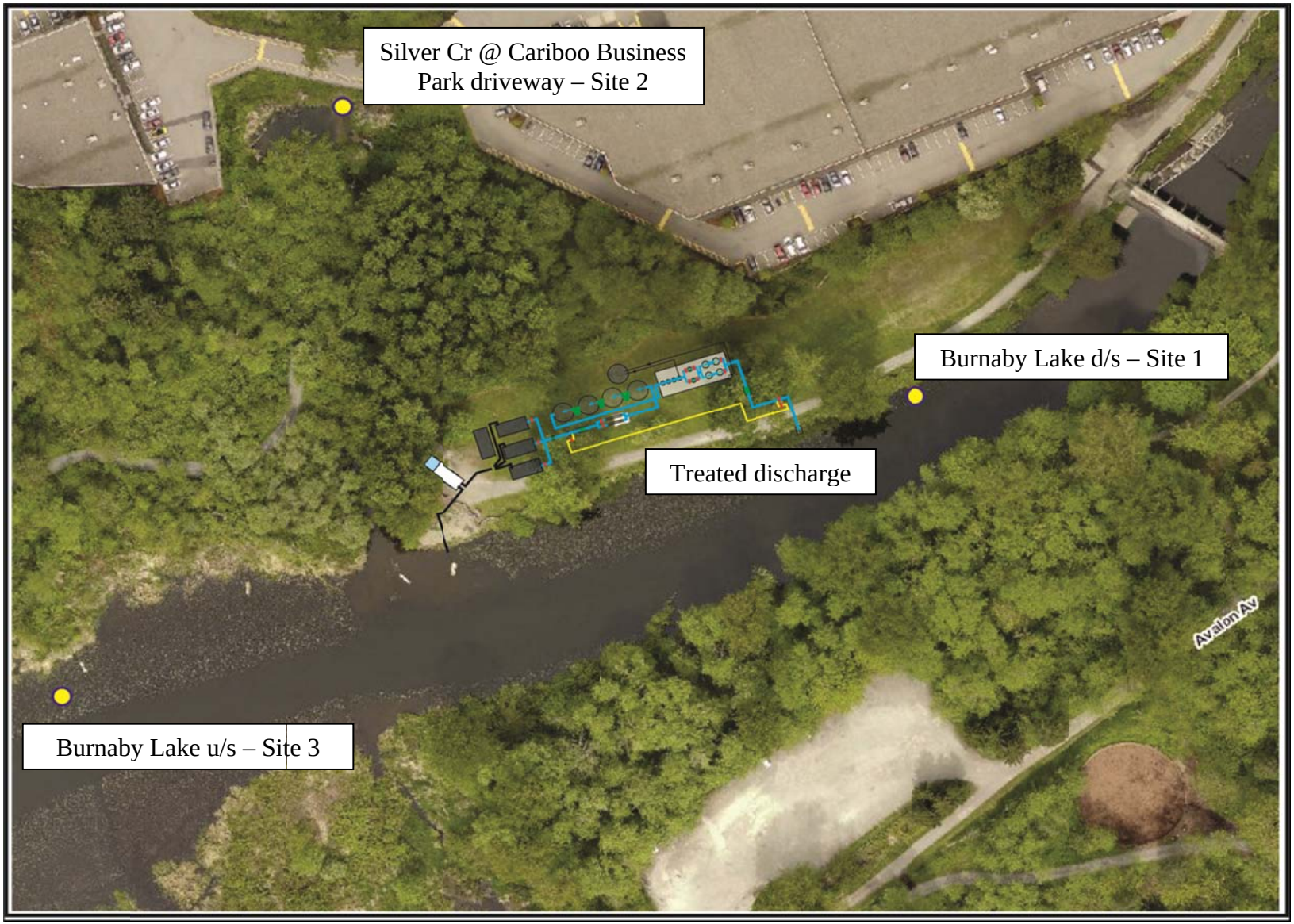

Figure 4-2. Location of water quality sampling stations and water treatment system

4.6 Wildlife Observations

Incidental wildlife observations during the coal recovery works included beaver *(Castor candensis)*, North American River Otter *(Lontra canadensis)*, Canada goose *(Branta canadensis)*, Great Blue Heron (*Ardea herodias*), and Mallard Ducks *(Anas platyrhynchos)*.

4.7 Burnaby Lake Site Restoration

Coal recovery from the alluvial fan required access for heavy equipment and trucks as well as other disturbances to install and operate the water treatment system. Upon completion of coal recovery, the alluvial fan and other disturbed areas were assessed to compare pre and post coal recovery conditions. Restoration plans for disturbed areas were prepared based on the results of the survey and in consultation with Metro Vancouver and MFLNRO. Site restoration included the following (Appendix 5, Photos 32-38):

- Lay down and staging areas were restored based on discussions and requirements expressed by Metro Vancouver (property owner).
- Gravel was removed (from lay down areas) and the associated disturbed areas were restored and re-seeded. A truck load of Turf Builder Pro-soil was brought in for the restoration of the disturbed areas and the drainage ditches.
- Two truckloads of clean gravels were donated by CN to Burnaby Lake Park for use by Metro Vancouver. At the request of Metro Vancouver the gravel was staged in the parking lot south of the confluence of Silver Creek and Burnaby Lake.
- As discussed with Metro Vancouver personnel, the drainage ditches we filled with clean crush rock then capped with the Turf Builder Prosoil and seeded. This will continue to allow the park to drain but will provide a solid flat surface to aid lawn mowing and other maintenance.
- Pedestrian trails were restored to pre-construction condition. The PVC culvert across the walkway was reinstalled to its previous placement and tested to ensure its functionality had not been affected.
- Rakes and an excavator were used to turn the nesting beach sand in order to eliminate compaction. The beach sand was raked to a depth of ≤20 cm, depending on the depth of the base compact clay material. Organics (leaf matter, root systems, tree stumps) were removed from the nesting beach. Pedestrian exclusion fencing was reinstated and signage was replaced;
    - MFLNRO visited the site during fence restoration and directed Quantum to re-position the fence to expand the nesting beach by approximately 4 m^2.
- Turtle basking platforms were pressure washed to remove coal and/or staining and then reinstalled back to their original position, ~5 m offshore from the nesting beach.

Riparian planting was not required along Burnaby Lake as limited disturbance to riparian vegetation resulted from the program.

5.0 Coal Recovery in Silver Creek

5.1 Silver Creek Mainstem

The majority of the coal deposits in Silver Creek were located above the wetted edge in small pockets allowing recovery with hand tools. Isolation and dewatering in support of coal recovery was not considered necessary (or feasible) as these activities could have impacted eggs or alevins. However an estimated 5 m^3 of coal was recovered with minimal impact to local water quality and riparian habitat, as well as minimal risk to buried eggs or alevins as suitable mitigation measures were implemented. Mitigation measures included:

- Coal recovery took place under low flow conditions and focused on localized deposits above the water level.
- Access through the channel was minimized to avoid potential disturbance of buried eggs or alevins.
- Disturbance of riparian vegetation was minimized by using a small number of designated access trails and by to pushing vegetation aside wherever possible, or minimal cutting of vegetation if necessary (e.g. grubbing was not permitted, except for non-native species).
- Vacuums (e.g. industrial shop vac) with extended suction hoses to specifically target coal deposits were used to target some coal deposits.
- Where coal recovery took place using shovels or close to the wetted edge, measures to isolate the immediate work area and control the risk from accidental spills were implemented where possible (e.g. temporary placement of geo-textile, plywood, silt fence or poly sheeting to contain spilled coal during recovery).
- In addition to removing coal, the crew removed other *non-spill* related waste products identified during the deposition assessment (e.g., remnant snow fence, plastics) and other non–natural products incidentally observed.
- To ensure workers conducting coal removal were aware of the potential impacts from recovery work they were oriented by the Triton project environmental monitor:
    - Workers were advised on the size and type of deposits to be removed, methods to minimize disturbance of wetted habitat and riparian vegetation during access, (e.g., temporary isolation and avoidance); and,
    - The monitor conducted periodic inspections to assess progress of the work, and evaluate the success of the recovery and the methods being used to recover coal.

Upon completion of coal recovery a survey of the channel was conducted to compare remaining deposits with those identified during the initial deposition assessment. The final survey identified only trace amounts of coal and confirmed the goal of >90% recovery had been achieved.

5.2 Silver Creek Off-channel Habitat

Removal of coal from the off channel habitat area near the Cariboo Business Park driveway (21 m x 2 m) was completed with mechanically assisted removal (vac truck) on March 22, 2014. (Appendix 5, Photos 39-40). The work area was isolated with sand bags wrapped in plastic and was dewatered to facilitate coal removal. All coal removed for this site was taken to the water treatment system and processed in the same manner as the coal from Burnaby Lake. Prior to coal removal, an aquatic life salvage was undertaken to look for and remove fish, turtles and amphibians. No fish, turtles or amphibians were observed during the salvage. There was no vegetation removal during the recovery in this area, so no replanting was required.

Coal deposition assessments in the off channel area identified deposits ranging from a depth of 50 mm to 200 mm, however during the recovery, material was removed to a depth of approximately 500 mm to increase the wetted depth and improve the overall functionality of the off channel habitat. An estimated 21.0 m^3 of material (e.g. coal, sediment and organics) was removed which restored capacity and enhanced functionality in the off channel pond. Coal recovery in this area was also monitored full time by the EM.

Upon completion of removal, the off channel area survey was repeated to compare remaining deposits with those identified during the initial deposition assessment. The final survey showed that no coal could be seen and the goal of >90% recovery had been achieved.

6.0 Summary and Conclusions

6.1 Silver Creek restoration in the CN ROW

The Silver Creek channel and bank stabilization program near the derailment site was completed by February10, 2014. Instream works were completed in the dry and turbidity data collected during construction indicate compliance with available provincial and federal water quality guidelines. However discharges originating for the City of Burnaby storm sewer system (e.g. during rain events) did occasionally exceed approved turbidity guidelines for aquatic life (Appendix 2 and 4). No spills of potentially hazardous materials occurred during the work. A total of 343 fish were salvaged including 216 Coho Salmon, 95 Cutthroat Trout, and 32 Lamprey. A total of 23 trees identified as Danger Trees or considered at risk, for or from, beaver damage were either removed or topped. Trees were replaced at a ratio of 2:1 and additional shrub planting was conducted both in areas disturbed by construction and along the south bank of the stream in open patches. A total of 241 plants were installed in the ROW by March 20, 2014.

6.2 Coal recovery

An estimated total of 142.8 tonnes of mixed coal, organic and mineral fines was removed during the coal recovery program. Based on the recovery performance criteria identified in the field, no further coal removal is considered practical without significant removal of important stream bed material (e.g. spawning gravels). Aquatic life salvages were successful in removing 61 fish, 107 turtles and seven amphibians from working areas. All turtles were delivered to MFLNRO Species at Risk Biologist Kym Welstead as agreed upon at project start up.

Park use was maintained via the temporarily re-routed trail and site restoration was completed by April 11, 2014 in consultation with Metro Vancouver personnel. Sediment controls (e.g. silt fencing) installed in Burnaby Lake helped maintain compliance with water quality guidelines for particulates. Water quality monitoring confirmed the treatment system adjusted the pH toward neutral [17], maintained low levels of TSS (<2 mg/L); with no detected PAH in the treated discharge and only one incidence of a single metal (lead) above background conditions in the treated discharge. Mitigation measures to protect the turtle nesting beach (containment pad and filter fabric, installing sediment fence to restrict foot traffic, isolating aquatic recovery areas) worked to protect the nesting beach and nearby offshore habitats from physical disturbance and / or potential contamination from spills.

[17] With some short term elevated pH levels (e.g. 9.21 in a March 7, 2014 analytical sample) at start up; which did not result in pH levels > 9.0 in the receiving environment

7.0 Closing

If you have any questions, comments or concerns please feel free to contact the undersigned at 604 631 2231 or Dschiller@triton-env.com

Prepared by:

Darcy Schiller B.Sc., BIT
Biologist

Reviewed by:

Peter Frederiksen, Dip.T. CPESC
Project Manager

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APPENDIX 1

COAL DEPOSITION SURVEY PHOTOS

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Photo 1. Example of large particle deposition across the channel near Silver Creek confluence with Burnaby Lake, January 16, 2014.

Photo 2. Sample of coal particle size in Silver Creek, from fines to 6 cm (large gravel), at the confluence (41m downstream of footbridge), January 16, 2014.

Photo 3. Example of surface dusting in Silver Creek, 35 m downstream of footbridge, January 16, 2014.

Photo 4. Small pocket (0.4 m^2) of large particles (1 - 4 cm diameter) up to 12 cm thick, observed near the footbridge in Silver Creek, January 16, 2014.

Photo 5. Stratified deposit of various particle sizes (fines at the surface, coarser grain underneath) with sand layers in between, in Silver Creek 118 m upstream from footbridge, January 16, 2014.

Photo 6. Deposition area (3.75 m2) of fines to 3-5 mm particles, up to 25 cm thick in Silver Creek 195 m upstream from footbridge, January 16, 2014.

Photo 7. Representative coarse particle size of core samples collected along the west portion of alluvial fan in Burnaby Lake, January 17, 2014.

Photo 8. Representative example of fine particle size core sample and division of substrate layers collected along the east portion of the alluvial fan (25 m transect 4 m from shore), January 17, 2014.

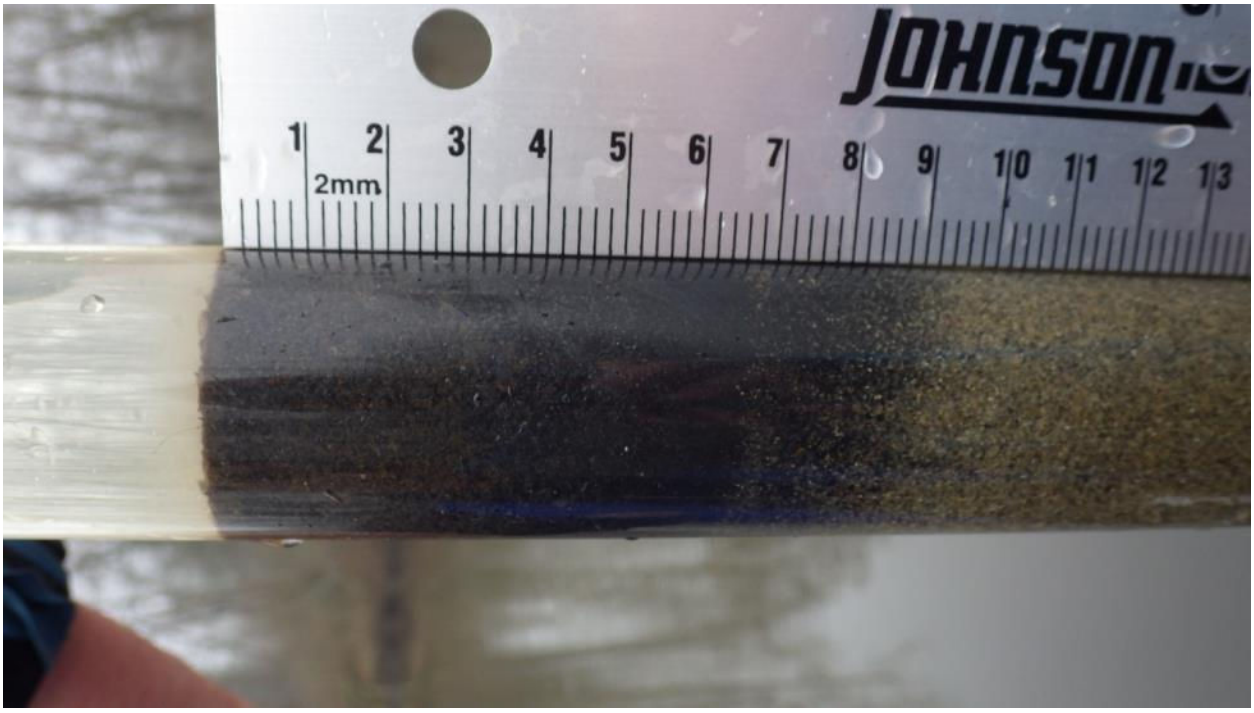

Photo 9. Example of clear contact between coal deposition and underlying sand substrate. Core sample collected on alluvial fan at 25 m transect, 15.5 m from shore in Burnaby Lake, January 17, 2014.

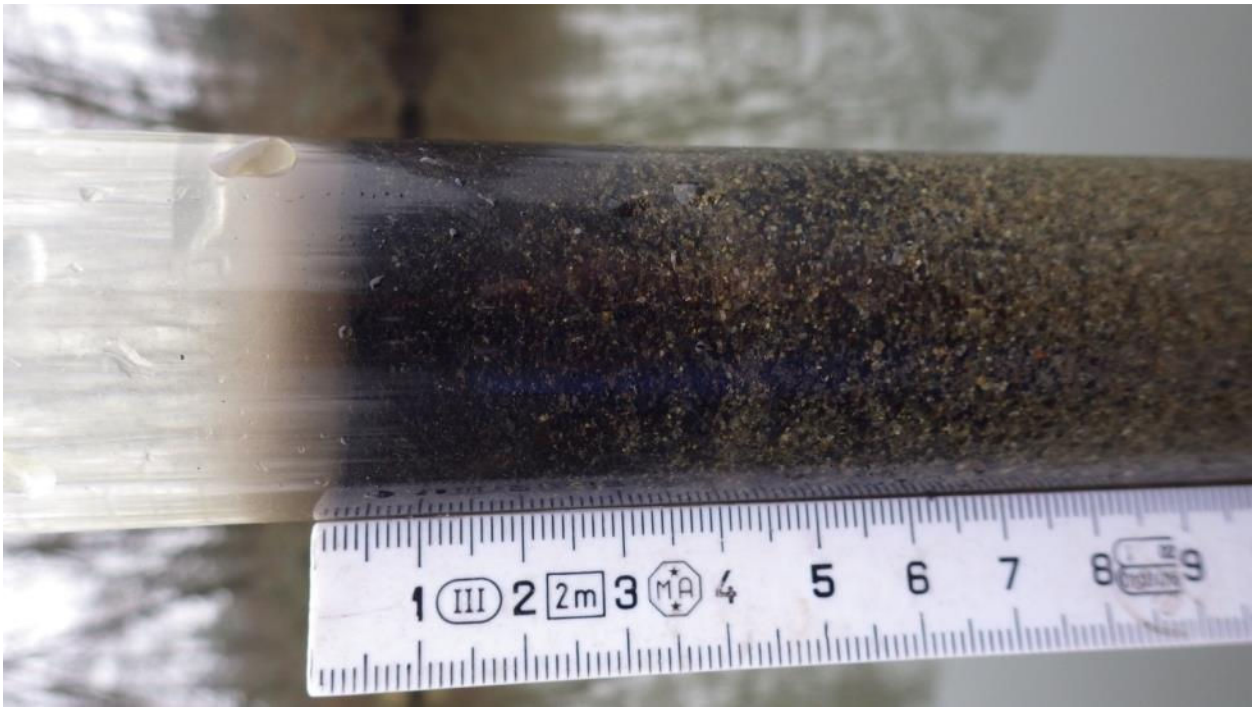

Photo 10. Example of mixed contact between coal deposition and underlying sand substrate. Core sample collected on alluvial fan at 30 m transect, 13.5 m from shore in Burnaby Lake, January 17, 2014.

Photo 11. Example of surface deposition observed on an elevated bench along Brunette River approximately 1.3 m above low water level. The deposit was 15 m long by 7 m wide (estimated coverage of 1% and 1-5 mm deep) approximately 50 m downstream of the Gaglardi Overpass, January 29, 2014.

Photo 12. Example of surface deposition located on an elevated bench along Brunette River approximately 0.8 m above low water level. The deposit was 4 m long by 1.5 m wide (estimated coverage of 1% and up to 5 mm deep) located approximately 40 m downstream of Hume Park, New Westminster, January 29, 2014.

Photo 13. Example of surface deposition on an elevated bench along Brunette River approximately 1.1 m above low water level. The deposit was 25 m long by 1 m wide (estimated coverage of 5%, and approximately 1 mm deep), January 29, 2014.

Photo 14. Example of surface deposition on an elevated bench along Brunette River located approximately 145 m downstream of the Cariboo Dam, January 29, 2014

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APPENDIX 2

SILVER CREEK DERAILMENT SITE STABILIZATION AND COAL RECOVERY PHOTOS

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Photo 1. Example of upstream site segregation net and City of Burnaby storm sewer system discharge into Silver Creek at Government Street, upstream of CN crossing.

Photo 2. Example of site segregation net in Silver Creek, downstream of working area at CN crossing.

Photo 3. One of the CN crossing culverts (estimated at 50% capacity) before sediment removal.

Photo 4. View of upstream site segregation and pump in Silver Creek, looking downstream at the CN crossing from Government Street.

Photo 5. Example of culvert cleaning from isolated work area. Clean water was diverted into a single culvert (shown at the bottom of the photo), while sediment and turbid water was cleaned from other culverts in isolation.

Photo 6. Example of typical set-up for outlet hose discharge from the work area. Turbid water from disturbed work areas was discharged onto filter fabric to eliminate erosion, and into a vegetated area for infiltration and sediment control.

Photo 7. Danger trees and other trees deemed hazardous to railway infrastructure in or near areas of beaver activity were assessed and removed during Silver Creek bank protection/stabilization works.

Photo 8. Example of turbid water originating for the City of Burnaby storm sewer and being discharged into Silver Creek, January 28, 2014 following a rain event.

Photo 9. Water from upstream of the work area (in this case turbid water originating from the City of Burnaby storm sewer system) was intercepted by pumps and diverted around the work area, January 28, 2014 following a rain event.

Photo 10. Water from upstream of the work area (in this case turbid water originating from the City of Burnaby storm sewer system) was discharged back into Silver Creek downstream of the work area, January 28, 2014 following a rain event. Note cleaner water on left from upstream work area.

Photo 11. Area downstream of CN crossing after culvert cleaning was complete and bank stabilization works had begun. Disturbed water being removed for infiltration to ground.

Photo 12. View of nearly completed bank protection work along the southeast bank downstream of the CN crossing with round rock and gravel installed for fish habitat enhancement at the bottom of the riprap.

Photo 13. After the riprap was installed on the southeast bank plastic was used to construct a temporary gravity diversion channel and contain the flow along the bank in order to allow work to proceed on the northwest side of the channel.

Photo 14. View of functioning gravity diversion on the southeast edge of the pool downstream of the CN crossing.

Photo 15. After riprap was installed along both banks round rock and gravel were installed in the bottom of the channel to prevent scour at the outfall and improve fish habitat conditions.

Photo 16. A temporary culvert was used to bypass the outlet pool at the City of Burnaby storm sewer discharge point into Silver Creek. The culvert was installed to allow completion of the upstream stabilization work, but also assisted with diverting water between culverts to facilitate culvert cleaning.

Photo 17. Functioning temporary culvert used to bypass the upstream work area during bank stabilization works upstream of the CN crossing.

Photo 18. Installing riprap along the western bank of Silver Creek at the storm sewer discharge point upstream of the CN crossing.

Photo 19. After the riprap was installed along the banks round rock and gravel was installed in the bottom of the channel to limit erosion at the storm sewer discharge point, and improve fish habitat conditions.

Photo 20. View of the temporary culvert positioned to divert water to the eastern CN culverts and allow bank protection work to proceed on the west side of the channel, and facilitate cleaning of the western culverts.

Photo 21. Round rock and gravel being placed in the channel at the City of Burnaby storm sewer discharge point to limit erosion and improve fish habitat conditions.

Photo 22. Erosion protection works nearing completion at the outfall pool from the City of Burnaby storm sewer discharge point into Silver Creek.

Photo 23. After work on the outlet pools was complete, a net and pumps were installed for site segregation to allow completion of additional bank protection/stabilization work downstream.

Photo 24. Example of site segregation (isolation net(s)) and diversion pumps used to isolate the work area downstream of the CN crossing.

Photo 25. Banks protection/stabilization works underway in Silver Creek within the isolated and dewatered work area downstream of the CN crossing.

Photo 26. Example of a typical sump used to collect turbid water from disturbed work areas during the downstream channel works. Turbid water was discharged to vegetated areas for infiltration to ground.

Photo 27. Banks protection/stabilization works underway within an isolated and dewatered work area in Silver Creek downstream of the CN crossing.

Photo 28. Upstream view of site segregation for the bank protection/stabilization works conducted at the channel bend where Silver Creek turns south away from the CN track.

Photo 29. Discharge point for diversion pumps used during the channel works downstream of the CN crossing. Rocks and filter fabric were used to prevent erosion and reduce potential sediment mobilization at the point of discharge.

Photo 30. Riprap installation taking place at the channel bend where Silver Creek turns south away from the CN track. Work was conducted to minimize disturbance of pre-existing large woody debris (LWD) present in the channel.

Photo 31. In order to improve channel capacity in Silver Creek downstream of the CN crossing a channel constriction (vegetated knoll) was removed during the downstream bank protection/stabilization works.

Photo 32. Hand removal of coal was conducted opportunistically throughout the bank protection/stabilization work in Silver Creek.

Photo 33. Rock weir installed to prevent channel down cutting at the bend where Silver Creek turns south away from the CN track.

Photo 34. Rootwads remaining from tree removal were also used as part of the bank protection/stabilization work and for fish habitat enhancement in Silver Creek.

Photo 35. Downstream view of Silver Creek channel and rootwads from tree removal used for bank protection/stabilization work and fish habitat enhancement.

Photo 36. After riprap installation was complete along the banks, round rock and gravel were installed in the bottom of the channel to enhance fish habitat conditions.

Photo 37. Downstream view of completed bank protection/stabilization works at the channel bend. Note presence of pre-existing LWD left undisturbed in the channel wherever possible.

Photo 38. Upstream view from near the channel constriction after the bank protection/stabilization works were completed, the modified channel bed was washed with water and flow was restored.

Photo 39. Cross channel view of the City of Burnaby storm sewer outfall into Silver Creek, after the bank protection/stabilization works were completed.

Photo 40. Downstream of the CN crossing outfall in Silver Creek, after the bank protection/stabilization works were completed.

Photo 41. Downstream view of the main channel downstream of the CN crossing in Silver Creek, after the bank protection/stabilization works were completed.

Photo 42. Upstream view of rootwads installed along the south bank downstream of the CN crossing, after the bank protection/stabilization works were completed.

Photo 43. After the works were complete, erosion and sediment control measures were installed to prevent erosion and sediment mobilization from areas disturbed during construction or by heavy equipment access.

Photo 44. Downstream view from Government Street showing the completed bank protection/stabilization work at of the City of Burnaby storm sewer outfall during a rain event.

Photo 45. Downstream view showing the completed bank protection/stabilization works on the downstream side of the CN crossing during a rain event.

Photo 46. Downstream view of the completed bank protection/stabilization work in the main channel downstream of the CN crossing.

Photo 47. Downstream view of the completed bank protection/stabilization works at the channel bend where Silver Creek turns south away from the CN track (photo taken during a rain event).

APPENDIX 3

GRASS AND NATIVE WOODY PLANT SEED MIX TABLE

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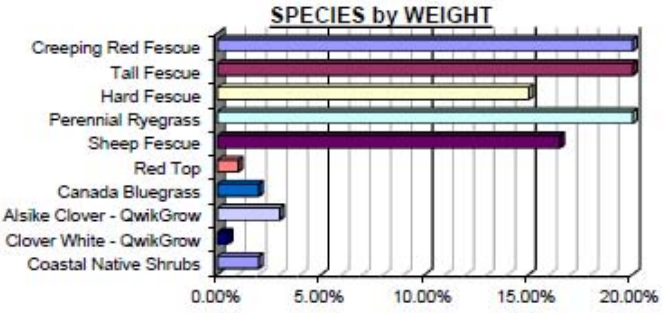
DENBOW
innovating naturally

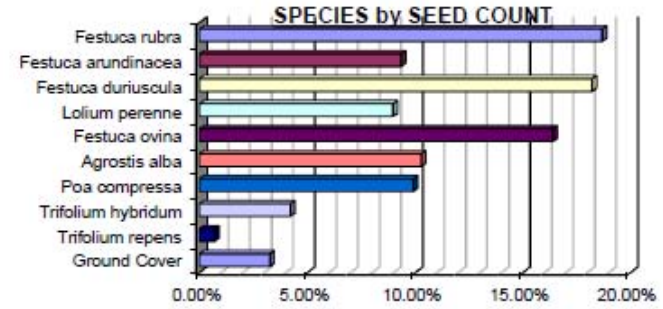
Low Grow Reclamation Mix with Shrubs

Common Name	Weight	Count	Latin Name	Code
Creeping Red Fescue	20.00%	18.69%	Festuca rubra	*T2976-000*
Tall Fescue	20.00%	9.35%	Festuca arundinacea	*R3122-000*
Hard Fescue	15.00%	18.22%	Festuca duriuscula	*R3039-000*
Perennial Ryegrass	20.00%	8.97%	Lolium perenne	*A4312-000*
Sheep Fescue	16.50%	16.40%	Festuca ovina	*R3096-000*
Red Top	1.00%	10.28%	Agrostis alba	*R4164-000*
Canada Bluegrass	2.00%	9.91%	Poa compressa	*R1904-000*
Alsike Clover - QwikGrow	3.00%	4.21%	Trifolium hybridum	*L2204-011*
Clover White - QwikGrow	0.50%	0.70%	Trifolium repens	*L2304-011*
Coastal Native Shrubs	2.00%	3.27%	Ground Cover	*L2304-011*
	100.00%	100.00%		
		Grade	Canada No. 1 Ground Cover	

-Quick, low-growing mix with a compliment of wildflower seed adapted to coastal BC.
-Excellent Erosion Control properties.
-Excellent drought (fire) resistance.
-Ideal for Reclamation/Revegetation work where aesthetics and Erosion Control are important.

-Red Osier Dogwood (Cornus sericea), Common Snowberry (Symphoricarpos albus), Salmonberry (Rubus spectabilis), Pacific Nine Park (Physocarpus capitatus, Seed grades Common No. 1 Ground Cover but all inputs meet/exceed the Canada No. 1 Forage standard and are certified BC Noxious weed free.





Denbow Seed Specification
1-888-933-6269 | www.denbow.com | sales@denbow.com

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APPENDIX 4

TURBIDITY DATA FOR THE SILVER CREEK STABILIZATION WORKS

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TABLE 4-1. Turbidity data for the Silver Creek stabilization works

Date	Time	Watercourse	Site 1[1] (NTU)	Site 2[2] (NTU)	Site 3[3] (NTU)	Site 4[4] (NTU)	Comments
18/Jan/14	12:00	Silver Creek	0.09	0.23	0.11	0.15	
18/Jan/14	13:00	Silver Creek	0.21	0.15	0.13	0.05	
18/Jan/14	14:00	Silver Creek	0.18	0.36	0.27	0.08	
18/Jan/14	15:00	Silver Creek	0.17	0.10	0.11	0.15	
18/Jan/14	15:30	Silver Creek	0.12	0.20	0.17	0.14	
19/Jan/14	10:00	Silver Creek	0.36	0.41	0.40	0.56	
19/Jan/14	12:00	Silver Creek	0.56	0.30	0.64	0.71	
19/Jan/14	15:30	Silver Creek	0.46	0.61	0.56	0.65	
21/Jan/14	10:00	Silver Creek	0.39	0.46	0.43	0.87	
21/Jan/14	11:00	Silver Creek	1.32	1.39	1.69	2.39	
21/Jan/14	13:30	Silver Creek	0.80	0.88	0.89	1.71	
21/Jan/14	14:30	Silver Creek	0.61	0.92	0.87	1.62	
21/Jan/14	15:30	Silver Creek	0.59	1.10	1.01	2.31	
22/Jan/14	9:00	Silver Creek	0.36	0.57	0.46	0.61	
22/Jan/14	11:00	Silver Creek	0.44	0.61	0.60	0.76	
22/Jan/14	13:00	Silver Creek	0.59	0.49	0.51	0.62	
22/Jan/14	14:30	Silver Creek	0.79	0.80	0.92	1.31	
22/Jan/14	15:30	Silver Creek	0.51	0.62	0.71	0.93	
25/Jan/14	9:30	Silver Creek	20.00	14.00	37.00	70.00	Increased turbidity related to storm water discharge not construction activities.
25/Jan/14	11:00	Silver Creek	90.00	78.00	80.00	85.00	
25/Jan/14	14:30	Silver Creek	62.00	72.00	68.00	101.00	
26/Jan/14	10:00	Silver Creek	0.31	0.48	0.41	0.62	
26/Jan/14	12:00	Silver Creek	0.38	0.31	0.35	0.53	
26/Jan/14	14:00	Silver Creek	0.60	1.37	0.72	0.68	
26/Jan/14	16:00	Silver Creek	0.42	1.08	0.58	0.62	
28/Jan/14	8:30	Silver Creek	7.61	9.15	8.87	10.10	
28/Jan/14	10:00	Silver Creek	18.20	20.80	21.10	20.20	
28/Jan/14	11:00	Silver Creek	21.20	21.80	20.80	20.20	
28/Jan/14	12:00	Silver Creek	164.00	152.00	162.00	164.00	Turbidity from storm water discharge during rain event
28/Jan/14	13:00	Silver Creek	8.64	11.10	12.80	9.74	
29/Jan/14	10:00	Silver Creek	7.76	8.26	8.95	8.61	
29/Jan/14	11:30	Silver Creek	9.81	11.20	11.30	10.80	
29/Jan/14	14:00	Silver Creek	9.60	10.20	9.75	9.62	
30/Jan/14	10:00	Silver Creek	17.80	18.30	18.10	17.70	
30/Jan/14	12:00	Silver Creek	21.70	23.10	22.20	21.70	
31/Jan/14	8:00	Silver Creek	1.47	1.48	1.61	1.52	
31/Jan/14	12:00	Silver Creek	1.51	1.45	1.72	1.58	
3/Feb/14	9:00	Silver Creek	5.61	6.91	6.72	6.12	
3/Feb/14	11:00	Silver Creek	4.11	4.21	4.23	4.19	
3/Feb/14	15:00	Silver Creek	10.10	10.40	10.30	10.50	

[1] Site 1: at storm water culvert outfall (upstream of worksite)
[2] Site 2: 50 m downstream of storm water culvert outfall (in worksite)
[3] Site 3: 100 m downstream of storm water culvert outfall (downstream of worksite)
[4] Site 4: 150 m downstream of storm water culvert outfall (downstream of worksite)

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APPENDIX 5

BURNABY LAKE COAL RECOVERY PHOTOS

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Photo 1. Installation of temporary park user path for the Burnaby Lake coal recovery program.

Photo 2. Temporary public path and fencing used to divert recreational users around work area.

Photo 3. Installation of temporary fencing for the Burnaby Like coal recovery program.

Photo 4. Installation of coal dewatering bins on top of plywood set over geotextile fabric to minimize damage to park areas.

Photo 5. Installation of water treatment system within a geotextile containment.

Photo 6. A temporary boom was installed across the channel to keep pleasure boaters away from the work area during coal recovery.

Photo 7. Sediment curtain installed around the work area in Burnaby Lake.

Photo 8. A 6 inch pump with a fish screen was installed in Silver creek upstream of the coal recovery work area to allow diversion of flow around the work area.

Photo 9. Coal collection bins were lined with geotextile fabric to assist in dewatering and sealed with expanding, quick dry caulking.

Photo 10. Turtle nesting beach salvage set up.

Photo 11. Salvaging and documenting and a turtle nesting site during the turtle beach salvage.

Photo 12. Neonate turtles salvaged from one nesting site on the nesting beach.

Photo 13. Shallow area of the alluvial were segregated with sediment fencing and salvaged for wildlife prior to any coal recovery.

Photo 14. Turtle traps were maintained and monitored throughout the Burnaby lake coal recovery program.

Photo 15. The isolated work area was partitioned with a grid to track and assess the effectiveness of coal recovery, and then coal recovery began in the shallow area using a vac truck with a modified hose end to prevent wildlife entrainment.

Photo 16. Coal recovery in the shallow area of alluvial using a vac truck and a second modification to the hose end to prevent wildlife entrainment, and improve effectiveness.

Photo 17. Shallow area segregated with sediment fencing with outer sediment curtain from the rest of the lake; grid for mapping coal removal progress.

Photo 18. Solid materials were often hand fed into the vac hose to minimize the potential for sucking up turtles or other aquatic wildlife.

Photo19. Divers operated the vac truck hoses during coal recovery of the deeper sections of the lake.

Photo 20. Vac trucks were emptied into the coal collection bin for the beginning of coal separation and water treatment.

Photo 21. Vac trucks were emptied into the coal collection bin where water was filtered out to the water treatment system and coal was removed by excavator.

Photo 22. Solids were removed from the coal collection bins by excavator and the material was trucked off site.

Photo 23. Sediment fencing was used to isolate shallow work areas during the coal recovery program, and proved to be effective at contain turbid water, as demonstrated by this photo.

Photo 24. After water was treated it was returned to the lake through filter fabric and silt fence to minimize sediment mobilization at the point of discharge.

Photo 25. Turtle beach was protected by filter fabric and sediment fence during coal recovery.

Photo 26. Containment constructed with geotextile, poly and plywood on the nesting beach to distribute the weight of the vac trucks and minimize compaction.

Photo 27. The vac trucks were parked on containment constructed with geotextile, poly and plywood on the nesting beach to distribute the weight and minimize compaction.

Photo 28. A fyke net was installed upstream of the site in Silver Creek to help segregate the site from fish in Silver Creek and monitor fry emergence.

Photo 29. Core samples were collected from various shallow and deep water areas throughout the duration of the coal recovery program in order to evaluate coal recovery and make decisions about subsequent clean-up efforts.

Photo 30. Core samples were collected on the alluvial fan and used to direct the suction dredging to target remaining coal deposits during the final stages of the coal recovery program in Burnaby Lake.

Photo 31. Upstream view near the confluence of Silver Creek and Burnaby Lake after coal recovery was completed.

Photo 32. Basking logs were washed off with clean high pressure water.

Photo 33. Basking logs were washed off, with clean high pressure water.

Photo 34. Removal of the sediment curtain and barrier fence began after coal recovery was complete.

Photo 35. Basking logs were returned to their former position after they had been cleaned and coal recovery was complete.

Photo 36. Crews raked the turtle nesting beach to reverse compaction and remove roots and other debris.

Photo 37. Southwest facing view of the turtle nesting beach after restoration was complete and the pedestrian exclusion fence was replaced.

Photo 38. Areas where equipment had been staged were covered with turf soil and seeded for restoration.

Photo 39. Removal of coal from the off channel habitat area just downstream of the Cariboo Business Park driveway.

Photo 40. The off channel habitat area near the Cariboo Business Park driveway after coal removal was completed.

APPENDIX 6

BURNABY LAKE COAL RECOVERY

TURTLE SALVAGE/RESTORATION

YALE SUBDIVISION