Appendix 15-G

Amphibian Baseline Report

DILLON CONSULTING

NWP COAL CANADA LTD

Amphibian Baseline Report

Crown Mountain Coking Coal Project

May 2020 – 12-6231

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Acronyms and Abbreviations

AIR	Application Information Requirements
BC	British Columbia
BC CDC	British Columbia Conservation Data Centre
BC EAA	*British Columbia Environmental Assessment Act*
BC MOE	British Columbia Ministry of Environment
BC WQGs	British Columbia Approved Water Quality Guidelines
BC WWQGs	British Columbia Working Water Quality Guidelines
BEC	Biogeoclimatic Ecosystem Classification
BU	Beaufort
BV Labs	Bureau Veritas Group
CCME	Canadian Council of Ministers for the Environment
CEAA	*Canadian Environmental Assessment Act*
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWQG	Canadian Water Quality Guidelines for the Protection of Aquatic Life
DL	Detection Limit
dw	dry weight
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
eDNA	Environmental DNA
EIS	Environmental Impact Statement
ESSF	Engelmann Spruce (Subalpine Fir)
ESSFdkp	Dry Cool Parkland Engelmann Spruce Subalpine Fir
ESSFdkw	Dry Cool Woodland Engelmann Spruce Subalpine Fir
ESSFdk1	Elk Dry Cool Engelmann Spruce Subalpine Fir Elk Dry
EVWQP	Elk Valley Water Quality Plan
GPS	Global Positioning System
ha	hectare
km	kilometer
LSA	Local Study Area
m	meters
mg/kg	milligram per kilogram
mg/L	milligram per Liter
MS	Montane Spruce
MSdw	Dry Warm Montane Spruce
NWP	NWP Coal Canada Ltd.
RIDC	Resource Inventory Standards Committee
RSA	Regional Study Area
SARA	*Species at Risk Act*

Teck	Teck Resources Limited
TEM	Terrestrial Ecosystem Mapping
US EPA	United States Environmental Protection Agency
VC	Valuable Component
wt	wet weight
WQGs	Water Quality Guidelines

Executive Summary

NWP Coal Canada Ltd (NWP) is proposing to develop the Crown Mountain Coking Coal Project ("the Project"), an open pit metallurgical coal mine in the Elk Valley coal field of southeastern British Columbia. The proposed Project is situated proximate to existing metallurgical coal mines, including the Teck Resources Limited (Teck) Elkview Operations located 8 km to the southwest and Line Creek Operations located 12 km to the north. The mine is expected to produce approximately 10,150 tonnes per day and up to 4.0 million run-of-mine tonnes per year for 15 years.

The Project is reviewable under both the federal *Canadian Environmental Assessment Act* (2012) and provincial *Environmental Assessment Act* (2002). An amphibian baseline program was conducted in 2014, 2017, 2018, and 2019 to support the Project baseline studies and the development of an environmental assessment. The baseline program focused on collecting information to document amphibian habitat occupancy (presence/non-detect), extent of occurrence and abundance, and amphibian habitat availability and distribution within and surrounding the Project area. This baseline report presents a summary of the information gathered through the amphibian baseline program and provides regional context based on publically-available information. Amphibians are highly susceptible to water quality issues and are often used as indicator species for aquatic health. As such, information gathered for this baseline report will be used to assess potential effects on amphibians and amphibian habitat as a result of proposed Project development and activities.

Based on publically available information, five amphibian species have the potential to occur in the vicinity of the Project: Columbia Spotted Frog (*Rana luteiventris*), Wood Frog (*Lithobates sylvaticus*), Western Toad (*Anaxyrus boreas*), Long-toed Salamander (*Ambystoma macrodactylum*), and Northern Pacific Treefrog (*Pseudacris regilia*). Western Toad is the only at-risk amphibian species suspected to occur in the area; this species is listed as Special Concern under Schedule 1 of the federal *Species at Risk Act* (2002), but is not considered to be sensitive at the provincial level.

Amphibian baseline survey methods included wetland perimeter searches, evening transect and road surveys, environmental DNA (eDNA) collection for Western Toad, tissue collection, and emergence surveys. Thirty-one wetlands and twenty-three ephemeral areas in the Alexander Creek, Elk River, Grave Creek, and Harmer Creek watersheds were visited over the course of the amphibian baseline program. Five wetlands and three ephemeral areas surveyed are located within the Project footprint. Tissue and water quality sampling was conducted at four wetlands where amphibians were observed to be abundant. Nineteen wetlands, two ephemeral areas, and six incidental areas had amphibian occupancy. Survey effort totalled 210 visits and 160 person-hours over the 4 survey years, and 4 of the 5 amphibian species suspected to be present in the LSA were documented: Western Toad, Columbia Spotted Frog, Wood Frog, and Long-toed Salamander. Northern Pacific Treefrog were not observed visually or through auditory surveys, nor were any other amphibian species encountered. A total of 134 Columbia Spotted

Frog, 26 Western Toad, 110 Wood Frog, and 151 Long-toed Salamander were detected in the study area.

Western Toad were the mostly widely distributed species, followed by Wood Frog, Columbia Spotted Frog, and Long-toed Salamander. Western Toad were most frequently documented in the Alexander Creek, Grave Creek, and Elk River watersheds. Columbia Spotted Frog, Wood Frog, and Long-toed Salamander were most frequently documented in the Elk River and Grave Creek watersheds, with limited observations in the Alexander Creek watershed. Only single observations of Long-toed Salamander and Western Toad occurred in the Harmer Creek watershed.

Columbia Spotted Frog, Wood Frog, and Long-toed Salamander egg masses and tadpoles were documented in the Elk River watershed, indicating this area is used as breeding habitat. Western Toad were only observed in the toadlet and adult life stages; however, given known migration distances from breeding to foraging and overwintering habitats, it is likely they are also breeding in the study area.

Most amphibian observations were recorded in marshes and shallow water wetlands with habitat characteristics such organic surface substrates, emergent vegetation cover, and warm temperatures. Western Toad adults and toadlets were found in wetlands, ephemeral areas, and forested areas throughout the LSA. Amphibian were commonly identified in the Alexander Creek (wetland survey sites WL4), Grave Creek (wetland survey sites WL11.1 and WL11.2), and Elk River (wetland survey sites WL13, WL15, WL16, and WL17) watersheds, with evidence of breeding commonly observed at wetland survey site WL4 in the Alexander Creek watershed and sites WL16 and WL17 in the Elk River watershed.

Selenium, chromium, and vanadium concentrations were not elevated in amphibian tissues collected when compared to guideline and reference values. Water quality at amphibian tissue sampling locations in the LSA showed single exceedances of three parameters (i.e., ammonia, fluoride, iron) above the long-term Canadian Water Quality Guidelines and only one exceedance of the short-term British Columbia Water Quality Guideline for dissolved iron.

1.0 Introduction

1.1 Project Overview

NWP Coal Canada Ltd (NWP) is proposing to develop the Crown Mountain Coking Coal Project (the Project), which is intended as an open pit metallurgical coal mine located within the Elk Valley coal field in the East Kootenay Region of southeastern British Columbia (BC; **Figure 1**). NWP is a jointly owned subsidiary of Jameson Resources Limited and Bathurst Resources Limited (Canada). The Project comprises ten coal licenses as shown on **Figure 1**. The Project is located between several existing metallurgical coal mines in the Elk Valley and Crowsnest coal fields, with Teck Resources Limited's (Teck) Elkview mine located approximately 8 kilometres (km) southwest of the Project area and their Line Creek mine located approximately 12 km north of the Project area. The Project area is located approximately 30 km by road from Sparwood, BC and is accessible by several Forest Service Roads, including Grave Creek Road in the northwest and Alexander Creek Road from the south.

The anticipated production capacity of the Project is up to 4.0 million run-of-mine tonnes per annum for a production duration of approximately 15 years. This equates to a coal production capacity of approximately 10,150 tonnes per day. Exploration activities have indicated that the coal at the Project site is typical of coking coals produced from existing mines in the Elk Valley. The high quality metallurgical coal would be transported via railway to coastal BC, where it would be shipped overseas to be used in steelmaking.

Key components of the proposed Project include, but are not limited to:

- Surface extraction areas (3 pits – north pit, east pit, and south pit);
- Waste rock management areas;
- Plant area (includes raw coal stockpile area, a processing plant, and site support facilities);
- Clean coal transportation route (via an overland conveyor and haul road);
- Rail load-out facility and rail siding (includes various auxiliary facilities);
- Power supply;
- Natural gas supply;
- Explosives storage;
- Fuel storage;
- Sewage treatment; and
- Water supply.

1.2 Purpose and Objectives of the Baseline Study

The Project is subject to both the *Canadian Environmental Assessment Act* (*CEAA*) 2012 and the *British Columbia Environmental Assessment Act (BC EAA)* 2002. Provincially, the Project is considered a Reviewable Project given that the production capacity of the mine will be greater than 250,000 tonnes per year of clean coal and will result in a disturbance greater than 750 hectares (ha) that was not previously permitted for disturbance (*BC EAA*, 2002). Federally, the Project is considered a Designated Project under the *CEAA* (2012) Regulations Designating Physical Projects, as the mine will have a production capacity of more than 3,000 tonnes per day. Project-specific terms of reference were developed for the provincial environmental assessment (EA) process (EAO, 2018) and the federal EA process (CEAA, n.d.).

Under the project-specific provincial Application Information Requirements (AIR; EAO, 2018) for the Project's EA, amphibians are identified as a Valued Component (VC) and as such, an understanding of amphibian occurrence and distribution in the Project area is required to adequately assess potential effects on this wildlife group as a result of Project activities. The specific amphibian VCs identified in the AIR (EAO, 2018) included Western Toad (*Anaxyrus boreas*) and Columbia Spotted Frog (*Rana luteiventris*). The Environmental Impact Statement (EIS) Guidelines (CEAA, n.d.) identify species at risk as a VC, which includes the listed Western Toad.

The key objective of the amphibian baseline program was to determine and describe existing amphibian species within and surrounding the Project. Specific to this, the baseline program focused on collecting information to document amphibian habitat occupancy (presence/non-detect), extent of occurrence and abundance, and amphibian habitat availability and distribution. This report presents a summary of amphibian baseline program results and includes relevant publically-available information on the amphibians at a regional level.

ELKFORD
SPARWOOD
CROWSNEST PASS
FERNIE
Alberta
British Columbia
Elk Valley Highway
Baker Drive
Fording Mine Road
Fording Forest Service Road
Brûlé Creek
Fording River
Line Creek
South Line Creek
Grave Lake
Harriet Lake
Grave Creek
Grave Creek Road
Lower Elk Valley Road
Elk River
Hummer Creek
West Alexander Creek
Alexander Creek
Alexander Creek FSR
Eriksson Creek
Michel Creek
Range Road 52A
Range Road 43A
Elk River
Fir Creek
Michel Creek
Sulphur-Hartley FSR
Hartley Lake Road
Hartley Creek Road
Dicken Road
Coleto Road
Corbin Road
Tecumseh Road
63 Street
16 Avenue
20 Avenue
Leach Creek FSR
Flathead Valley Road
Coal Creek Road
Fernie Coal Road
Coal Creek Pass Forest Service Road
43
3

LEGEND

- Terrestrial Local Study Area
- Project Footprint
- Coal Licences
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Provincial Park
- BC/Alberta Border

Crown Mountain Coking Coal Project

FIGURE 1.
Project Location

0 1 2 3 4 Kilometers

SCALE 1:200,000

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: LKD
Map Projection: NAD 1983 UTM Zone 11N

DILLON CONSULTING

PROJECT: 12-6231
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File Location: \\42dillon\CAD\GIS\2012 and Prior\126231 Crown Mountain\Bird and Amphibian Survey Maps\Baseline_2019\Amphibian\126231 Baseline Amphibian Project Location.mxd

1.3 Applicable Legislation and Guidelines

Amphibians and their habitat are protected under several pieces of federal and provincial legislation, including the federal *Species at Risk Act* (SARA; 2002), the provincial *Wildlife Act* (1996), and the provincial *Forest and Range Practices Act* (2002).

1.3.1 Federal

The purpose of *CEAA* (2012) is to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a designated project. The *CEAA* (2012) ensures that proposed projects are considered in a careful and precautionary manner in order to avoid significant adverse environmental effects. This process helps in planning and decision making and allows for the prediction of adverse environmental effects and the development of mitigation measures, as well as the understanding of cumulative effects on the landscape (Government of Canada, 2019).

The *SARA* (2002) provides legislative protection to specific listed species and their critical habitat in Schedule 1 of the *Act*. Schedule 1 of *SARA* (2002) is the official list of species at risk in Canada. Species are recommended to be designated on Schedule 1 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). As per Section 34 (1) of *SARA* (2002), all *SARA*-listed species of fish and migratory birds are protected on any lands within Canada, while other listed species are only protected under *SARA* (2002) if they occur on federal lands or waters.

The purpose of *SARA* (2002) is to prevent wildlife species from being extirpated or becoming extinct. SARA explicitly states that:

> *"No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species"* (*SARA* 2002, s. 32(1)).

In addition to individual protection for listed species, the habitat and residences of listed species are also protected:

> *"No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an endangered species or a threatened species"* (*SARA* 2002, s. 33).

Definitions of residences are also provided for some species at risk.

1.3.2 Provincial

The BC *EAA* (2002) allows for the review of major projects in order to assess their potential impacts to the environment (*EAA,* 2002). These projects are reviewed to ensure they meet environmental, economic, and social sustainability goals. Projects that fall under the *EAA* (2002) are assessed for

adverse environmental, economic, social, heritage, and health effects that have the potential to result throughout the duration of the project (*EAA*, 2002).

The BC *Wildlife Act* (1996) provides legislative protection from harm and harassment to all wildlife, with the exception of those activities permitted by regulations, such as hunting and trapping (*Wildlife Act*, 1996).

The BC *Forest and Range Practices Act* (2002) outlines how resource-based activities can be conducted on Crown land in BC, while ensuring protection of everything in and on them, such as plants, animals, and ecosystems (*Forest and Range Practices Act*, 2002). Broad habitat and species protection measures in the *Forest and Range Practices Act* provide direction for the protection of amphibians during activities such as clearing and road-building by forest and range licensees. Under the *Act*, habitats such as riparian areas and wetlands require special management and mitigation measures.

1.3.3 Policies and Guidelines

The B.C. Conservation Data Centre (BC CDC) assists in the conservation of BC's biodiversity by collecting and sharing scientific data and information about wildlife and ecosystems in BC (BC CDC, 2019a). The primary functions of the CDC are to:

- Compile a list of species and ecosystems that occur in BC;
- Assess conservation status ranks;
- Map known locations (element occurrences); and,
- Make data and information available to the public.

The BC CDC assigns conservation status ranks to BC's species and ecosystems according to the level of risk of being lost. Based on that, the CDC assigns a provincial Conservation Status Rank (red, blue, or yellow) that can be used to set conservation priorities. Red-listed species and ecosystems are at risk of being lost (extirpated, endangered or threatened); blue-listed species and ecosystems are of special concern; and yellow-listed species and ecosystems are at the least risk of being lost (BC CDC, 2019a).

A guideline relevant to the protection of amphibians and their habitat includes the *Develop with Care 2014 Environmental Guidelines for Urban and Rural Development* (Government of British Columbia, 2014). The guidelines mainly apply to private land development, but include a terms of reference for conducting biological inventories (Biolinx Environmental Research Ltd., 2014) that was used to guide the amphibian baseline program.

1.3.3.1 Amphibian Tissue Guidelines

Amphibian tissue guidelines have been developed for selenium, chromium, and vanadium (Janz et al., 2010; BC MOE, 2014; Windward et al., 2014; Golder Associates, 2015b). Guidelines for other metals in amphibian tissues have not been developed, nor are reference amphibian tissue concentration data readily available at the provincial or federal level. In some cases, guidelines developed for fish and/or

bird tissue are used as surrogate criteria where appropriate for sensitive wildlife, including amphibians, such as the BC MOE (2014) guideline for selenium in bird eggs.

Guidelines for selenium in bird eggs are typically used as a surrogate for amphibians and reptiles because the physiological response of egg development to selenium exposure is believed to be similar, and therefore guidelines derived for bird eggs are generally protective of other sensitive wildlife (Nagpal and Howell, 2001; BC MOE, 2014). The BC MOE (2014) guideline for selenium in bird eggs as a surrogate for reptiles and amphibians, including amphibian eggs, is 6 mg/kg dry weight (dw). A whole-body guideline is not available for amphibians.

Guidelines developed by the United States Environmental Protection Agency (US EPA) for selenium in fish tissue (egg and whole body) in the 2016 *Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater* are also intended to protect the entire aquatic community, including amphibians (egg masses and tadpoles; US EPA, 2016). Note that these guidelines are instantaneous measurements that are not to be exceeded.

Reference concentrations have been developed for chromium and vanadium because they were identified as contaminants of potential concern in the Elk Valley (Windward et al., 2014). The reference concentrations for the Elk Valley are 12.7 mg/kg dw chromium and 6.5 mg/kg dw vanadium (Windward et al., 2014). These concentrations were used as benchmarks to compare to amphibian egg mass tissue results collected as part of the amphibian baseline program.

1.3.3.2 Water Quality Guidelines

The Canadian Council of Ministers for the Environment (CCME) have developed Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG; CCME, 1999, updated 2007). Guidelines exist for short- and long-term exposures. The *Protocol for the Derivation of Water Quality Guidelines for the Protection of Aquatic Life* (CCME, 2007) state that:

> *"Short-term exposure guidelines are meant to estimate severe effects and to protect most species against lethality during intermittent and transient events (e.g., spill events to aquatic-receiving environments, infrequent releases of short-lived/non-persistent substances). In contrast, long-term exposure guidelines are meant to protect against all negative effects during indefinite exposures"* (Part I-6).

Water quality guidelines approved by the province (BC Water Quality Guidelines [BC WQG]) must be considered in decision-making that affects water quality in the province. The BC MOE have developed the *British Columbia Approved Water Quality Guidelines (BC WQGs): Aquatic Life, Wildlife & Agriculture* (BC MOE, 2019). Similar to the CWQGs, the BC MOE have established short-term maximum and long-term average guidelines. The *Long-Term Average vs. Short-Term Maximum Water Quality Guidelines* (BC MOE, 2016) define short-term maximum guidelines as levels that should never be exceeded in order to

meet the intended protection of the most sensitive species and life stages over a short-term exposure period.

Short-term maximum WQGs are intended to assess risks associated with infrequent exposure events such as spills. Long-term chronic average guidelines are intended to protect the most sensitive species and life stages against sub-lethal and lethal effects for indefinite exposures (BC MOE, 2016). The averaging approach allows concentrations of a substance to fluctuate above and below the guideline, provided that the short-term maximum is never exceeded and the long-term average is met over the specific averaging period (e.g., 5 samples in 30 days). The *Guidance for the Derivation and Application of Water Quality Objectives in British Columbia* (BC MOE, 2013) was referenced during the derivation of water quality guidelines for this baseline report.

Teck was required to develop the Elk Valley Water Quality Plan (EVWQP) in 2015, which is an area-based water quality management plan to ensure the health of the watershed while allowing for continued sustainable mining. As part of the EVWQP, baseline conditions of nitrate, sulphate, selenium, and cadmium were evaluated in the Elk River, Fording River, Lake Koocanusa, and tributaries. Selenium and nitrate were two main constituents observed to most frequently exceed the BC WQG. The purpose of the EVWQG was to identify a strategy and implement mitigation to address increasing selenium and nitrate water concentrations within the Elk Valley (Teck Resources Limited, 2015). A site-specific long-term water quality target of 0.019 mg/L was identified for selenium in the Elk River from Fording River to Michel Creek. Nitrate, sulphate, and cadmium targets within this reach of the Elk River are the same as the BC WQG and CWQG guidelines.

2.0 Baseline Program Overview

2.1 Study Areas

The Project is located approximately 30 km by road from Sparwood, British Columbia at 114°43.6'W and 49°48.4'N (**Figure 1**). The Project is situated in an area of steep topography of the Front Ranges Rocky Mountains of BC and accessed by several Forest Service Roads, including Grave Creek Forest Service Road from the west and Alexander Creek Road from the south. The Project is in the Elk River, Erickson Creek, Harmer Creek, Grave Creek, and Alexander Creek watersheds. Alexander Creek flows south from the Project area and subsequently joins Michel Creek. Michel Creek eventually discharges to the Elk River, which flows generally southwest and discharges to Lake Koocanusa, a lake which partially occurs in the State of Montana. Grave Creek flows in a westerly direction from the upper extent of the Project area and discharges to the Elk River. Harmer Creek, a tributary to Grave Creek, flows from the south to the north and joins Grave Creek east of the Elk River.

Three spatial boundaries were developed for the assessment of the Project on amphibians and are presented in the EA Application. The spatial boundaries include the Project footprint, the Local Study Area (LSA), and the Regional Study Area (RSA). Project-specific surveys conducted at the LSA scale are presented in this report, while the evaluation of amphibians at the RSA level is presented in a separate technical report. This baseline report will help inform the EA Application and focuses on characterizing the amphibian community and habitat within the LSA.

The Project footprint covers approximately 1,300 ha (**Figure 2**) and includes all anticipated Project components, such as the active mining area, waste rock management areas piles, and associated infrastructure following the Grave Creek Forest Service Road west to the Elk River.

The LSA covers approximately 24,100 ha (**Figure 2**). Rationale for selecting the LSA boundaries is as follows:

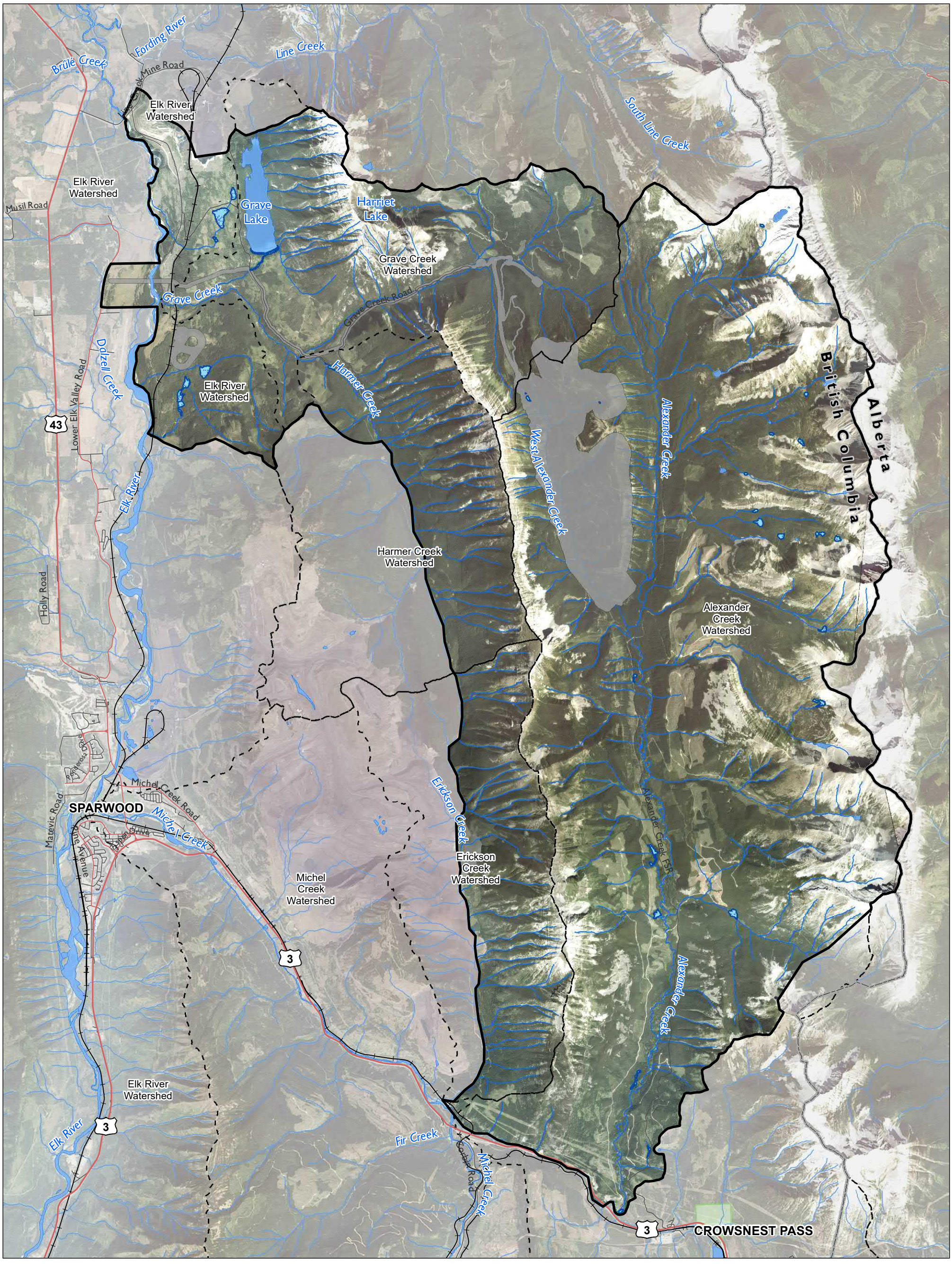
- Includes the Project footprint and areas that may experience potential direct and indirect impacts as a result of Project activities;
- Includes terrestrial habitat that may experience changes at an ecosystem level as well as changes to connectivity between ecosystems and landscapes;
- Includes watersheds that have the immediate potential to be directly or indirectly impacted by the Project, including Grave Creek, West Alexander Creek, and Alexander Creek; and
- Encompasses landscape features and known migration routes/movement corridors (e.g., Grave Creek Canyon).

The west side of the LSA is characterized by steep-sided ridges and subdued mountains, while those on the east are rugged with many cirques and U-shaped valleys. Elevations in the LSA range from 1,170

meters (m; 3,838 feet [ft]) along the Elk River west of Grave Lake up to almost 2,500 m (8,200 ft) along Erickson Ridge. The dominant wildlife habitat in the LSA consists of riparian habitat along Alexander and Grave Creeks and their tributaries, mature and immature conifer forest (including regenerating cutblocks), non-forested or sparsely forested areas on steep slopes dominated by grasses, forbs and shrubs created primarily by avalanches, and alpine grasslands.

The LSA consists of the Montane Spruce (MS) and Engelmann Spruce-Subalpine Fir (ESSF) Biogeoclimatic Ecosystem Classification zones. MS is represented solely by the Dry Warm Montane Spruce (MSdw) subzone at elevations below 1,600 m. This area is dominated by Douglas-fir (*Pseudotsuga menziesii*). The majority of the wetlands in the LSA are located in the MSdw subzone (Keefer Ecological Services Limited, 2020). The higher elevation ESSF BEC subzone comprises the rest of the study area. The ESSF zone is dominated by Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies* lasiocarpa; British Columbia Ministry of Forests, 1991) and has three subzones that occur in the LSA:

- The Elk Dry Cool Engelmann Spruce Subalpine Fir Elk Dry (ESSFdk1) subzone, which occurs adjacent to and above the MSdw to about 1900 m;
- The Dry Cool Woodland Engelmann Spruce Subalpine Fir (ESSFdkw) subzone, which occurs above the ESSdk1; and
- The Dry Cool Parkland Engelmann Spruce Subalpine Fir (ESSFdkp) subzone, which occurs at elevations greater than 2,100 m.



Crown Mountain Coking Coal Project

FIGURE 2.
Amphibian Baseline Program Study Areas

LEGEND

- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- Provincial Park
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:82,000

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: LKD
Map Projection: NAD 1983 UTM Zone 11N

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File Location: \\42dillon\CAD\GIS\2012 and Prior\126231 Crown Mountain\Bird and Amphibian Survey Maps\Baseline_2019\Amphibian\126231 Baseline Amphibian Program Study Areas.mxd

2.2 Wetlands and Ephemeral Sites

Most amphibians in BC require a wetland for some or all of their entire lifecycle (Biolinx Environmental Research Ltd., 2014). Wetlands such as fens, marshes, and swamps can provide suitable amphibian habitat (Royal BC Museum, 1999). A total of 36 wetland survey sites were classified, constituting approximately 41 ha or 0.17% of the LSA (**Figure 3**). Wetlands in the LSA were generally observed in flat areas, valleys, and bowls with many wetlands forming in basins, depression, and obstructions along drainage ways (e.g., presence of beaver dams). Many of the wetland observed within the LSA form wetland complexes of two or more distinct wetland association. Marshes occupied the greatest area of all wetland types in the LSA, followed by swamp, marsh-fen (transitional), shallow water, fen, and bog. Flood associations, although non-wetland ecosystems, were also observed in the LSA. Additional information on wetlands observed within the LSA is provided in Dillon Consulting Limited (2020) *Wetland Ecosystem Baseline Report*.

Ephemeral areas occur across the LSA (**Figure 3**) and can also provide temporary wetted habitat for amphibians. Ephemeral areas can include roadside ditches, tire ruts, and natural shallow depressions in the ground, among others, where water can pool and warm up quickly (British Columbia Ministry of Forests, Lands, and Natural Resources Operations, 2015). These areas can provide ideal habitat for breeding amphibians and tadpoles as they are typically fish-free (British Columbia Ministry of Forests, Lands, and Natural Resources Operations, 2015). Ephemeral areas are often seasonal and can change locations between years (British Columbia Ministry of Forests, Lands, and Natural Resources Operations, 2015) and it is expected that these areas change across the LSA from year to year.

Crown Mountain Coking Coal Project

FIGURE 3.
Wetland and Ephemeral Sites in the LSA

LEGEND

- Wetland
- Ephemeral Area
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:108,000

N
W E
S

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: LKD
Map Projection: NAD 1983 UTM Zone 11N

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File Location: \\42dillon\CAD\GIS\2012 and Prior\126231 Crown Mountain\Bird and Amphibian Survey Maps\Baseline_2019\Amphibian\126231 Baseline Amphibian Wetlands and Ephemeral Sites.mxd

2.3 Amphibians of the LSA

Amphibians range throughout BC and can be difficult to detect, as they are inconspicuous and secretive (Ministry of Environment, Lands and Parks Resources Inventory Branch, 1998). Amphibians use both aquatic and terrestrial environments throughout their lifecycles, with aquatic environments providing essential habitat for breeding, foraging, and/or overwintering, and terrestrial environments providing migration, foraging, and overwintering habitat (Ministry of Environment, Lands and Parks Resources Inventory Branch, 1998). Amphibians have highly permeable skin and are therefore dependent on water, as they require a source of moisture to avoid drying out (Biolinx Environmental Research Ltd., 2014). Their permeable skin renders them highly susceptible to water quality issues and are often used as indicator species for aquatic health (Biolinx Environmental Research Ltd., 2014). Amphibians are ectothermic (cold-blooded) species and derive their body heat from the environment; therefore, most amphibian species in BC become dormant and hibernate in the cold season and are less active in relatively high temperatures (Biolinx Environmental Research Ltd., 2014). Amphibians typically have a relatively small home range, with the exception of migrations between overwintering, breeding, and foraging habitats (Biolinx Environmental Research Ltd., 2014).

Within BC there are ten species of frogs, two species of toads, and six species of salamanders (Government of British Columbia, 2019). The BC CDC iMAP database indicates that Columbia Spotted Frog, Wood Frog (*Lithobates sylvaticus*), Western Toad, Long-toed Salamander (*Ambystoma macrodactylum*), and Northern Pacific Treefrog (*Pseudacris regilia*) have been documented within the LSA (BC CDC, 2019b). These species are listed in **Table 2-1** along with their conservation status. Western Toad is the only at-risk amphibian species suspected to occur in the LSA; this species is listed as Special Concern under Schedule 1 of *SARA* (2002), but is provincially yellow-listed (**Table 2-1**).

Table 2-1: Amphibian Species Potentially Present in the LSA (BC CDC, 2019b)

Species Common Name	Species Latin Name	SARA Status	COSEWIC Status	BC Conservation Status Rank
Columbia Spotted Frog	*Rana luteiventris*	-	Not at Risk	Yellow
Northern Pacific Treefrog	*Pseudacris regilla*	-	-	Yellow
Western Toad	*Anaxyrus boreas*	Schedule 1, Special Concern	Special Concern	Yellow
Wood Frog	*Lithobates sylvaticus*	-	-	Yellow
Long-toed Salamander	*Ambystoma macrodactylum*	-	Not at Risk	Yellow

The Rocky Mountain Tailed Frog (*Ascaphus montanus*) has the potential to occur in the LSA (BC CDC, 2019c), but this species is known to occur in the extreme southeast of BC with populations restricted to the Flathead River and Yahk River watersheds (Environment Canada, 2015), approximately 50 km south of the Project. Rocky Mountain Tailed Frog are highly site-specific and typically do not disperse more than 20 m per year (Environment Canada, 2015), suggesting that this species is unlikely to be present in the Project's LSA.

The Northern Leopard Frog (*Lithobates pipiens*) was previously present in the area, but is presumed to be locally extirpated since the 1980s (BC CDC, 2019d). The National Recovery Strategy for the Northern Leopard Frog suggests only two populations of this species exist in the Rocky Mountains: in the Creston Valley, and in the Upper Kootenay floodplain (Bummer's Flats north of Cranbrook, BC; Environment and Climate Change Canada [ECCC], 2017). The Northern Leopard Frog typically migrates 5 to 10 km between habitat types (ECCC, 2017); given these populations are approximately 70 to 150 km from the LSA, it is unlikely that this species is present in the LSA.

3.0 Methods

Baseline surveys were conducted to obtain information on amphibian habitat occupancy, extent of occurrence and abundance, and habitat availability and distribution within the LSA. Between 2014, 2017, 2018, and 2019, 210 surveys were completed across the LSA. Thirty-one (31) wetlands and twenty-three (23) ephemeral areas were targeted to assess amphibian occupancy and habitat characteristics. Accessible wetlands and ephemeral areas in the LSA were surveyed within the Alexander Creek, Grave Creek, Harmer Creek, and Elk River watersheds. Biogeoclimatic Ecosystem Classification (BEC) subzones were considered in the characterization of aquatic habitat over the course of the survey years and survey types. The majority of wetlands (27) surveyed for amphibians were in the MSdw subzone, 3 were in ESSFdk1, and 1 was in ESSFdkw. Further details for each wetland and ephemeral area, including BEC subzone, total area, and wetland class (where applicable) are presented in **Appendix A**.

All surveys were conducted by a team of two experienced biologists and targeted a wide range of habitat types, elevations, slopes, and stand ages throughout the LSA. Multiple types of amphibian surveys were conducted and were selected based on the study objectives and the behaviour of the target species (e.g., Western Toad and Columbia Spotted Frog). The amphibian surveys completed as part of the baseline program include the following:

- Wetland perimeter searches;
- Evening roadside transect surveys;
- Environmental DNA (eDNA);
- Emergence surveys, and
- Tissue collection.

Completed surveys of the amphibian baseline program are outlined in **Table 3-1** and survey locations are shown in **Figure 4.** Amphibians were also recorded incidentally during other baseline surveys (e.g., wetland and breeding bird surveys).

Table 3-1: Surveys Completed for the Amphibian Baseline Program

Survey Type	Survey Year	Survey Dates	Wetlands and Ephemeral Survey Sites	Total Effort (person-hours)	Target Species
Wetland Perimeter Searches	2014	June 5 – June 11	WL4; WL6.2; WL11.1; WL11.2; EPH4.2; EPH106	127.8	
		June 29 – July 4	WL1; WL5.3; WL5.4; field north of WL5.4; WL11.1; WL11.2; WL13; WL17; EPH100.1; EPH112		

Survey Type	Survey Year	Survey Dates	Wetlands and Ephemeral Survey Sites	Total Effort (person-hours)	Target Species
Wetland Perimeter Searches, Cont'd	2017	June 6 – June 9	WL1; WL4; WL5.1; WL5.2; WL5.3; WL6; WL11.1; WL11.2; WL13; WL17; WL18; EPH103; EPH104.1		Columbia Spotted Frog; Long-toed Salamander; Northern Pacific Treefrog; Western Toad; Wood Frog
		June 30 – July 6	WL4.1; WL6; WL6.2; WL9; WL11.1; WL13; WL17; EPH104		
	2018	April 22 – April 28	WL1; WL4; WL5.1; WL5.2; WL5.3; WL9; WL11.1; WL11.2; WL11.3; WL13		
		May 3 – May 9	WL1; WL4; WL5.1; WL5.3; WL10; WL13; WL15; WL16; WL17; EPH102; EPH114; EPH115		
		July 1 – July 5	WL1; WL7; WL8.1; WL8.2; WL8.3; WL9; WL11.1; WL13; WL14; WL15; WL17		
		July 26 – July 30	WL1; WL3; WL6; WL8.1; WL8.2; WL8.3; WL13		
	2019	May 7 – May 9	WL2; WL3; WL4; WL5.1; WL5.2; WL5.3; WL6; WL9; WL12; WL13; WL14; WL15; WL16; WL17; WL19		
		May 22 – May 25	WL1; WL4; WL9; WL11.1; WL11.2; WL11.3; WL12; WL13; WL14; WL16; WL17; WL18; EPH100.1; EPH100.2		
		July 4 – July 11	WL2; WL3; WL4; WL5.1; WL5.2; WL5.3; WL6; WL8.1; WL8.2; WL8.3; WL9; WL11.1; WL11.2; WL11.3; WL12; WL13; WL14; WL15; WL16; WL17; WL18; WL20; WL21; WL22; EPH4.2; EPH100.1; EPH100.2		
		July 25, 2019	WL16		

Survey Type	Survey Year	Survey Dates	Wetlands and Ephemeral Survey Sites	Total Effort (person-hours)	Target Species
Evening Roadside Transects	2018	May 6	WL18; EPH100.1; EPH1003; EPH1004; EPH1005; EPH1006; EPH1007; EPH1008; EPH1009; EPH1010	1.3	Western Toad; migrating adult amphibians
Tissue and Water Sample Collection	2017	July 6	WL4; WL17	-	Columbia Spotted Frog; Long-toed Salamander; Wood Frog
	2018	May 5 – May 9	WL4; WL13; WL15; WL17		
		July 4	WL15		
	2019	May 9	WL15; WL17		
		May 22	WL4		
eDNA	2019	July 5 – July 10	WL2; WL4; WL5.2; WL5.3; WL11; WL12; WL14; WL15; WL16; WL17; WL18; WL21; WL22	-	Western Toad
Emergence Surveys	2019	September 10 – 13	WL1; WL4; WL5.1; WL5.2; WL5.3; WL5.4; field north of WL5.4; WL6, WL6.1; WL6.2; WL9; WL10; WL11.1; WL14; WL15; WL16; WL17; WL18; WL19; WL21; EPH100.1; EPH100.2; EPH104.1; EPH104.2	31.0	Western Toad Toadlets

Crown Mountain Coking Coal Project

FIGURE 4.
Amphibian Baseline Surveys

LEGEND

- Emergence Survey
- Perimeter Search
- Evening Roadside Transect Surveys
- eDNA Survey
- Tissue and Water Quality Sampling Location
- Evening Roadside Transect
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:108,000

N W E S

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: LKD
Map Projection: NAD 1983 UTM Zone 11N

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PROJECT: 12-6231
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File Location: \\42dillon\CAD\GIS\2012 and Prior\126231 Crown Mountain\Bird and Amphibian Survey Maps\Baseline_2019\Amphibian\126231 Baseline Amphibian Baseline Surveys.mxd

3.1 Wetland Perimeter Searches

Wetland perimeter searches were conducted to determine the presence or non-detection of amphibian species within the LSA. Perimeter searches were conducted in accordance with the *Inventory Methods for Pond-breeding Amphibians and Painted Turtle (Version 2.0)* systematic survey methods for amphibians in wetlands or riparian areas *(*Ministry of Environment, Lands and Parks Resources Inventory Branch, 1998). One-hundred-fifty-seven (157) wetland perimeter searches were completed in 2014, 2017, 2018, and 2019 in thirty (30) wetlands and thirteen (13) ephemeral areas (**Figure 4**). The wetland perimeter searches entailed two experienced biologists walking the shoreline and the forested perimeter of a wetland, when accessible, and documenting visual encounters of any amphibian species. Surveys were conducted on days with a wind speed less than 5 on the Beaufort (BU) scale. When observed, amphibian species were identified, documented, geo-located by GPS waypoint, photographed, and habitat features were noted.

Information recorded for all wetlands and ephemeral areas surveyed as part of the wetland perimeter searches included:

- Wetland classification;
- Presence and dominance of submergent and emergent vegetation;
- Substrate type;
- Fish presence and beaver activity;
- Enumeration and classification of snags and coarse woody debris; and
- *In-situ* water parameters (pH, temperature, dissolved oxygen, salinity, and conductivity).

3.2 Evening Roadside Transect Surveys

Evening roadside transect surveys were conducted to target the calling population of Western Toad and migrating adults of all other amphibian species potentially present within the LSA. Surveys were conducted in accordance with the Ministry of Environment, Lands and Parks Resources Inventory Branch (1998) *Inventory Methods for Pond-breeding Amphibians and Painted Turtles* (*Version 2.0)*. Evening roadside transect surveys are most successful during the breeding season when mass migration occurs, and prove to be useful when migrating amphibians move away from or toward a pond after a heavy rainfall event. As such, road surveys were completed by two experienced biologists in early May 2018. Transects were driven along Grave Creek Road and Grave Lake Road (**Figure 4**) at a speed under 20 km/hour with high beam lights on to look for moving toads where suitable habitat was visually present. A total of 12 call survey stations where suitable habitat was observed were visited once each along the transects (**Figure 4**). Surveys were completed 30 minutes after dusk and continued no later than midnight in conditions with a wind speed no more than 5 on the BU scale. Surveys were completed one to two days after a heavy rainfall event, when possible. If an amphibian was encountered, the species and age class were identified and the individual was documented, georeferenced with GPS, and photographed.

3.3 Environmental DNA

The environmental DNA (eDNA) approach is generally used to determine presence/non-detection of species by sampling the physical media of their environments (i.e., water, soil) and testing for the presence of their DNA. This method has proven to be a cost effective and non-invasive way to determine presence/non-detection for cryptic and/or low-density species such as Western Toad (Hobbs et al., 2019). As such, eDNA was used as part of the amphibian baseline program to document the presence of Western Toad within the LSA. Bureau Veritas Group (BV Labs; formerly Maxxam Analytics) has a Western Toad DNA assay (2019) that has been developed, tested, and applied using a three part process similar to the process in Veldhoen et al. (2016) to minimize the rate of false negative and false positive results. The technical specifications of the assay are provided in **Appendix B**.

The Western Toad assay was developed for application across the species' range. As an additional positive control measure, a site of confirmed Western Toad presence was sampled to verify that the eDNA test elicited a positive test result for the local population (WL21). The Western Toad eDNA surveys were completed as per the BC MOE (2017a) *Environmental DNA Protocol for Freshwater Aquatic Ecosystems (Version 2.2)*. Samples were collected from wetlands within the LSA where Western Toad were suspected to occur but presence was unknown during the breeding season when Western Toad are most active and eDNA is likely most abundant. A total of 13 sites across the LSA were sampled for Western Toad using eDNA (**Figure 4**). Triplicate biological replicates (three samples from one location in each wetland), one negative control (field-filtered deionized water), and one positive control (confirmed Western Toad observation in water) were collected. During these surveys, incidental amphibian observations and associated habitat features were also recorded.

The collected eDNA water samples were filtered (0.45 µm cellulose nitrate) and the DNA was preserved through silica desiccation. BV labs completed the eDNA testing, which included testing for viable DNA in the sample using the IntegritE-DNA™ test and eight technical replicates (the test was performed on the same sample eight times) for the target species. Only samples that passed (4/4) the InegritE-DNA™ test were assessed for the target species. In consultation with the University of Victoria and BV Labs, Dillon interpreted the eDNA test results using the methodology from Hobbs et al. (2019), which considers a sample "positive" if more than two (of eight) technical replicates returns a positive result. A sample is considered "suspected" if one of eight technical replicates returns a positive result. A site was considered positive if more than one (of three) biological replicates were positive or if more than two biological replicates were suspected. A site was considered suspected if only one of the biological replicates was classified as suspected. For the purposes of this report, any sites resulting in suspected Western Toad detections were considered positive as a conservative approach.

3.4 Emergence Surveys

Forty-three (43) surveys for emerging Western Toad toadlets were conducted throughout the LSA in early September 2019. Wetlands and drainages where Western Toad had previously been observed were targeted (**Figure 4**). Surveys followed the methods outlined in Bull (2009) on Western Toad dispersal of new mesomorphs. Surveys were conducted during daylight hours when temperatures were above 5°C and winds were less than 5 on the BU scale, and some surveys were conducted during rainy periods. Surveys were conducted by two experienced biologists, one walking in or immediately adjacent to the stream or wetland and the other 5 to 20 m parallel with the stream or wetland. Surveys kept a slow pace (approximately 2 km/hr) and vegetation was gently pushed aside while surveyors walked the sites.

3.5 Tissue and Water Sample Collection

Co-located tissue and water quality sample collection was conducted to characterize baseline metal concentrations in amphibians and their environment to support the Project's Human Health and Ecological Risk Assessment. Tissue collection included sampling egg masses and tadpole tissues of Columbia Spotted Frog, Wood Frog, and Long-toed Salamander in 2017, 2018, and 2019. Appropriate permits were obtained prior to collection of any amphibian tissues. A General Wildlife Permit (CB17-273619) was obtained from the BC Ministry of Forests, Lands, and Natural Resource Operations in 2017 for the collection of Columbia Spotted Frog, Wood Frog, and Long-toed Salamander eggs and tadpoles. A permit was obtained from the BC Ministry of Forests, Lands, and Natural Resource Operations and Rural Development in 2018 (Permit No. CB18-301015) and 2019 (Permit No. CB19-475260) to collect, temporarily possess, and transport Columbia Spotted Frog, Wood Frog, and Long-toed Salamander egg masses and tadpoles. To limit impacts on the amphibian populations in the LSA, tissue sample collection was limited to 10 samples per species per permit year.

Tissue collection was completed in tandem with other amphibian baseline surveys in 2017, 2018, and 2019 at wetlands where these species were known to be abundant. All surveys were conducted by two experienced biologists walking the perimeter of each wetland and listening for calling adults to find spawning locations and tadpoles. To find egg masses, snow free and accessible wetlands were searched in the spring of 2018 and 2019 during the amphibian breeding season in April and May. Not all amphibians breed at the same time, but attempts were made to time surveys when egg masses would be the most abundant. Seven egg mass samples were collected from WL4, WL13, WL15, and WL17 in May 2018 and 2019 (**Figure 4**). To find tadpoles, accessible wetlands were searched in July of 2017 and 2018. Three tadpoles were collected from WL4, WL15, and WL17 in July 2017 and 2018 (**Figure 4**).

Egg masses or portions of egg masses were collected by hand using nitrile gloves and tadpoles were captured with a small dip net and placed into a clear Plexiglas viewer or sample bag for species identification. Each tadpole was identified to ensure that the correct species were sampled and that non-permitted species (i.e., Western Toad) were not collected. Egg masses were identified by close

examination *in situ*, as well as examination of individual eggs. Once identification was confirmed, the capture location was obtained with a handheld GPS. Egg masses and tadpoles were weighed on site, as sample sizes were required to be a minimum of five grams each. Tadpole samples were humanly euthanized via concussion, and all samples were immediately placed on ice for transport from the field and later frozen (Close et al., 1986). The collected egg masses and tadpoles were transported by air to ALS Environmental in Burnaby, BC for analysis.

While handling live specimens, the following safety protocols were adhered to:

- Disposable nitrile gloves were worn during all tissue sampling and the biologists did not wear lotions, perfumes, insect repellent, or any other potentially harmful substances;
- Tadpoles were processed separately, where possible, to prevent the spread of disease and/or predation;
- Equipment, waders, and boots were disinfected between wetlands and watersheds to prevent the spread of potential disease or infection;
- Handling of amphibians was avoided and no adults were handled; and
- Collection of tadpoles was completed quietly and gently to prevent any undue stress or impact.

Co-located surface water quality samples were collected at WL4, WL13, and WL17 in May 2018, at WL15 in May and July 2018, and at WL4, WL15, and WL17 in May 2019. Surface water samples collected from each of the 12 sampling stations were analysed for the following parameters:

- Physical tests (general chemistry);
- Anions and nutrients;
- Total and dissolved organic carbon;
- Total and dissolved metals; and
- Polycyclic aromatic hydrocarbons (PAHs).

Grab samples were collected at each sampling location into clean, pre-labelled bottles supplied by the laboratory. Standard protocols were followed regarding sample handling and storage, holding times, test validity, and controls. Field personnel wore nitrile gloves, faced upstream, and submerged the sample bottles until they were full. Preservatives were used for total/dissolved metals, total/dissolved organic carbon, and PAHs. Samples were shipped to BV Labs in Burnaby, BC in 2017 and 2018, and to ALS Environmental in Burnaby, BC in 2019.

3.6 Data Analysis

3.6.1 Amphibian Community Data

For all amphibian species encountered as part of the baseline survey, the number of adults, juveniles, and egg masses recorded over the four years across all survey types were summed per wetland and grouped by watershed. Statistical analyses could not be completed because multi-year detections at the

same locations were uncommon. Species richness, the number of species detected per survey or wetland, was determined by summing the total number of species observed. Breeding species richness, the number of species known to be breeding at a given survey location, was determined by summing the number of species for which signs of breeding (i.e., egg masses, tadpoles) were observed at a survey location over the four survey years. Survey effort (person-hours) was determined for each survey and survey location over the years by multiplying the length of each survey by two to account for the effort expended by both biologists.

3.6.2 Tissue and Water Quality Data

Amphibian tissues and co-located surface water samples were collected at four locations in 2018 and 2019 to determine the existing amphibian tissues and water quality conditions to support future bioaccumulation and risk assessment modelling.

Summary statistics (minimum, maximum, geometric mean, and standard deviation) for the results of tissue analyses were calculated, and concentrations were converted to dry weight (dw) from wet weight (wt) using laboratory-determined percent moisture content for each sample to compare with reference and guideline concentrations. Tissue concentrations were considered by sample type (i.e., tadpole or egg mass) and concentrations were compared to relevant guidelines for chromium, selenium, vanadium, as discussed in **Section 1.3.3**.

Summary statistics (minimum, maximum, geometric mean, and standard deviation) for all parameters detected in the co-located water quality samples were calculated and derivations for parameter-dependent guidelines were completed. Results were compared to both federal (CWQG) and provincial (BC WQG) long-term and short-term surface water guidelines that apply to the Project in order to identify potential effects to aquatic life, in addition to target concentrations identified in the Elk Valley Water Quality Plan (Teck Resources Limited, 2015).

4.0 Results

Four of the five amphibian species suspected to be present in the LSA were documented during the amphibian baseline program surveys conducted in 2014, 2017, 2018, and 2019: Western Toad; Columbia Spotted Frog; Wood Frog; and Long-toed Salamander. Within the LSA, a total of 31 wetlands and 23 ephemeral areas were surveyed as part of the amphibian baseline program (**Figure 3**). Northern Pacific Treefrog were not observed visually or aurally during any surveys, and no other amphibian species were observed during the surveys. Raw data for all surveys completed is presented in **Appendix C**.
Results from the amphibian baseline program are presented as follows:

- Section 4.1 describes the overall amphibian community in the LSA and details results for each survey type;
- Section 4.2 describes amphibian habitat and distribution across the LSA; and
- Section 4.3 describes the co-located tissue and water quality sampling results.

4.1 Amphibian Community

A total of 412 amphibian detections were recorded in the LSA during the amphibian baseline surveys (**Table 4-1**): 18 Western Toad (13 adults; 5 toadlets); 134 Columbia Spotted Frog (37 adults; 39 tadpoles; 58 egg masses); 109 Wood Frog (40 adults; 3 tadpoles; 66 egg masses); and 151 Long-toed Salamander (0 adults; 43 tadpoles; 108 egg masses). In addition, 16 unidentified adult frogs and 48 tadpoles were observed (**Appendix C**); however, these data have been excluded from the report as the species could not be confirmed. In addition to the 412 amphibian detections during the baseline surveys, 5 adult and 3 toadlet Western Toad and 1 adult Wood Frog were observed incidentally between survey locations and during breeding bird surveys (**Appendix C**).

Table 4-1: Amphibian Detections in the LSA

Species	Number Observed During Surveys				Total
	Adult	Toadlet	Tadpole	Egg Mass	
Columbia Spotted Frog	37	-	39	58	134
Long-toed Salamander	0	-	43	108	151
Western Toad	13	5	0	0	18
Wood Frog	40	-	3	66	109
Total					412

During the amphibian baseline program, 210 visits to 31 wetlands and 23 ephemeral survey sites in the LSA were conducted over approximately 160.1 person-hours throughout the 2014, 2017, 2018, and 2019 survey years (**Table 4-2**; **Appendix C**). Amphibians were detected at 18 wetland survey sites and 2 ephemeral areas during the baseline surveys, as well as incidentally at sites WL5.1, WL6, and WL13 (**Appendix C**).

Survey sites with the greatest number of observations included: WL17, WL16, WL15, WL18, and WL13 (138, 82, 32, 30, and 24 detections, respectively) in the Elk River watershed; WL4 (57 detections) in the Alexander Creek watershed; and survey sites WL11.1 and WL11.2 (14 and 10 detections, respectively) in the Grave Creek watershed (**Table 4-2**). The only two ephemeral areas at which amphibians were detected were EPH100.1 and EPH100.2 (four detections each) in the Elk River watershed (**Table 4-2**).

There were 12 wetland survey sites at which amphibians were not detected: WL3, WL5.3, WL5.4, WL6.1, WL7, WL8.1, and WL8.3 in the Alexander Creek watershed; WL10 in the Harmer Creek watershed; WL11.3 in the Grave Creek watershed; and WL19, WL20, and WL22 in the Elk River watershed. One adult frog was detected at survey site WL14 in the Elk River watershed, but the species could not be confirmed. Of the 23 ephemeral areas observed, no amphibians were detected at 21 locations: EPH4.2, the field north of WL5.4; EPH103, EPH104.1, EPH104.2, EPH105, EPH106 in the Alexander Creek watershed; EPH112 in the Grave Creek watershed EPH114 in the Harmer Creek watershed; and EPH101, EPH102, EPH113, EPH115, EPH1003, EPH1004, EPH1005, EPH1006, EPH1007, EPH1008, EPH1009, and EPH1010 in the Elk River watershed (**Appendix C**).

Table 4-2: Amphibian Observations per Survey Site

Location	Columbia Spotted Frog			Long-toed Salamander		Western Toad		Wood Frog			Total
	Adult	Tadpole	Egg Mass	Tadpole	Egg Mass	Adult	Toadlet	Adult	Tadpole	Egg Mass	
WL1	0	0	0	0	0	1	0	1	0	0	2
WL2	1	0	0	0	0	0	0	0	0	0	1
WL4	12	18	22	0	4	0	0	0	0	1	57
WL5.2	1	0	0	0	0	1	0	0	0	0	2
WL6	0	0	0	0	0	0	1	0	0	0	1
WL6.2	0	0	0	3	0	0	0	0	0	0	3
WL8.2	0	0	0	0	0	1	0	0	0	0	1
WL9	0	0	0	5	0	0	0	0	0	0	5
WL11.1	9	0	0	1	0	2	0	2	0	0	14
WL11.2	6	0	0	0	0	1	0	3	0	0	10
WL12	0	0	0	0	0	0	0	1	0	0	1
WL13	2	0	0	0	0	5	4	8	0	5	24
WL15	1	0	0	0	0	0	0	8	3	20	32

Location	Columbia Spotted Frog			Long-toed Salamander		Western Toad		Wood Frog			Total
	Adult	Tadpole	Egg Mass	Tadpole	Egg Mass	Adult	Toadlet	Adult	Tadpole	Egg Mass	
WL16	1	6	0	4	56	0	0	4	0	11	82
WL17	1	15	36	0	48	0	0	9	0	29	138
WL18	0	0	0	30	0	0	0	0	0	0	30
WL21	0	0	0	0	0	1	0	0	0	0	1
EPH100.1	1	0	0	0	0	0	0	3	0	0	4
EPH100.2	2	0	0	0	0	1	0	1	0	0	4
Total	**37**	**39**	**58**	**43**	**108**	**13**	**5**	**40**	**3**	**66**	**412**

Western Toad were detected at 18 locations in the LSA (**Figure 5**). Adult Western Toad were documented across the LSA, while toadlets were documented in only four locations in the LSA: survey sites WL5.1 and WL6 in the Alexander Creek watershed, WL13 in the Elk River watershed, and incidentally at location I998 near West Alexander Creek (**Figure 5**). No Western Toad egg masses or tadpoles were observed over the survey years. Western Toad were documented at wetlands and ephemeral areas in the LSA from May to July across the sampling years, primarily during wetland perimeter searches.

Columbia Spotted Frog were detected at 11 locations across the LSA (**Figure 6**). Adults were observed in the Alexander Creek, Grave Creek, and Elk River watersheds, while tadpoles and egg masses were observed in the Alexander Creek and Elk River and watersheds only. Wood Frog were detected at 12 locations (**Figure 7**). Adults were observed in the Grave Creek and Elk River watersheds; tadpoles were observed in the Elk River watershed only; and egg masses were observed in the Alexander Creek and Elk River watersheds. Long-toed Salamander were detected at 7 locations (**Figure 8**). Tadpoles were observed in the Alexander Creek, Grave Creek, Harmer Creek, and Elk River watersheds, and egg masses were observed in the Alexander Creek and Elk River watersheds.

All Columbia Spotted Frog, Wood Frog, and Long-toed Salamander egg mass observations occurred in May and tadpole observations occurred in June and July, with the exception of one Long-toed Salamander observation recorded in September 2019. The adult life stages of Columbia Spotted Frog and Wood Frog were documented in the LSA during the spring, summer, and fall. Only the egg mass and tadpole life stages of Long-toed Salamander were observed, with no adult observations recorded during the baseline program.

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FIGURE 5.
Western Toad Observations

LEGEND

- Adult
- Toadlet
- eDNA - Positive
- eDNA - Suspected
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:82,000

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: LKD
Map Projection: NAD 1983 UTM Zone 11N

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PROJECT: 12-6231
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Crown Mountain Coking Coal Project

FIGURE 6.
Columbia Spotted Frog Observations

LEGEND

- Adult
- Tadpole
- Egg Mass
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:108,000

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W E
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Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
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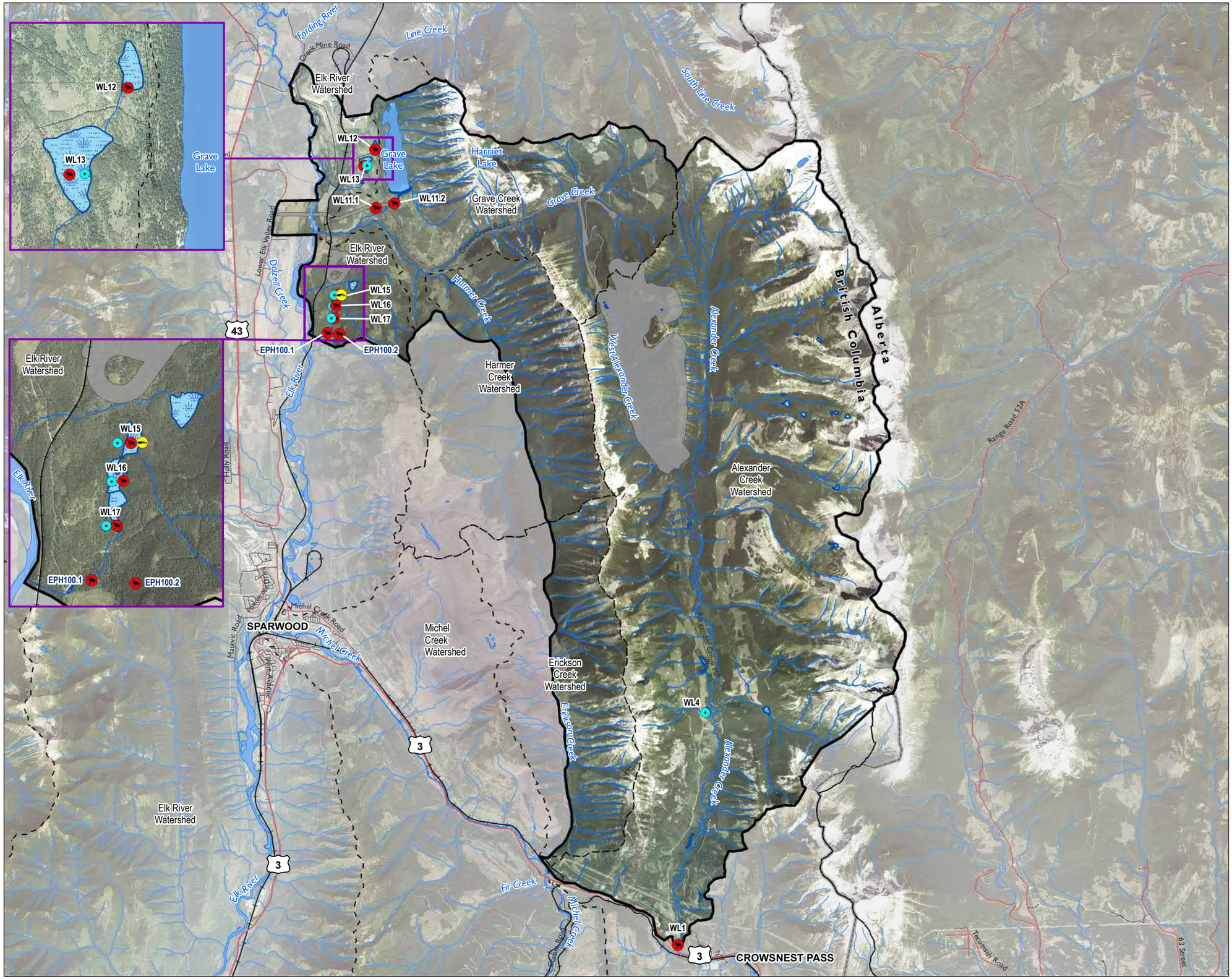

Crown Mountain Coking Coal Project

FIGURE 7.
Wood Frog Observations

LEGEND

- Adult
- Tadpole
- Egg Mass
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:108,000

N W E S

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

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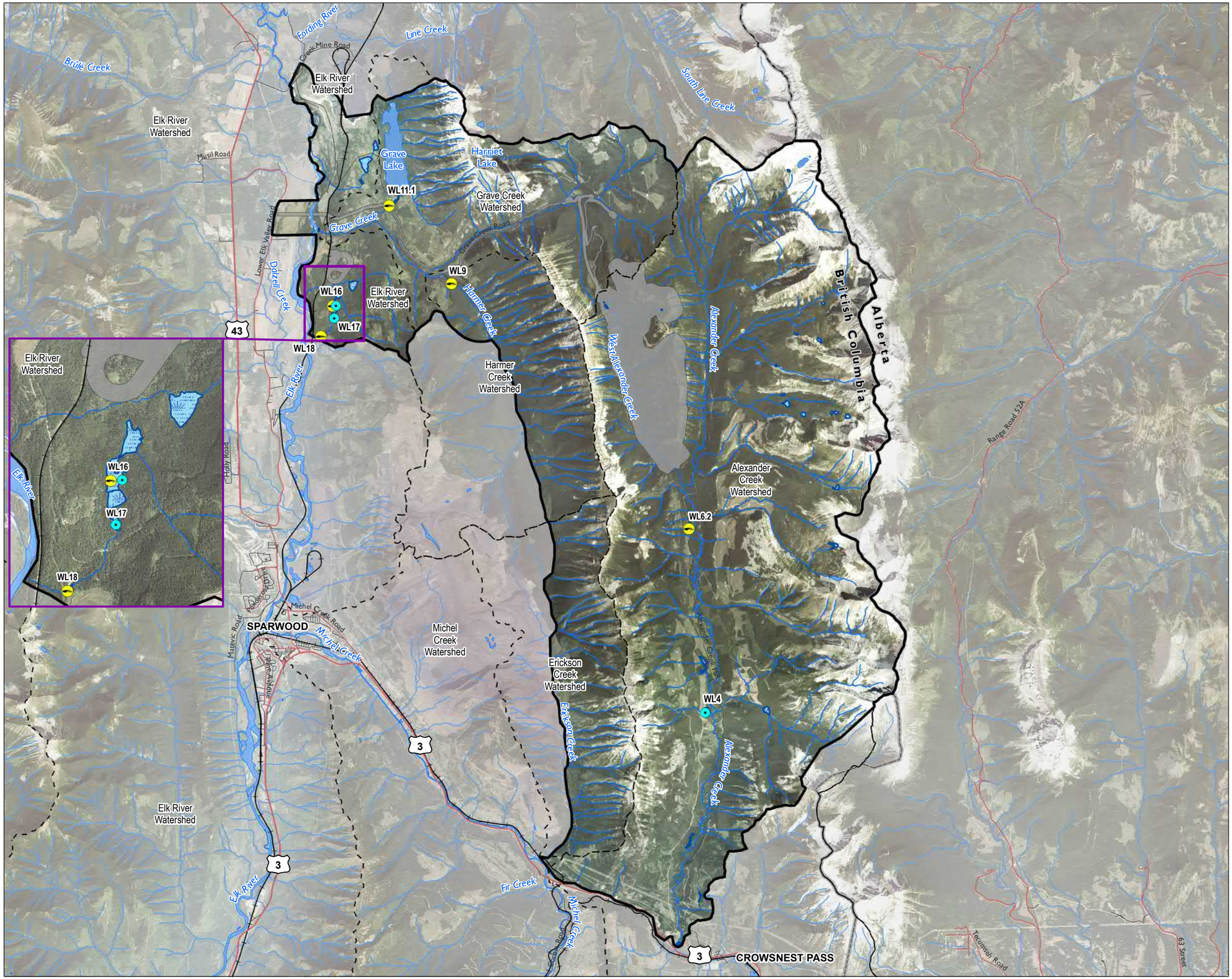

Crown Mountain Coking Coal Project

FIGURE 8.
Long-toed Salamander Observations

LEGEND

- Tadpole
- Egg Mass
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:108,000

N W E S

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

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PROJECT: 12-6231
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File Location: \\42dillon\CAD\GIS\2012 and Prior\126231 Crown Mountain\Bird and Amphibian Survey Maps\Baseline_2019\Amphibian\126231 Baseline Amphibian Long-Toed Salamander Observations.mxd

4.1.1 Wetland Perimeter Searches

A total of 406 amphibian detections were recorded over 157 perimeter searches in 30 wetlands and 13 ephemeral areas over 127.8 person-hours in 2014, 2017, 2018, and 2019 (**Table 4-3**; **Appendix C**). All four amphibian species detected during the baseline program were observed during the perimeter searches: 132 Columbia Spotted Frog, 148 Long-toed Salamander, 18 Western Toad, and 108 Wood Frog (**Table 4-3**). In addition, 16 unidentified adults and 48 unidentified tadpoles were observed during the perimeter searches (**Appendix C**).

Table 4-3: Amphibians Observed during Wetland Perimeter Surveys, 2014 and 2017-2019

Species	No. Observed				
	Adult	Toadlet	Tadpole	Egg Mass	Total
Columbia Spotted Frog	35	-	39	58	132
Long-toed Salamander	0	-	40	108	148
Western Toad	13	5	0	0	18
Wood Frog	39	-	3	66	108
Total	87	5	82	232	406

Amphibians were detected at 16 wetland survey sites and 2 ephemeral areas during the perimeter searches (**Table 4-4**). Survey Site WL17 yielded the greatest number of amphibian detections (138), followed by sites WL16 (82), WL4 (56), WL15 (32), WL18 (30), WL13 (24), WL11.1 (14), and WL11.2 (10). Detections were less than 10 individuals at the other 10 survey sites (**Table 4-4**).

Table 4-4: Perimeter Search Amphibian Detections

Survey Site	Columbia Spotted Frog			Long-toed Salamander		Western Toad		Wood Frog			Total
	Adult	Tadpole	Egg Mass	Tadpole	Egg Mass	Adult	Toadlet	Adult	Tadpole	Egg Mass	
WL1	0	0	0	0	0	1	0	1	0	0	2
WL2	1	0	0	0	0	0	0	0	0	0	1
WL4	11	18	22	0	4	0	0	0	0	1	56
WL5.2	0	0	0	0	0	1	0	0	0	0	1
WL6	0	0	0	0	0	0	1	0	0	0	1
WL8.2	0	0	0	0	0	1	0	0	0	0	1
WL9	0	0	0	5	0	0	0	0	0	0	5
WL11.1	9	0	0	1	0	2	0	2	0	0	14
WL11.2	6	0	0	0	0	1	0	3	0	0	10
WL12	0	0	0	0	0	0	0	1	0	0	1
WL13	2	0	0	0	0	5	4	8	0	5	24
WL15	1	0	0	0	0	0	0	8	3	20	32
WL16	1	6	0	4	56	0	0	4	0	11	82
WL17	1	15	36	0	48	0	0	9	0	29	138
WL18	0	0	0	30	0	0	0	0	0	0	30
WL21	0	0	0	0	0	1	0	0	0	0	1
EPH**100.1**	1	0	0	0	0	0	0	2	0	0	3
EPH**100.2**	2	0	0	0	0	1	0	1	0	0	4
Total	**35**	**39**	**58**	**40**	**108**	**13**	**5**	**39**	**3**	**66**	**406**

4.1.2 Evening Roadside Transect Surveys

No Western Toad were observed during the evening roadside transect surveys, nor were any other migrating amphibian species detected during the 1.3 person-hours of effort along the two road transects and 12 call survey stations (**Appendix C**).

4.1.3 Environmental DNA

Environmental DNA analysis techniques for Western Toad were conducted at 13 wetlands in the LSA with one wetland serving as a positive control (wetland survey site WL21 - visual *in situ* Western Toad presence). Four samples failed the IntegritE-DNA™ test and required cleanup of DNA inhibitors. After cleanup, three samples (one each from survey sites WL11, WL14, and WL21) passed the IntegriE-DNA™ test and were tested for Western Toad. Of all the samples collected, only one sample from site WL2 failed the IntegritE-DNA™ test even after cleanup. This sample was not tested for Western Toad. Results indicate that one positive detection of Western Toad occurred at wetland survey site WL5.3, one suspected detection of Western Toad occurred at site WL4, 8 positive detections occurred at site WL21, and the remainder of the wetlands sampled resulted in non-detection for Western Toad **(**Figure 5; **Table 4-5**). As a conservative approach, the suspected eDNA occurrence was treated as a positive occurrence for the purposes of this report. The raw data from the eDNA analysis is presented in **Appendix D**.

Table 4-5: Western Toad eDNA Results for Wetlands Sampled

Survey Site ID	eDNA Positive Detection*	Inferred Western Toad Presence
WL2	0/8	No
WL4	**1/8**	Suspected
WL5.2	0/8	No
WL5.3	**2/8**	Yes
WL11	0/8	No
WL12	0/8	No
WL14	0/8	No
WL15	0/8	No
WL16	0/8	No
WL17	0/8	No
WL18	0/8	No
WL21**	**8/8**	Yes
WL22	0/8	No

* Indicates the highest detection rate in triplicate set

**Visual positive

4.1.4 Emergence Surveys

No Western Toad toadlets were observed in the LSA during the 43 emergence surveys in 19 wetlands and 5 ephemeral areas in September 2019 over 31.0 person-hours (**Table 4-6**). Single observations of adult Columbia Spotted Frog were recorded in WL4 and WL5.2, one adult Wood Frog was detected in EPH100.1, and three Long-toed Salamander tadpoles were detected in WL6.2 (**Table 4-6**).

Table 4-6: Amphibians Observed during Emergence Surveys, September 2019

Species	No. Observed				
	Adult	Toadlet	Tadpole	Egg Mass	Total
Columbia Spotted Frog	2	0	0		3
Long-toed Salamander	0	0	3	0	3
Western Toad	0	0	0	0	0
Wood Frog	1	0	0	0	0

4.2 Amphibian Habitat and Distribution

Most amphibian observations were recorded in marshes and shallow water wetlands with habitat characteristics such as peat and organic surface substrates, emergent vegetation cover, and moderate temperatures. The greatest number of amphibian detections occurred in the Alexander Creek (WL4), Grave Creek (WL11.1 and WL11.2), and Elk River (WL13, WL15, WL16, and WL17) watersheds, with key breeding areas identified at WL4 in the Alexander Creek watershed and WL16 and WL17 in the Elk River watershed.

Amphibian species richness per survey site varied from 0 to 4. The most species-rich and diverse wetlands were WL11.1 in the Grave Creek watershed and WL4 in the Alexander Creek watershed, in which all four amphibian species were detected (**Figure 9**). Survey sites with species richness of 3 included WL11.2 in the Grave Creek watershed and sites WL13, WL16, WL17, and EPH100.2 in the Elk River watershed.

Breeding richness, the number of species breeding at a survey site ranged from 0 to 3 (**Figure 10**). The most species-rich breeding sites were WL4 in the Alexander Creek watershed and WL16 and WL17 in the Elk River watershed, at which tadpoles and/or egg masses for Columbia Spotted Frog, Long-toed Salamander, and Wood Frog were observed. Only one breeding species was detected at the other five survey sites at which breeding was recorded (**Figure 10**).

Amphibian habitat and distribution across the Alexander Creek, Grave Creek, Elk River, and Harmer Creek watersheds is discussed in the following subsections.

Crown Mountain Coking Coal Project

FIGURE 9.
Amphibian Species Richness in the LSA

LEGEND

- 1 (Lowest)
- 2
- 3
- 4 (Highest)
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:82,000

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

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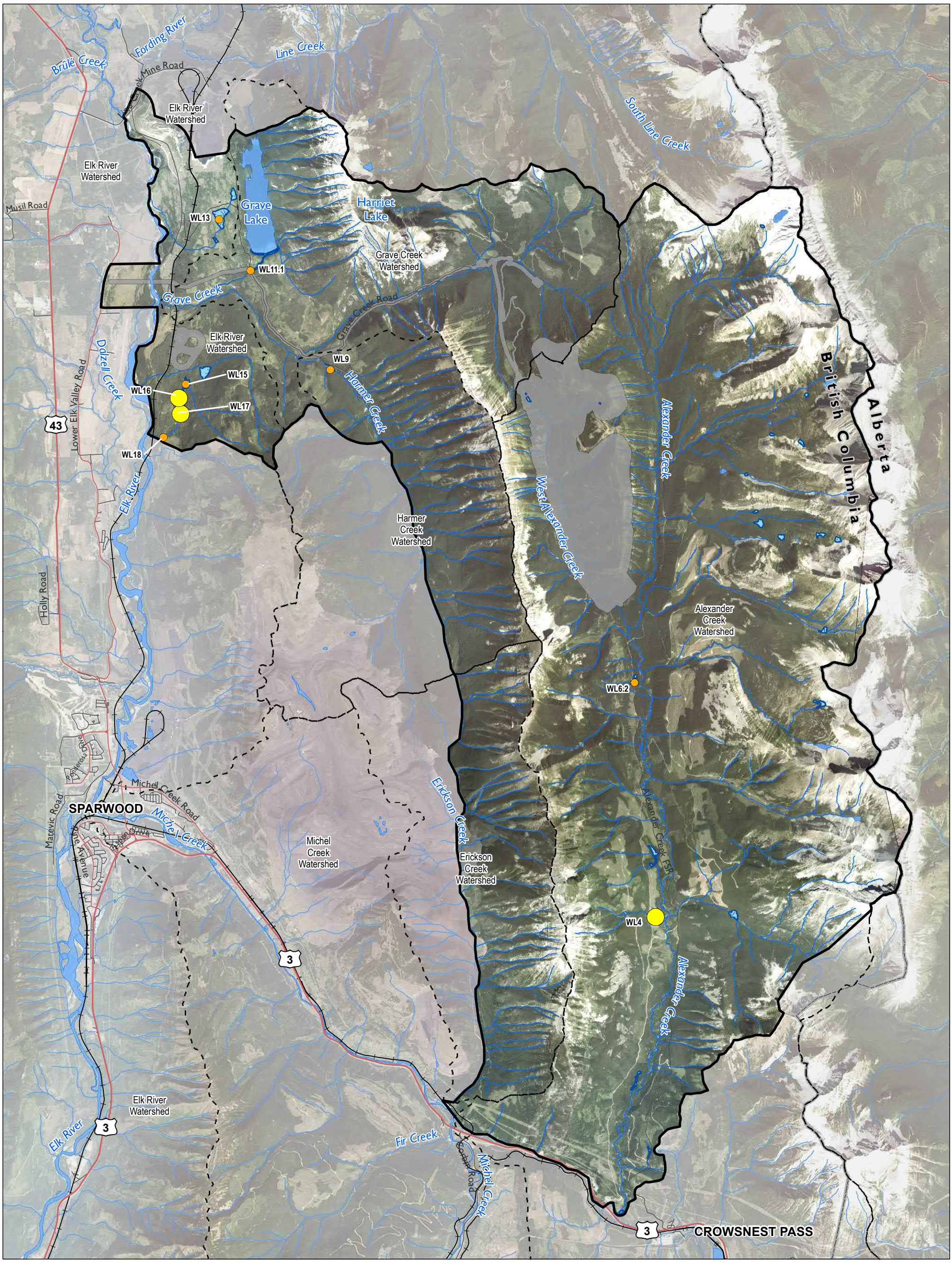

Crown Mountain Coking Coal Project

FIGURE 10.
Amphibian Breeding Richness in the LSA

LEGEND

- 1 (Lowest)
- 2
- 3
- 4 (Highest)
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:82,000

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4.2.1.1 Alexander Creek Watershed

Within the Alexander Creek watershed, 17 wetlands were visited 80 times and 7 ephemeral areas were visited 12 times over the 4 survey years. Western Toad were documented at eight wetlands and four incidental locations (**Figure 5**); Columbia Spotted Frog were documented at three wetlands (**Figure 6)**; and Wood Frog and Long-toed Salamander were documented at two wetlands **(Figure 7** and **Figure 8**; **Table 4-7**). Incidental observations were recorded at four locations in the Alexander Creek watershed: 1 adult Western Toad at each of I994, I995, and I997, and one Western Toad toadlet at I998 (**Figure 5**; **Appendix C**).

Wetland survey site WL4 was the most species-rich, with all four amphibian species observed over the course of the baseline program documented in this wetland (**Table 4-7**; **Figure 9**). Where evidence of breeding occurred (egg mass and tadpoles), the breeding species richness was also determined. Site WL4 had the highest breeding species richness of 3 in the Alexander Creek Watershed, where egg masses were documented for Columbia Spotted Frog, Wood Frog, and Long-toed Salamander (**Table 4-7**; **Figure 10**). Amphibian observations at WL4 were dominated by the Columbia Spotted Frog, which were observed over multiple years in all life stages (egg mass, tadpole, adult). Site WL6.2 was the only other location with evidence of breeding in the Alexander Creek watershed, with a single observation of Long-toed Salamander tadpoles in September 2019. Aside from observations at sites WL4 and WL6.2, all other amphibian observations in the Alexander Creek watershed were single-year observations with one to two species present. Western Toad toadlets were documented at sites WL5.1 and WL6 and in incidental location I998, and the remainder of the observations were adults (no egg masses or tadpoles were observed). Each observation was of a single Western Toad, and there were no multi-year observations in the same location. Survey sites in the Alexander Creek watershed where no amphibians were detected included wetlands WL3, WL5.3, WL5.4, WL6.1, WL7, WL8.1, and WL8.3, and ephemeral areas EPH4.2, the field north of WL5.4; EPH103, EPH104.1, EPH104.2, EPH105, and EPH106 (**Appendix C**).

The majority of amphibian observations in the Alexander Creek watershed occurred in the lower elevation MSdw BEC subzone in marshes and shallow water wetlands. Higher elevation observations in the ESSFdk1 subzone were only of Western Toad; one in a shallow water alpine wetland (survey site WL8.2 located within the Project footprint), three incidental observations in the forested slopes of West Alexander Creek, and one incidental observation near Deadman's Pass (**Figure 5**). Common habitat characteristics at sites where amphibians were observed within the Alexander Creek watershed include: substrates of peat, organics, silt, and sand; low to moderate emergent vegetation cover; presence of coarse woody debris; and water temperatures between 7 and 15°C (**Table 4-7**). In general, habitat characteristics were similar between the sites with and without amphibian occupancy (**Appendix A**).

Table 4-7: Alexander Creek Watershed Amphibian Survey Results and Habitat Characteristics

Survey Site	Year	Month	Life Stage	Western Toad	Columbia Spotted Frog	Wood Frog	Long-toed Salamander	Overall Species Richness	Breeding Species Richness	BEC Subzone	Primary Wetland Type *	Surface Substrate	Emergent Vegetation Cover (%)	Coarse Woody Debris**	Temperature (°C)	Potential for Fish Presence	Located within Project Footprint?
Occupied Survey Sites																	
WL1	2014	July	Adult	1	-	1	-	2	0	MSdw	Marsh	Peat, Silt, Sand	33-66	Y	7.3	Fish bearing	No
WL2	2019	July	Adult	-	1	-	-	1	0	MSdw	Fen	Peat, Silt	0-33	N	7.9-11.5	Unlikely	No
WL4	2014	June	Adult	-	1	-	-	4	3	MSdw	Marsh	Peat, Organics, Silt, Sand	33-66	Y	10.4-15	Fish bearing	No
	2017	June	Tadpole	-	10	-	-										No
			Adult	-	2	-	-										
		July	Tadpole	-	5	-	-										
	2018	May	Egg Mass	-	8	-	-										
			Adult	-	3	-	-										
	2019	May	Egg Mass	-	5, 9	1	4										
			Adult	-	5	-	-										
		July	Tadpole	-	3	-	-										
			Unknown	Suspected***	-	-	-										
		September	Adult	-	1	-	-										
WL5.1	2014	June	Toadlet	1*	-	-	-	1	0	MSdw	Marsh	Peat, Organics, Silt, Sand, Gravel	66-100	Y	6.8	Fish bearing	No
WL5.2	2019	September	Adult	1	1	-	-	2	0	MSdw	Marsh	Peat, Organics, Silt, Sand	33-66	Y	9.1	Fish bearing	No
WL5.3	2019	July	Unknown	Present***	-	-	-	1	0	MSdw	Marsh	Peat, Organics, Silt, Sand	33-66	N	9.5	Fish bearing	No
WL6	2017	June	Toadlet	1	-	-	-	1	0	MSdw	Marsh	Organics, Silt, Sand	0-33	Y	13-13.3	Fish bearing	No
WL6.2	2019	September	Tadpole	-	-	-	3	1	1	MSdw	Shallow Water	Gravel	0-33	Y	n/a	Not sampled	No
WL8.2	2018	July	Adult	1	-	-	-	1	0	ESSFdk1	Shallow Water	Peat, Organics, Silt	0-33	Y	14.9	Unlikely	Yes
WL21	2019	July	Adult	1	-	-	-	1	0	MSdw	Marsh	Peat, Organics, Silt, Sand, Gravel	0-33	Y	6.2	Fish bearing	No

* Many wetlands observed within the LSA form wetland complexes of two or more distinct wetland associations

** Y = Yes; N = No; n/a = not applicable

*** Based on eDNA detection

4.2.1.2 Grave Creek Watershed

In the Grave Creek watershed, 3 wetlands were visited 20 times and 5 ephemeral areas were visited 6 times over the 4 survey years. Western Toad were documented at two wetlands and one incidental location (**Figure 5**); Columbia Spotted Frog and Wood Frog were documented at two wetlands (**Figure 6** and **Figure 7**); and Long-toed Salamander were documented at one wetland (**Figure 8**).

Wetland survey sites WL11.1 and WL11.2 in the Grave Creek watershed had high species richness (4 and 3, respectively; **Table 4-8**; **Figure 9**) and low breeding species richness (1 at WL11.1 and 0 at WL11.2; **Figure 10**). A Western Toad toadlet was documented at survey site WL11.1, and all other Western Toad observations in the Grave Creek watershed were of adults. Columbia Spotted Frog and Wood Frog adults were the only life stage of these species observed in the Grave Creek watershed, while only Long-toed Salamander tadpoles were observed. No amphibians were observed at survey sites WL11.3 or EPH112 in the Grave Creek watershed. One adult Western Toad was incidentally observed at location at I996 in July 2019 (**Appendix C**).

Observations of amphibians in the Grave Creek watershed occurred in marshes and shallow water wetlands of the MSdw (**Table 4-14**). One Western Toad was observed incidentally in the ESSFdk1 subzone in the upper Grave Creek watershed in a steep, re-planted cutblock. Within the Grave Creek watershed, amphibians were commonly observed in wetlands with the following habitat characteristics: surface substrates of peat, organics, silt, and sand; low to moderate emergent vegetation cover; coarse woody debris presence; and water temperatures between 12 and 15°C (**Table 4-8**). In general, habitat characteristics were similar between the sites with and without amphibian occupancy (**Appendix A**).

Table 4-8: Grave Creek Watershed Amphibian Survey Results and Habitat Characteristics

Survey Site	Year	Month	Life Stage	Western Toad	Columbia Spotted Frog	Wood Frog	Long-toed Salamander	Overall Species Richness	Breeding Species Richness	BEC Subzone	Primary Wetland Type*	Surface Substrate	Emergent Vegetation Cover (%)	Coarse Woody Debris**	Temperature (°C)	Potential for Fish Presence	Located within Project Footprint?
WL11.1	2014	July	Adult	1	7	1	-	4	1	MSdw	Marsh	Peat, Organics, Silt, Sand	0-33	Y	11.7-14	Fish bearing	Yes
	2017	June	Toadlet	1	-	-	-										
		July	Tadpole	-	-	-	1										
	2019	July	Adult	-	2	1	-										
WL11.2	2014	July	Adult	1	2	-	-	3	0	MSdw	Shallow Water	Peat, Organics, Silt, Sand, Gravel	33-66	Y	15.2	Not sampled	No
	2019	July	Adult	-	2	3	-										

* Many wetlands observed within the LSA form wetland complexes of two or more distinct wetland associations

** Y = Yes; N = No; n/a = not applicable

4.2.1.3 Elk River Watershed

In the Elk River watershed, 9 wetlands were visited 62 times and 10 ephemeral areas were visited 16 times over the 4 survey years. Western Toad were only documented at one wetland and one ephemeral area (**Figure 5**); Columbia Spotted Frog were documented at four wetlands and two ephemeral areas (**Figure 6**); Wood Frog were documented at five wetlands and two ephemeral areas (**Figure 7**); and Long-toed Salamander were documented at three wetlands (**Figure 8**; **Table 4-9**).

Wetland survey sites WL13, WL16, and WL17, and ephemeral area EPH100.2 in the Elk River watershed had species richness of 3 (**Table 4-9**; **Figure 9 - 10**). Sites WL16 and WL17, both with a breeding species richness of 3, were found to have the highest breeding richness in the Elk River watershed. Evidence of breeding occurred in all but one wetland (site WL12) visited in the Elk River watershed, and was documented for all amphibian species observed as part of the baseline program with the exception of Western Toad. Western Toad toadlets were observed over multiple years at WL13, and adults were observed at this site each survey year. Additionally, a single adult Western Toad was documented at EPH100.2 in 2019.

Amphibian observations in the Elk River watershed were dominated by Wood Frog, followed by Columbia Spotted Frog, and both of these species had evidence of breeding. Long-toed Salamander were observed to be breeding at WL16, WL17, and WL18. No amphibians were detected at survey sites WL19, WL20, WL22, EPH101, EPH102, EPH113, EPH115, EPH1003, EPH1004, EPH1005, EPH1006, EPH1007, EPH1008, EPH1009, and EPH1010 in the Elk River watershed. One adult frog was detected at survey site WL14 in the Elk River watershed, but the species could not be confirmed (**Appendix C**).

Observations in the Elk River watershed occurred in the MSdw subzone generally in marshes, shallow water wetlands, and ephemeral areas. Common habitat characteristics of wetland where amphibians were observed include: substrates of peat and organics; high emergent vegetation cover; and water temperatures between 12 and 18°C **(Table 4-9**). In general, habitat characteristics were similar between the sites with and without amphibian occupancy (**Appendix A**).

Table 4-9: Elk River Watershed Amphibian Observations and Habitat Characteristics

Survey Site	Year	Month	Life Stage	Western Toad	Columbia Spotted Frog	Wood Frog	Long-toed Salamander	Overall Species Richness	Breeding Species Richness	BEC Subzone	Primary Wetland Type*	Surface Substrate	Emergent Vegetation Cover (%)	Coarse Woody Debris**	Temperature (°C)	Potential for Fish Presence	Located within Project Footprint?
WL12	2019	July	Adult	-	-	1	-	1	0	MSdw	Transitional Marsh-Fen	Peat, Organics	66-100	N	14.6-18	Not sampled	No
WL13	2014	June	Toadlet	2	-	-	-	3	1	MSdw	Swamp	Peat, Organics	66-100	N	n/a	Not sampled	No
			Adult	2	-	1	-										
	2017	June	Adult	1	1	3	-										
	2018	May	Egg Mass	-	-	5	-										
			Toadlet	2	-	-	-										
			Adult	-	1 (incidental)	1	-										
	2019	July	Adult	2	-	3	-										
WL15	2018	May	Egg Mass	-	-	10	-	2	1	MSdw	Marsh	Peat, Organics	66-100	N	12	Unlikely	No
			Adult	-	-	4	-										
		July	Tadpole	-	-	3	-										
	2019	May	Egg Mass	-	-	10	-										
			Adult	-	-	2	-										
		July	Adult	-	1	2	-										
WL16	2019	May	Egg Mass	-	-	11	3, 53	3	3	MSdw	Marsh	Peat, Organics	66-100	Y	12.2	Unlikely	No
		July	Tadpole	-	6	-	4										
			Adult	-	1	4	-										
WL17	2014	July	Tadpole	-	4	-	-	3	3	MSdw	Marsh	Peat, Organics	66-100	N	12.7-15.8	Potential	No
			Adult	-	-	2	-										
	2017	June	Adult	-	-	3	-										
		July	Tadpole	-	11	-	-										
	2018	May	Egg Mass	-	8	27	-										
	2019	May	Egg Mass	-	28	2	48										
			Adult	-	-	1	-										
		July	Adult	-	1	3	-										
WL18	2019	July	Tadpole	-	-	-	34	1	1	MSdw	Shallow Water	Peat, Organics, Sand	66-100	Y	11.7	Potential	No

Survey Site	Year	Month	Life Stage	Western Toad	Columbia Spotted Frog	Wood Frog	Long-toed Salamander	Overall Species Richness	Breeding Species Richness	BEC Subzone	Primary Wetland Type*	Surface Substrate	Emergent Vegetation Cover (%)	Coarse Woody Debris**	Temperature (°C)	Potential for Fish Presence	Located within Project Footprint?
EPH100.1	2014	June	Adult	-	-	1	-	2	0	MSdw	n/a	Peat, Organics	0	N	n/a	n/a	No
	2019	May	Adult	-	1	-	-										
		July	Adult	-	-	1	-										
		September	Adult	-	-	1	-										
EPH100.2	2019	May	Adult	1	1	-	-	3	0	MSdw	n/a	Peat, Organics, Sand	0-33	N	n/a	n/a	No
		July	Adult	-	1	1	-										

* Many wetlands observed within the LSA form wetland complexes of two or more distinct wetland associations

** Y = Yes; N = No; n/a = not applicable

4.2.1.4 Harmer Creek Watershed

In the Harmer Creek watershed, 2 wetlands were visited 13 times and 1 ephemeral area was visited once over the 4 survey years. One Western Toad was documented at incidental area I999 in July 2018 (**Figure 1**) and five Long-toed Salamander tadpoles were documented in WL9 in July 2017 (**Figure 8**; **Table 4-10**). Columbia Spotted Frog and Wood Frog were not documented in this watershed. Overall species richness and breeding richness was low (1) for WL9 (**Figure 9 and 10**). No amphibians were detected at survey sites WL10 and EPH114 in the Harmer Creek watershed.

Within the Harmer Creek watershed, Long-toed Salamander tadpoles were documented in WL9, a floodplain surrounding a shallow water wetland with a surface substrate composed of organics, silt, sand, and gravel, and a water temperature of 11°C. A single adult Western Toad was incidentally observed in a moist forest understory dominated by *Carex* species. In general, habitat characteristics were similar between the sites with and without amphibian occupancy (**Appendix A**).

Table 4-10: Harmer Creek Watershed Amphibian Observations and Habitat Characteristics

Survey Site	Year	Month	Life Stage	Western Toad	Columbia Spotted Frog	Wood Frog	Long-toed Salamander	Overall Species Richness	Breeding Species Richness	BEC Subzone	Primary Wetland Type*	Surface Substrate	Emergent Vegetation Cover (%)	Coarse Woody Debris**	Temperature (°C)	Potential for Fish Presence	Located within Project Footprint?
WL9	2017	July	Tadpole	-	-	-	5	1	1	MSdw	n/a (Floodplain)	Organics, Silt, Sand, Gravel	0-33	N	11	Unlikely	No

* Many wetlands observed within the LSA form wetland complexes of two or more distinct wetland associations

** Y = Yes; N = No; n/a = not applicable

4.3 Tissue and Water Sample Collection

Columbia Spotted Frog, Wood Frog, and Long-toed Salamander were targeted for tissue collection to provide a baseline measure of metal concentrations in amphibian tissues. Egg mass samples were collected in May 2018 and 2019, and tadpoles were collected in July 2017 and 2018. Egg masses were preferentially collected, and tadpoles were only collected in locations where egg masses had not previously been sampled. In 2017 and 2018, co-located surface water quality samples were also collected to inform the baseline conditions in the surrounding environment.

During the 2017 field season, two Columbia Spotted Frog tadpole tissue samples were collected from wetland survey sites WL4 and WL17 (**Table 4-11**; **Figure 11**). Fewer wetlands with amphibians were encountered than anticipated during the 2017 field season and therefore additional sampling was completed in 2018. In 2018, three Wood Frog egg masses, one Wood Frog tadpole, and one Columbia Spotted Frog egg mass were collected from four wetlands in the LSA, WL4, WL13, WL15, and WL17 (**Table 4-11**; **Figure 11**). During the 2018 sample season, amphibian tissue samples were particularly difficult to collect due to weather and seasonality, as such follow up sampling was completed in 2019. In 2019, two Wood Frog egg masses and one Columbia Spotted Frog egg mass were collected from three wetlands, survey sites WL4, WL15, and WL17 (**Table 4-11**; **Figure 11**). Most tissue samples were collected in the Elk River watershed, except for two Columbia Spotted Frog egg masses and one tadpole from wetland survey site WL4 in the Alexander Creek watershed. No Long-toed Salamander samples were collected over the course of the baseline program.

Table 4-11: Amphibian Tissue and Water Quality Sample Collection

Year	Date	Watershed	Wetland	Columbia Spotted Frog	Wood Frog	Water Quality Sample ID
2017	July 6	Alexander Creek	WL4	Tadpole	-	-
		Elk River	WL17	Tadpole	-	-
2018	May 5	Elk River	WL15	-	Egg Mass	18-WF-WL9B
		Elk River	WL17	-	Egg Mass	18-WL9
	May 8	Elk River	WL13	-	Egg Mass	18-WF-10
	May 9	Alexander Creek	WL4	Egg Mass		18-CSF-07
	July 4	Elk River	WL15	-	Tadpole	WET21
2019	May 9	Elk River	WL15	-	Egg Mass	WF-WL15-19
		Elk River	WL17	Egg Mass	-	CSF-WL17-19
	May 21	Alexander Creek	WL4	Egg Mass	-	CSF-4.1-19

4.3.1 Comparison to Tissue Guideline Values

Results for the laboratory analyses of metals in amphibian tissues and summary statistics (minimum, maximum, geometric mean, and standard deviation) are provided in **Appendix E**. Tissue concentrations were considered by sample type (i.e., tadpole or egg mass). A summary of tissue concentrations for parameters with relevant guidelines is provided in **Table 4-12.**

The mean concentration of selenium in tadpoles collected was 3.26 mg/kg dw (range: 2.39 to 5.33). The mean concentration of selenium in egg masses was 2.83 mg/kg dw (range: 1.86 to 5.00). Selenium levels in all tadpole tissue samples were below the US EPA (2016) guideline value for fish (8.5 mg/kg dw). Concentrations of selenium in all amphibian egg samples collected were below the BC MOE (2014) guidelines for bird eggs and the US EPA (2016) guideline for fish. No exceedances of Elk Valley reference concentrations for chromium or vanadium (Windward et al., 2014) were observed in the amphibian egg samples, as all samples were below the detection limit (**Table 4-12**).

Table 4-12: Amphibian Tissue Concentrations and Guideline Values for Selenium, Chromium, and Vanadium

Species	Watershed	Wetland	Date	Selenium (mg/kg dw)	Chromium (mg/kg dw)	Vanadium (mg/kg dw)
Tadpole Tissue						
Guideline Value				8.5[a]	-	-
Columbia Spotted Frog	Alexander Creek	WL4	July 6, 2017	2.39	-	-
Columbia Spotted Frog	Elk River	WL17	July 6, 2017	2.72	-	-
Wood Frog	Elk River	WL15	July 4, 2018	5.33	-	-
Egg Mass						
Guideline Value				6[b]; 15.1[c]	12.7[d]	6.5[d]
Wood Frog	Elk River	WL15	May 5, 2018	2.09	<DL	<DL
Wood Frog	Elk River	WL17	May 5, 2018	1.86	<DL	<DL
Wood Frog	Elk River	WL13	May 8, 2018	2.59	<DL	<DL
Columbia Spotted frog	Alexander Creek	WL4	May 9, 2018	2.17	<DL	<DL
Wood Frog	Elk River	WL15	May 9, 2019	5.00	<DL	<DL
Columbia Spotted Frog	Elk River	WL17	May 9, 2019	3.57	<DL	<DL
Columbia Spotted Frog	Alexander Creek	WL4	May 21, 2019	3.77	<DL	<DL

a: Whole body US EPA (2016) guideline for fish
b: Egg BC MOE (2014) guideline for bird eggs
c: Egg US EPA (2016) guideline for fish
d: Egg reference value for amphibians developed by Windward et al. (2014)

DL = detection limit. Chromium DL = 0.040 mg/kg wet weight; Vanadium DL = 0.020 mg/kg wet weight

4.3.2 Water Quality at Tissue Sampling Locations

Federal (CWQG) and provincial (BC WQG) surface water guidelines, as well as the Elk Valley Water Quality Plan, were considered in order to identify potential effects to aquatic life. The BC WQG are more regionally relevant and often parameter-dependent, and are therefore more useful at characterizing the existing water quality. The CWQG are developed based on data from across Canada and are typically more conservative to account for certain regional conditions that may or may not apply in BC; therefore, these guidelines were applied as a conservative comparison measure. Descriptions of the relevant guidelines are provided in **Section 1.3.3**.

The results from the water quality samples and an indication of whether they exceed the BC WQG and CWQG are provided in **Table 4-13**. Both short- and long-term guidelines were applied. Note that since the monitoring frequency of the baseline program was insufficient to meet the requirements for the specified averaging period (e.g., 5 samples over 30 days), individual samples are compared against the long-term average guideline. Therefore, failure of any individual sample to meet the long-term average guideline may not be of concern, as the long-term guideline is meant to be compared to averaged values.

Parameters without guidelines or guideline exceedances are not further discussed and are shown in **Appendix F**. The phosphorous guideline was excluded as it only applies to lakes where salmonids are the predominant fish species due to concerns over eutrophication. Lakes were not sampled for the amphibian baseline program and none of the wetlands sampled for water quality had documented salmonid presence. Basic statistics (minimum, maximum, geometric mean, and standard deviation) for all parameters are provided in **Appendix F**. Calculations for parameter-dependent guidelines are provided in **Appendix G**.

With the exception of fluoride, there were few guideline exceedances of any of the parameters measured. The majority of exceedances were from wetland survey site WL17 in May 2019, in which total ammonia, total fluoride, and total iron all exceeded the long-term CWQG (**Table 4-13**). The dissolved iron at site WL17 exceeded the short-term BC WQG; the only exceedance of a short-term BC WQG for any parameter measured. Total iron at WL4 in May 2019 also exceeded the long-term CWQG. Total fluoride exceeded the long-term CWQG in all but one sample, and no samples exceeded the short-term BC WQG. Where guidelines existed, there were no exceedances of the long-term BC WQG or the short-term CWQG. Water quality targets specific to the Elk Valley Water Quality Plan were not exceeded.

Table 4-13: Water Quality Guideline Exceedances at Sampled Wetlands in the LSA

Date	Watershed	Wetland	Original Sample Code	Total Ammonia (mg/L)	Total Fluoride (mg/L)	Total Iron (mg/L)	Dissolved Iron (mg/L)
BC WQG (short-term)[1]				**2.35 – 10.6***	**1.50 – 1.67***	**1**	**0.35**
BC WQG (long-term)[1]				*0.40 – 1.66**	-	-	-
CWQG (long-term)[2]				0.171 – 1.54*	0.12[3]	0.3	-
May 5, 2018	Elk River	WL15	18-WF-WL9B	-	0.23	-	-
	Elk River	WL17	18-WL9	-	0.19	-	-
May 8, 2018	Elk River	WL13	18-WF-10	-	0.27	-	-
May 9, 2018	Alexander Creek	WL4	18-CSF-07	-	0.13	-	-
July 4 2018	Elk River	WL15	WET21	-	0.26	-	-
May 9, 2019	Elk River	WL15	WF-WL15-19	-	0.21	-	-
	Elk River	WL17	CSF-WL17-19	0.262	0.23	0.9	**0.41**
May 21, 2019	Alexander Creek	WL4	CSF-4.1-19	-	-	0.7	-

[1] BC MOE, 2016

[2] CCME, 1999 (updated 2007)

[3] Interim guideline

Bold indicate exceedance(s) of short-term maximum BC WQG

Underline indicates exceedance(s) of long-term CWQG

*Parameter-dependent guidelines – see **Appendix F**

Crown Mountain Coking Coal Project

FIGURE 11.
Amphibian Tissue Collection and Co-located Water Quality Sampling Locations

LEGEND

Columbia Spotted Frog
- Egg Mass and Water Quality
- Tadpole

Wood Frog
- Egg Mass and Water Quality
- Tadpole and Water Quality
- Terrestrial Local Study Area
- Project Footprint
- Highways
- Arterial Roads
- Local/Resource Roads
- Railway (Canadian Pacific)
- Watercourse
- Waterbody
- Wetland
- Watershed
- BC/Alberta Border

0 1 2 3 4 Kilometers

SCALE 1:108,000

N W E S

Map Drawing Information: Data Provided by Province of British Columbia, NWP Coal Canada Ltd., Dillon Consulting Limited

Map Created By: JFC/RBB
Map Checked By: LKD
Map Projection: NAD 1983 UTM Zone 11N

DILLON CONSULTING

PROJECT: 12-6231
STATUS: FINAL
DATE: 2021-08-04

File Location: \\42dillon\CAD\GIS\2012 and Prior\126231 Crown Mountain\Bird and Amphibian Survey Maps\Baseline_2019\Amphibian\126231 Baseline Amphibian Tissue Collection and Co-Located Water Quality Sampling.mxd

5.0 Discussion

5.1 Amphibian Habitat and Distribution

The amphibian baseline program results confirm that amphibian occupancy and suitable habitat are dispersed throughout the LSA. Nineteen of the thirty-one wetland survey sites, two of the twenty-three ephemeral areas, and six incidental areas had amphibian occupancy. Four amphibian species were documented in the LSA over the course of the baseline program (i.e., Western Toad, Columbia Spotted Frog, Wood Frog, and Long-toed Salamander), and amphibians were found in all four watersheds surveyed: Alexander Creek, Grave Creek, Elk River, and Harmer Creek.

Areas of high amphibian detection (≥ 10 amphibians) occurred in the Alexander Creek watershed (WL4); Grave Creek watershed (WL11.1 and WL11.2); and the Elk River watershed (WL17, Wl16, WL15, WL18, and WL13). Two ephemeral areas (EPH100.1 and EPH100.2) in the Elk River watershed contained amphibians, suggesting these areas provide temporary habitat for amphibians. Both ephemeral areas are culvert-created wetted areas located between wetland sites WL17 and WL18, and may provide a movement corridor for amphibians between these two wetlands. In the LSA, most amphibians were documented in marshes and shallow-water wetlands.

Western Toad were the mostly widely distributed species, followed by Wood Frog, Columbia Spotted Frog, and Long-toed Salamander. Western Toad were most frequently documented in the Alexander Creek watershed, followed by the Grave Creek and Elk River watersheds. Columbia Spotted Frog, Wood Frog, and Long-toed Salamander were most frequently documented in the Elk River and Grave Creek watersheds, with limited observations in the Alexander Creek watershed. Only single observations of Long-toed Salamander and Western Toad occurred in the Harmer Creek watershed. Based on overall species richness, amphibian observations were greatest in the Alexander Creek watershed at WL4, in the Grave Creek watershed at WL11.1, and WL11.2, and in the Elk River watershed at WL13, WL16, and WL17. These species-rich areas are consistent with amphibian detections, with the exception of WL15 (which had a higher detection rate) and WL16 (which had a higher species richness).

Columbia Spotted Frog, Wood Frog, and Long-toed Salamander egg masses and tadpoles were documented in the Elk River watershed, indicating this area is used as breeding habitat. Egg masses of these three species were documented at WL4, suggesting this wetland was also used as breeding habitat in the Alexander Creek watershed. No egg masses or tadpoles of Western Toad were documented in the LSA; however, toadlets were observed in survey sites WL5.1 and WL6 in the Alexander Creek watershed; WL13 in the Elk River watershed; and incidentally at location I998 near West Alexander Creek. Based on the breeding species richness (the number of species with evidence of breeding), WL4 and WL17 in the Alexander Creek and Elk River watersheds, respectively, appear to support amphibian breeding activity.

The breeding season in the LSA for Columbia Spotted Frog, Wood Frog, and Long-toed Salamander appears to occur in May, as indicated by all egg mass observations for these species. Tadpoles were documented between June and July, suggesting these species may emerge and migrate to their wintering habitats in the late summer or early fall in the LSA, as has been documented for these species in other areas of Canada (Canadian Herpetological Society, 2017a). One observation of Long-toed Salamander tadpoles at wetland survey site WL6.2 in September 2019 suggests their emergence may have been later that year.

Preferred Columbia Spotted Frog breeding habitat in the Rocky Mountains is generally in shallow permanent pools (James, 1998). In the LSA, Columbia Spotted Frog egg masses and tadpoles were found in marshes with associated shallow water wetlands (WL4, WL16, and WL17). While Wood Frog are known to prefer shallow, fish-free ephemeral wetlands in forested areas that are less than one metre deep (Canadian Herpetological Society, 2017b), in the LSA they were found in permanent wetlands (marshes, shallow water, fens), some with fish presence, as well as some ephemeral areas. Long-toed Salamander prefer fish-free permanent or semi-permanent wetlands for breeding, and were typically found in permanent marsh and shallow water wetlands in the LSA, some of which are known to be occupied by fish. Other habitat features that generally corresponded with amphibian observations and that may be important in the LSA included surface substrate with peat and organics, some emergent vegetation cover, and relatively warm water temperatures (7 to 15°C).

While Adult Western Toad, Columbia Spotted Frog, and Wood Frog were documented in the LSA, no adult Long-toed Salamander were observed. Adult Long-toed Salamander seek shelter in logs, rocks, underground burrows and crevices (Canadian Herpetological Society, 2017a), which makes them difficult to detect and may explain why no adults of this species were observed.

Western Toad were found in several wetlands and a few ephemeral areas, as well as in some forested areas away from waterbodies. The adult Western Toad can travel up to 6 km from their breeding sites to their foraging sites in the summer (Bull, 2009; Browne and Paszaowksi, 2010; COSEWIC, 2012), and also exhibit fidelity to their breeding sites (ECCC, 2016). Given these characteristics and that adult and toadlet Western Toads were documented throughout the LSA, it is likely that Western Toad are breeding in the LSA. Western Toad metamorphose into toadlets within two to three months of egg-laying (Davis, 2002; ECCC, 2016). Given that all toadlet observations in the LSA occurred between May and July, and that winter conditions persist in this area until late-March to early-April, it is likely that breeding and egg laying occur between April and May in the LSA.

Western Toad were observed in all watersheds surveyed in the LSA, with the majority of observations in the Alexander Creek watershed, including several observations at higher elevations near West Alexander Creek. No Western Toad egg masses or tadpoles were found in the LSA during the surveys, making it difficult to identify specific breeding habitats. Toadlets are known to migrate to greater than 1 km from their breeding habitats upon hatching, whereupon they follow drainage paths and stay within 200 m of

water (Bull, 2009; Browne & Paszaowksi, 2010; Davis, 2002); therefore, locations where toadlets were documented in the LSA cannot be assumed to be breeding habitats. One Western Toad toadlet was observed at a higher elevation near West Alexander Creek in July not far from wetland site WL8.2, where an adult Western Toad was observed. Given that no other pools or wetlands were observed in this higher-elevation area other than WL8.2, there is potential for this area to support breeding habitat for Western Toad.

In an effort to identify whether the calling population of Western Toad is present in the LSA, evening roadside transect surveys were conducted. No toads were detected, which may have been due to the limited survey effort, or the fact that the surveys may have been conducted outside of the breeding window. Therefore, although the overall results confirm Western Toad are present in the LSA, it remains unclear whether these observations are from the calling population or non-calling population.

Of the 13 wetlands sampled for eDNA, results indicate that Western Toad are confirmed to be present in two wetlands (i.e., WL5.3 and WL21). The relatively high number of non-detections of Western Toad from the eDNA sampling could be the result of one or more of the following: Western Toad were not present in the wetlands sampled; Western Toad may be present but did not breed during the 2019 breeding season in the sampled wetlands, thus no tadpoles would be present in the wetlands sampled (adults spend the majority of their time on land, so eDNA may not have been detected in the water); or Western Toad eDNA dilution was too low to be detected by the primer.

The results of the amphibian baseline program are consistent with findings from studies undertaken for projects in the surrounding area. Studies conducted by Teck (Golder Associates, 2015a) for the Elkview Operations environmental assessment detected Western Toad and Wood Frog in the study area through completion of 44 plot surveys conducted over 7 days between May and July 2013 (Golder Associates, 2015a). Generally, Western Toad were observed in ponds and Wood Frog were observed in marshes and ephemeral pools/puddles. Similar to the Crown Mountain baseline program findings, the study by Teck (Golder Associates, 2015a) detected both adult and toadlet Western Toads, and Wood Frog adults, tadpoles, and egg masses in the study area. However, this study also documented Western Toad tadpoles and egg masses, which may be a potential source of breeding habitat supporting the adult and toadlet populations found in the Elk River and Grave Creek watersheds of the Crown Mountain baseline program LSA.

Columbia Spotted Frog were not observed during the Teck study (Golder Associates, 2015a); however, it was noted that this species likely occurs in the study area based on habitat and observations within the vicinity of the Elkview Operations (Golder Associates, 2015a). No Long-toed Salamander were documented as part of the Teck study for the Elkview Operations (Golder Associates, 2015a). Unlike the findings for Crown Mountain amphibian baseline program, amphibians were not present at the majority of the sites surveyed; amphibians were only present in a few localized areas during the study period.

Studies completed for Teck's Line Creek Operations baseline amphibian study (Teck Coal Ltd., 2011) determined that Western Toad is likely to be present, but detected few in the study area, consistent with the results herein. There were no amphibian surveys completed during as part of Teck's Line Creek Operations baseline program (Teck Coal Ltd., 2011).

5.2 Amphibian Tissues and Water Quality

Tissue collection results indicate that concentrations of selenium in amphibian tissues (including whole-body and egg samples) are not elevated above applicable guideline values. Guidelines do not currently exist for the evaluation of other metals in amphibians; therefore, it is difficult to comment on levels of other metals in amphibian tissues in the LSA. Chromium and vanadium concentrations in amphibian egg tissue did not exceed the Elk Valley reference values (Windward et al., 2014) in any of the samples collected.

Surface water quality guideline exceedances were limited to single exceedances of total ammonia, total fluoride, and total and dissolved iron at wetland site WL17, and total iron at WL4. Each of these parameters exceeded the long-term CWQG, with only one sample exceeding the short-term BC WQG for dissolved iron. Total fluoride exceeded the long-term CWQG at all but one location, but had no exceedances of the short-term BC WQG. Water quality targets specific to the Elk Valley were not exceeded.

The long-term CWQG is meant to be compared against averaged concentrations from intensive sampling (5 samples in 30 days), and comparing these discrete sample concentrations was a conservative measure. Further sampling would be required to determine whether any of the exceedances of the long-term CWQG represent a risk to aquatic health. The short-term BC WQG are more relevant to the site, particularly for parameter-dependent guidelines. Given that only one sample slightly exceeded a short-term BC WQG for one parameter (dissolved iron), and with the exception of total fluoride (which is currently an interim CCME guideline), only a few parameters exceeded the long-term CWQG, the existing water quality in the sampled wetlands is not considered to pose a risk to aquatic health.

Amphibian egg tissues collected for other projects in the vicinity of the Project generally showed elevated levels of selenium, chromium, and vanadium north of the Project, and similar levels west of the Project. During studies completed for Teck's Elkview Operations west of the Project, two Long-toed Salamander egg masses were collected in 2014 from a mine-exposed wetland (Golder Associates, 2015b). Selenium concentrations ranged from 2.12 to 2.23 mg/kg dw, which is within the range of concentrations identified in the egg masses analyzed for the Project. Concentrations of vanadium were above the reference concentration developed by Windward et al. (2004) in one of the two amphibian egg masses in the Teck study (9.58 mg/kg dw). Elevated levels of chromium compared to the reference concentration were not identified in the amphibian eggs collected in the Elkview Operations study.

At Teck's Line Creek Operations north of Crown Mountain in 2009 to 2010, Columbia Spotted Frog egg mass samples were collected at one mine-exposed area and Western Toad egg masses were collected at two mine-exposed areas (Teck Coal Ltd., 2011). Average selenium concentrations in the Columbia Spotted Frog egg masses (6.8 mg/kg dw) and Western Toad egg masses (11.0 mg/kg dw) from one of the two locations sampled exceeded the BC MOE (2014) guideline of 6 mg/kg dw. Chromium and vanadium maximum concentrations in the Columbia Spotted Frog egg masses also exceeded the Elk Valley reference concentrations (Teck Coal Ltd., 2011). The maximum chromium concentrations ranged from 14 to 46 mg/kg dw compared to the 12.7 reference concentration, and the maximum vanadium concentrations ranged from 0.77 to 12 mg/kg dw compared to the 6.5 mg/kg dw reference concentration.

6.0 Summary

Amphibian baseline surveys were conducted in the LSA in 2014, 2017, 2018, and 2019. Surveys included wetland perimeter searches, roadside evening calling surveys, emergence surveys, eDNA surveys, and tissue and water quality collection surveys. Four amphibian species were detected throughout the LSA: Western Toad, Columbia Spotted Frog, Wood Frog, and Long-toed Salamander. Along with adults, Columbia Spotted Frog, Wood Frog, and Long-toed Salamander egg masses and tadpoles were documented, indicating these species breed in the wetlands and ephemeral areas of the LSA. Western Toad were only observed in the toadlet and adult life stages; however, given known migration distances from breeding to foraging and overwintering habitats, it is likely they are also breeding in the LSA. Based on the timing of observations, there is potential for amphibians detected in the LSA to breed between April and May and migrate from their breeding habitats to their overwintering habitats in early to late fall.

Most amphibian observations were recorded in marshes and shallow water wetlands with habitat characteristics such as peat and organic surface substrates, emergent vegetation cover, and moderate temperatures. Western Toad were found in wetlands, ephemeral areas, and forested areas throughout the LSA. Highest observations of amphibian occurred in the Alexander Creek (WL4), Grave Creek (WL11.1 and WL11.2), and Elk River (WL13, WL15, WL16, and WL17) watersheds, with breeding areas identified at WL4 in the Alexander Creek watershed and WL16 and WL17 in the Elk River watershed.

Selenium, chromium, and vanadium concentrations were not elevated in amphibian tissues collected in the LSA when compared to guideline and reference values. Water quality at amphibian tissue sampling locations showed single exceedances of a few parameters (ammonia, fluoride, iron) above the long-term CWQG, and only one exceedance of the short-term BC WQG for dissolved iron, suggesting that the existing water quality at the sampled wetlands is generally suitable for aquatic life.

References

BC Conservation Data Centre (BC CDC). (2019a). BC Conservation Data Centre. Retrieved February 6, 2020, from https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre.

BC Conservation Data Centre (BC CDC). (2019b). CDC iMap [web application]. Retrieved November 20, 2019 from http://maps.gov.bc.ca/ess/sv/cdc/

BC Conservation Data Centre (BC CDC). (2019c). BC Species and Ecosystems Explorer [web application]. Retrieved November 20, 2019 from http://a100.gov.bc.ca/pub/eswp/

BC Conservation Data Centre (BC CDC). (2019d). BC Species and Ecosystems Explorer [web application]. Retrieved December 13, 2019 from http://a100.gov.bc.ca/pub/eswp/reports.do?elcode=AAABH01170

Biolinx Environmental Research Ltd. (2014). *Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia (2014)*. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/herptilebmp_complete.pdf

British Columbia Ministry of Environment (BC MOE), Water Protection & Sustainability Branch, Environmental Sustainability and Strategic Policy Division. (2013). *Guidance for the Derivation and Application of Water Quality Guidelines in British Columbia*. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/wqo_proc_guidance.pdf

British Columbia Ministry of Environment (BC MOE), Water Protection & Sustainability Branch, Environmental Sustainability and Strategic Policy Division. (2014). *Ambient Water Quality Guidelines for Selenium – Technical Report Update*. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/bc_moe_se_wqg.pdf

British Columbia Ministry of Environment (BC MOE), Water Protection & Sustainability Branch, Environmental Sustainability and Strategic Policy Division. (2016). *Long-Term Average vs. Short-Term Maximum Water Quality Guidelines*. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/max-vs-long-term-wq-guidelines-fs.pdf

British Columbia Ministry of Environment (BC MOE). (2017a). *Environmental DNA Protocol for Freshwater Aquatic Ecosystems Version 2.2*. Retrieved from https://www.hemmera.com/wp-content/uploads/2018/08/171115-eDNA-protocol-V2.2.pdf

British Columbia Ministry of Environment and Climate Change Strategy (BC MOE), Water Protection & Sustainability Branch, Environmental Sustainability and Strategic Policy Division. (2019). *British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report.* Retrieved from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf

British Columbia Ministry of Forests. (1991). *Ecosystems of British Columbia*. Retrieved from https://www.for.gov.bc.ca/hfd/pubs/docs/srs/srs06.pdf

British Columbia Ministry of Forests, Lands, and Natural Resource Operations. (2015). *Guide to Identification of Low-Elevation Wetlands in the Okanagan Valley using Primary Indicators.* Retrieved from http://a100.gov.bc.ca/pub/eirs/finishDownloadDocument.do?subdocumentId=10211

Browne, C., & Paszaowski, C. (2010). Hibernation Sites of Western Toads (Anaxyrus boreas) Characterization and Management Implications. *Herpetological Conservation and Biology 5*(1), 49-63.

Bull, E. (2009). Dispersal of Newly Metamorphosed and Juvenile Western Toads (Anaxyrus boreas) in Northeastern Oregon. *Herpetological Conservation and Biology 4*(2), 236-247.

Bureau Veritas. (2019). Understanding Environmental DNA Testing. Retrieved from https://www.bvlabs.com/insights/articles/understanding-environmental-dna-testing

Canadian Council of Ministers of the Environment (CCME). (2007). *A Protocol for the Derivation of Water Quality Guidelines for the Protection of Aquatic Life 2007*. Retrieved from http://ceqg-rcqe.ccme.ca/download/en/220

Canadian Council of Ministers for the Environment (CCME). (1999 [updated 2007]). *Canadian Water Quality Guidelines for the Protection of Aquatic Life. In Canadian Environmental Quality Guidelines.* Winnipeg, Canada: Canadian Council of Ministers for the Environment.

Canadian Environmental Assessment Act SC 2012, c. 19, s. 52. Retrieved from https://laws-lois.justice.gc.ca/eng/acts/c-15.21/page-1.html

Canadian Environmental Assessment Agency (CEAA) (n. d.). *Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012, Crown Mountain Coking Coal Project, NWP Coal Canada Ltd*.

Canadian Herpetological Society. (2017a). Western Long-toed Salamander. Retrieved on October 23, 2019, from http://canadianherpetology.ca/species/species_page.html?cname=Western%20Long-toed%20Salamander

Canadian Herpetological Society. (2017b). Wood Frog. Retrieved on October 23, 2019 from http://canadianherpetology.ca/species/species_page.html?cname=Wood%20Frog

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2012). *COSEWIC Assessment and Status Report on the Western Toad Anaxyrus boreas in Canada.* Retrieved from www.registrelep-sararegistry.gc.ca/default_e.cfm

Davis, T.M. (2002). *Research Priorities for the Management of the Western Toad, Bufo boreas, in British Columbia. B.C. Minist. Water, Land and Air Protection, Biodiversity Branch, Victoria, BC. Wildlife Working Report No. WR-106.*

Dillon Consulting Limited. (2020). *Wetland Ecosystems Baseline Report – Crown Mountain Coking Coal Environmental Assessment*.

Environmental Assessment Act, SBC 2002, c. 43. Retrieved from https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/laws-rules/environmental-assessment-act

Environmental Assessment Office (EAO). (2018). *Application Information Requirements: Crown Mountain Coking Coal Project*. NWP Coal Canada Ltd. Retrieved from https://projects.eao.gov.bc.ca/api/document/5ae234fccf072d002a31a99c/fetch/Application_Information_Requirements

Environment Canada. (2015). *Recovery Strategy for the Rocky Mountain Tailed Frog (Ascaphus montanus) in Canada. Species at Risk Act* Recovery Strategy Series. Ottawa, Canada: Environment Canada.

Environment and Climate Change Canada (ECCC). (2016). *Management Plan for the Western Toad (Anaxyrus boreas) in Canada.* Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/mp-western-toad-e-proposed.pdf

Environment and Climate Change Canada (ECCC). (2017). *Recovery Strategy for the Northern Leopard Frog (Lithobates pipiens), Rocky Mountain population in Canada. Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. 2 parts, 24 pp. + 47 pp.

Forest and Range Practises Act, SBC 2002, c. 69. Retrieved from https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/legislation-regulation/forest-range-practices-act

Golder Associates. (2015a). *Elkview Operations Baldy Ridge Extension Project, Annex J – Wildlife and Wildlife Habitat Baseline Report*. Submitted to Teck Coal Limited Elkview Operations. Report Number 1213490003/R50.

Golder Associates. (2015b). *Elkview Operations Baldy Ridge Extension Project, Annex Q – Selenium Concentrations in Aquatic Biota Baseline Report.* Submitted to Teck Coal Limited Elkview Operations. Report Number 1213490003/R49.

Government of British Columbia. (2019). *Amphibians in B.C.* Retrieved on October 22, 2019 from https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-conservation/amphibians-reptiles/amphibians-in-b-c

Government of British Columbia. (2014). *Develop with Care 2014 Environmental Guidelines for Urban and Rural Land Development in British Columbia*. Retrieved from https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices/develop-with-care

Government of Canada. (2019). *Basics of Environmental Assessment*. Retrieved on November 13, 2019, from https://www.canada.ca/en/impact-assessment-agency/services/environmental-assessments/basics-environmental-assessment.html

Hobbs, J., Round, J.M., Allison, M.J., & Helbing, C.C. (2019). Expansion of the known distribution of the Coastal Tailed Frog, *Ascaphus truei*, in British Columbia, Canada using robust eDNA detection methods. *PLoS One*, *14*(3), 1-16.

James, J. D. (1998). *Status of the Columbia Spotted Frog (Rana luteiventris) in Alberta*. Retrieved from https://www.abconservation.com/downloads/AWSR/Reptile%20Amphibian%20and%20Fish%20Reports/Status%20of%20Columbia%20Spotted%20Frog%20in%20Alberta_1998.pdf

Janz, D.M., Deforest, D.K., Brooks, M.L., Chapman, P.M., Gilron, G., Hoff, D., Wayland, M. (2010). Selenium Toxicity to Aquatic Organisms. In Chapman, P.M., Adams, W.J., Brooks, M.L., Delos, C.G., Luoma, S., Maher, W.A., Sanders, R.W. (Eds.), *Ecotoxicology of Selenium in the Aquatic Environment* pp. 141-231. Pensacola, FL: SETAC Press.

Keefer Ecological Services Ltd. (2020). *Terrestrial Ecosystem Mapping Report Crown Mountain Coking Coal Project.*

Ministry of Environment, Lands and Parks Resources Inventory Branch. (1998). *Inventory Methods for Pond-breeding Amphibians and Painted Turtles. Version 2.0.* Retrieved from https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/pond.pdf

Nagpal, N.K., & Howell, K. (2001). *Water Quality Guidelines for Selenium: Technical Appendi*x. Victoria, Canada: British Columbia Ministry of Environment, Water Protection and Sustainability Branch Environmental Sustainability and Strategic Policy Division.

Royal BC Museum. (1999). *A Photographic Journey Exploring the Beauty and Wonder of Northern Boreal Muskeg*. Retrieved from https://royalbcmuseum.bc.ca/exhibits/living-landscapes/prnr/photo_journey/contents.htm

Species at Risk Act (SARA), SC 2002, c.29. Retrieved from https://laws-lois.justice.gc.ca/eng/acts/s-15.3/

Teck Coal Ltd. (2011). *Line Creek Operations. Annex J: Line Creek Operations Phase II Project Wildlife and Wildlife Habitat Baseline Report*.

Teck Resources Limited. (2015). *Elk Valley Water Quality Plan*. Retrieved from https://www.teck.com/media/2015-Water-elk_valley_water_quality_plan_T3.2.3.2.pdf

United States Environmental Protection Agency (US EPA). (2016). *Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater.* Retrieved from https://www.epa.gov/sites/production/files/2016-07/documents/aquatic_life_awqc_for_selenium_-_freshwater_2016.pdf

Veldhoen, N., J. Hobbs, G. Ikonomou, M. Hii, M. Lesperance, & Helbing, C.C. (2016). Implementation of Novel Design Features for qPCR-Based eDNA Assessment. *PLOS ONE*, *11*, 1-23.

Wildlife Act, RSBC 1996, c. 488. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/environmental-assessments/acts-and-regulations/2002-act-regulations-documents/ea_act_2002.pdf

Windward Environmental, Minnow Environmental Inc. and CH2M HILL Limited. (2014). *Elk River Watershed and Lake Koocanusa, British Columbia – Aquatic Environment Synthesis Report. Prepared for Teck Coal Limited, Sparwood, BC.*

Appendix A

Wetland and Ephemeral Area Locations

Table A-1. Wetland Classification and Characteristics

Wetland	Watershed	UTM Coordinates (NAD 83)	No. Surveys	BEC Subzone	Elevation (m)	Total Area (ha)[1]	Primary Wetland Classification	Average Depth (m)	Depth Description	Algae[2]	Emergent Vegetation Cover (%)	Cattails Present	Peat	Organics	Silt
1	Alexander	11U 663941 5502585	9	MSdw	1305	0.55	Marsh	0-0.5	Variable	*Chara* sp.	33-66	N	Y	-	Y
2	Alexander	11U 664229 5505500	2	MSdw	1348	0.51	Fen	0-0.5	Variable	none	0-33	N	Y	-	Y
3	Alexander	11U 664310 5505768	3	MSdw	1355	0.76	Fen	0	Uniform	none	0-33	N	Y	-	Y
4	Alexander	11U 664742 5509372	14	MSdw	1422	2.12	Marsh	0.5-1.5	Variable	*Chara* sp.	33-66	N	Y	Y	Y
5.1	Alexander	11U 664626 5510566	9	MSdw		0.41	Marsh	0	Uniform	*Chara* sp.	66-100	N	Y	Y	Y
5.2	Alexander	11U 664736 5510647	6	MSdw	1441	0.59	Marsh	0-0.5	Uniform	*Chara* sp.	33-66	N	Y	Y	Y
5.3	Alexander	11U 664733 5510766	8	MSdw	1441	0.14	Marsh	0.5-1.5	Variable	*Chara* sp.	33-66	N	Y	Y	Y
5.4	Alexander	11U 664688 5510880	4	MSdw	1444	1.92	Swamp	0-0.5	Variable	none	0	N	Y	-	Y
6	Alexander	11U 664264 5514861	8	MSdw	1494	0.45	Marsh	0-0.5	Uniform	*Chara* sp.; gelatinous algae	0-33	N	-	Y	Y
6.1	Alexander	11U 664237 5514806	1	MSdw	1492	0.16	Marsh	0-0.5	Uniform	*Chara* sp.	66-100	N	-	-	-
6.2	Alexander	11U 664262 5514742	3	MSdw	1494	0.02	Shallow water	0.5-1.5	Variable	*Chara* sp.	0-33	N	-	-	-
7	Alexander	11U 663476 5521127	1	ESSFdkw	2089	0.08	Marsh	0-0.5	Uniform	none	33-66	N	Y	Y	-
8.1	Alexander	11U 661756 5521351	3	ESSFdk1	1873	0.04	Marsh	0-0.5	Uniform	none	66-100	N	Y	Y	Y
8.2	Alexander	11U 661807 5521243	3	ESSFdk1	1873	0.55	Shallow water	>1.5	Variable	none	0-33	N	Y	Y	Y
8.3	Alexander	11U 661860 5521194	3	ESSFdk1	1873	0.03	Marsh	0-0.5	Uniform	none	66-100	N	Y	-	-
9	Harmer	11U 657290 5521906	9	MSdw	1325	0.57	Floodplain	0-0.5	Variable	none	0-33	N	-	Y	Y
10	Harmer	11U 657123 5522007	4	MSdw	1322	0.03	Marsh	0-0.5	Uniform	none	66-100	N	-	Y	Y
11.1	Grave	11U 655465 5524177	11	MSdw	1263	0.21	Marsh	0-0.5	Uniform	*Chara* sp.	0-33	Y	Y	Y	Y
11.2	Grave	11U 655622 5524247	6	MSdw	1265	0.88	Shallow water	0.5-1.5	Variable	*Chara* sp.	33-66	Y	Y	Y	Y
11.3	Grave	11U 655790 5524528	3	MSdw	13325	0.78	Marsh	0.5-1.5	Uniform	none	66-100	Y	Y	Y	Y
12	Elk	11U 655054 5525819	7	MSdw	1298	2.44	Transitional marsh/fen	0-0.5	Uniform	none	66-100	Y	Y	Y	-
13	Elk	11U 654738 5525349	11	MSdw	1285	8.84	Swamp	0.5-1.5	Variable	*Chara* sp.	66-100	N	Y	Y	-
14	Elk	11U 654394 5521844	7	MSdw	1217	4.79	Marsh	0-0.5	Uniform	none	66-100	N	1.0	-	Y
15	Elk	11U 653981 5521570	7	MSdw	1216	2.59	Marsh	0-0.5	Uniform	none	66-100	N	Y	Y	-
16	Elk	11U 653822 5521252	8	MSdw	1215	2.44	Marsh	0-0.5	Uniform	*Chara* sp.	66-100	Y	Y	Y	-
17	Elk	11U 653864 5520896	13	MSdw	1214	0.67	Marsh	0-0.5	Variable	*Chara* sp.	66-100	N	Y	Y	-
18	Elk	11U 653471 5520358	6	MSdw	1188	0.10	Shallow water	0.5-1.5	Uniform	none	66-100	Y	Y	Y	-
19	Elk	11U 653953 5521371	2	MSdw	1227	0.02	Marsh	0-0.5	Uniform	none	0-33	N	Y	Y	-
20	Elk	11U 654656 5524876	1	MSdw	1279	0.61	Marsh	0-0.5	Uniform	none	66-100	N	Y	-	Y
21	Alexander	11U 666454 5509468	2	MSdw	1509	2.82	Marsh	0.5-1.5	Variable	none	0-33	N	Y	Y	Y
22	Alexander	11U 664602 5504023	1	MSdw	1431	0.69	Swamp	0-0.5	Variable	none	66-100	N	Y	-	-

Notes

1 Total and divisional sizes will vary with time, season, interpretation; they are estimates

2 Algae - Chara sp. - large macro algae present in many wetlands in study area (Ca++, alkaline)

3 Beaver Presence: R = Recent evidence; O = Older evidence; N = No evidence

Table A-1. Wetland Classification and Characteristics

Wetland	Sand	Gravel	Fish Detected	Beaver Presence[3]	Dominant Forest Species Adjacent	Date	Temperature (C)	Sp. Conductivity (mS/cm)	Conductivity (mS/cm)	Total Dissolved Solids (g/L)	Salinity	DO %	DO (mg/L)	pH	ORP	Turbidity (NTU)
1	Y	-	Y	R	Spruce	2019-07-15[6]	7.3	0.4849	320.6	-	-	52.2	6.26	6.68	145.3	-
2	-	-	N	N	-	2019-07-09	7.9	0.4951	-	0.3217	0.24	-	3.86	7.52	140.2	-
						2019-07-09	11.5	0.471	-	0.3062	0.23	-	5.26	7.46	96.6	-
3	-	-	N	N	-	2019-07-09	19.2	0.5158	-	0.3347	0.25	-	3.34	7.42	116.2	-
4	Y	-	N	N	Spruce	2019-05-22	10.4	2.36	0.504	328	-	20.8	2.32	6.87	-14.7	54
						2019-07-09	15	0.5422	-	0.3617	0.26	-	1.7	6.91	71.3	-
						2019-07-09	10.4	0.3505	-	0.2282	0.17	-	8.81	7.71	170.9	-
5.1	Y	Y	Y	O	Spruce/Pine	2019-07-08	6.8	0.3509	-	0.2282	0.17	-	8.4	7.5	140.2	-
5.2	Y	-	Y	O	Spruce/Pine	2019-07-08	9.1	0.3039	-	0.1976	0.15	-	7.64	7.92	131.3	-
5.3	Y	-	N	R	Spruce/Pine	2019-07-08	9.5	0.2665	-	0.1729	0.13	-	8.05	8.04	140.9	-
5.4	-	-	N	R	Spruce/Pine	-	-	-	-	-	-	-	-	-	-	-
6	Y	-	N	O	Spruce	2019-07-06	13.3	-	0.4293	0.2782	0.21	-	9.16	7.81	162	-
						2019-07-06	13	-	0.4318	0.2808	0.21	-	8.8	7.51	167.3	-
6.1	-	-	N	O	Spruce/Pine	-	-	-	-	-	-	-	-	-	-	-
6.2	-	Y	N	O	Spruce/Pine	-	-	-	-	-	-	-	-	-	-	-
7	-	-	N	N	-	-	-	-	-	-	-	-	-	-	-	-
8.1	-	-	N	N	-	2019-07-11	12.2	0.1131	-	0.0708	0.05	-	8.22	6.37	108.5	-
8.2	-	-	N	N	-	2019-07-11	14.9	0.781	-	0.0507	0.04	-	7.04	6.74	89.9	-
8.3	-	-	N	N	-	-	-	-	-	-	-	-	-	-	-	-
9	Y	Y	N	R	Spruce/Pine	2019-07-07	11		0.5627	0.366	0.27	-	8.79	8.03	159.2	-
10	Y	-	N	N	Spruce/Pine	-	-	-	-	-	-	-	-	-	-	-
11.1	Y	-	Y	O	Spruce/Pine	2019-07-04	11.7	0.4245		0.2775	0.21		4.68	7.06	139.3	-
						2019-07-07	14	0.5168		0.3361	0.25		5.16	7.46	92.7	-
11.2	Y	Y	N	O	Spruce/Pine	2019-07-04	15.2	0.242		0.2424	0.18		9.05	8.03	146.7	-
11.3	-	-	Y	O	Spruce/Pine	2019-07-04	15.6	0.3076	-	0.2002	0.15	-	7.96	8.34	155.4	very clear
12	-	-	N	N	Aspen	2019-07-04	14.6	0.45	-	0.2925	0.22	-	8.84	8.15	150.7	-
						2019-07-04	15.1	0.4354	-	0.2827	0.21		3.66	7.06	135	clear
						2019-07-07	18	-	-	-	-	-	-	-	-	-
13	-	-	N	N	Aspen	-	-	-	-	-	-	-	-	-	-	-
14	-	-	N	N	Spruce/Aspen	2019-07-05	19.8	0.834		0.5395	0.41		5.58	8.27	158.3	
15	-	-	N	O	Spruce/Fir	2019-05-09	10.4	1.034	0.746	672		35.7	3.95	7.5	-99.7	3.75
						2019-07-05	12	0.81	-	0.5265	0.4	-	2.95	7.51	91.1	
16	-	-	N	O	Spruce/Fir	2019-07-05	12.2	0.727	-	0.4745	-	-	4.44	7.34	149.8	-
17	-	-	N	O	Spruce	2019-05-09	15.8	0.792	0.653	514	-	65.5	6.45	7.54	105.5	9.54
						2019-07-05	12.7	0.834		0.5395	0.41		11.41	7.84	127	
18	Y	-	N	O	Spruce/Pine	2019-07-05	11.7	0.732	-	0.475	0.36	-	11.89	8.22	129.5	-
19	-	-	N	N	Spruce	-	-	-	-	-	-	-	-	-	-	-
20	-	-	N	N	Aspen	-	-	-	-	-	-	-	-	-	-	-
21	Y	Y	N	R	Pine	2019-07-09	6.2	0.2301		0.149	0.11		6.94	7.62	127.9	0.1495
22	-	na	N	N	Aspen	2019-07-10	10.7	0.6001	-	0.39	0.29	-	1.65	7.12	78.6	-

Table A-2. Ephemeral Area Characteristics

Ephemeral Areas	Watershed	UTM Coordinates (NAD 83)	No. Surveys	BEC Subzone	Total Area (ha)	Habitat Description	Average Depth (m)	Depth Description	Algae	Emergent Vegetation Cover (%)	Cattails Present	Peat	Organics	Mineral (soil)	Silt	Sand	Gravel	Fish Detected	Beaver Presence	Dominant Forest Species Adjacent
4.2	Alexander	11U 664636 5503622	2	MSdw	0.03	Meadow	0	Uniform	none	0	N	Y	Y	Y	-	-	-	N	O	Spruce
Field North of WL5.4	Alexander	11 U 664612 5511011.	2	MSdw	0.06	Meadow	0-0.5	Uniform	none	0	N	Y	Y	Y	-	-	-	N	R	Spruce/Pine
100.1	Elk River	11U 653750 5520704	5	MSdw	0.01	FSR/Culvert created wetted area	0.5-1.5	Variable	none	0	N	Y	Y	-	-	-	-	N	N	Aspen/Spruce
100.2	Elk River	11U 653795 5520621	3	MSdw	0.03	FSR/Culvert created wetted area	0.5-1.5	Variable	none	0-33	N	Y	Y	-	-	Y	-	N	N	Aspen/Spruce
101	Grave Creek	11U 653772 5523073	1	MSdw	0.01	FSR ditch	0.5-1.5	Variable	none	0	N	-	-	Y	Y	Y	-	N	N	Aspen/Grassland
102	Grave Creek	11U 654331 5523592	2	MSdw	0.01	Large shallow water puddle under a deciduous canopy. Dries up in summer.	0-0.5	Uniform	none	0	N	-	-	-	Y	Y	-	N	N	Aspen
103	Alexander	11U 664240 5515728	2	MSdw	0.02	River floodplain/Meadow	0.5-1.5	Uniform	none	0	N	-	-	-	Y	Y	-	N	N	Spruce
104.1	Alexander	11U 664207 5514917	3	MSdw	0.01	FSR/Culvert created wetted area	0.5-1.5	Uniform	none	0	N	-	-	-	Y	Y	-	N	N	Spruce
104.2	Alexander	11U 664191 5514809	2	MSdw	0.01	FSR/Culvert created wetted area			none	0	N	-	-	-	Y	Y	-	M	N	-
105	Alexander	11U 664491 5512885	0	MSdw	0.01	River bank depression	0.5-1.5	Variable	none	0	N	-	Y	-	-	Y	Y	M	N	Spruce/Fir
106	Alexander	11U 664964 5510133	1	MSdw	0.01	River floodplain/Meadow	0.5-1.5	Variable	none	0	N	-	Y	-	-	Y	Y	N	N	-
112	Grave Creek	11U 662134 5524644	1	MSdw	0.01	Wet meadow, no open water	0-0.5	Uniform	none	na	N	-	Y	-	-	-	-	N	N	-
113	Elk River	11U 654475 5525412	1	MSdw	0.02	Meadow	0-0.5	Uniform	none	33-66	N	Y	Y		-	-	-	N	N	Aspen
114	Harmer Creek	11U 657680 5522035	1	MSdw	0.00	Ditch-like puddle with shallow water (when present) adjacent to recently re-planted cutblocks; no canopy	0-0.5	Uniform	none	0	N	-	-	-	Y	-	-	N	N	Cutblock - Pine
115	Elk River	11U 653631 5523879	1	MSdw	0.01	Rail ditch	0	Uniform	*Chara* sp.	0	N	-	-	-	Y	-	-	N	N	Aspen/Spruce
1003	Elk River	11U 653384 5520953	1	MSdw	0.02	FSR ditch	0-0.5	Uniform	none	0	N	-	-	Y	-	-	-	N	N	Aspen/Spruce
1004	Elk River	11U 653352 5521534	1	MSdw	0.02	Rail ditch	0-0.5	Uniform	none	0	N	-	-	Y	-	-	-	N	N	Aspen/Spruce
1005	Elk River	11U 653243 5521908	1	MSdw	0.02	FSR ditch	0-0.5	Uniform	none	0	N	-	-	Y	-	-	-	N	N	Aspen/Spruce
1006	Grave Creek	11U 654173 5523884	1	MSdw	0.02	FSR/Culvert created wetted area	0-0.5	Uniform	none	0-33	N	-	-	Y	-	-	-	N	N	Aspen/Spruce
1007	Grave Creek	11U 655445 5524195	1	MSdw	0.02	Shallow water wetland	0-0.5	Uniform	*Chara* sp.	0-33	N	-	-	-	-	-	-	Y	O	Spruce/Pine
1008	Elk River	11U 655087 5525661	1	MSdw	0.02	Meadow/FSR ditch	0-0.5	Uniform	none	no access	N	-	-	Y	-	-	-	N	N	Aspen
1009	Elk River	11U 653588 5524052	1	MSdw	0.02	Culvert created wetted area	0-0.5	Uniform	none	33-66	N	Y	Y	Y	Y	-	-	N	N	Cutblock
1010	Elk River	11U 653914 5525475	1	MSdw	0.02	Meadow	0-0.5	Uniform	none	0	N	-	-	Y	-	-	-	N	N	Aspen/Spruce

Table A-3. Incidental Observation Locations and Characteristics

Incidental Observations	Watershed	UTM Location (NAD 83)	No. Visits	BEC Subzone	Habitat Description
994	Alexander	11U 662230 5519864	1	ESSFdk1	n/a
995	Alexander	11U 666922 5509080	1	ESSFdk1	n/a
996	Grave	11U 663167 5524496	1	ESSFdk1	Steep cutblock (mostly pine; fairly high elevation; recent re-planted, thick dead grass layer)
997	Alexander	11U 662192 5520100	1	ESSFdk1	Willows, mature and young spruce higher up in the valley
998	Alexander	11U 662299 5520637	1	ESSFdk1	Found in upper West Alexander Valley in seeping wet meadow adjacent (50m) to creek in open area (no trees) under colt's foot.
999	Harmer	11U 657954 5521465	1	MSdw	Moist forest understory dominated by *Carex* species

Appendix B

eDNA Methods

Western Toad (*Anaxyrus (Bufo) boreas*) eDNA Assay Validation Information

eDNA assay Validation

All eDNA assays are validated through a rigorous multi-step evaluation protocol that includes tests of DNA target specificity and amplification sensitivity. All eDNA tests available at Bureau Veritas Laboratories have been validated for performance using interlaboratory verification.

General eDNA Assay Information

Target Species	Western Toad (*Anaxyrus (Bufo) boreas*)
Species Abbreviation	ANBO
eDNA qPCR Primer/Probe set	eANBO1
eDNA qPCR Format	TaqMan

eDNA Assay Specificity Tests

A. qPCR Activity: Multi-species analysis of eDNA assay efficiency

Multiple qPCR reactions (n=25) performed per target DNA. Detection within the standardized eDNA qPCR assay = Yes									
ASMO	ANBO-VI	ANBO-YK	LICA	PSRE	RAAU	RAPR	TAGR	HOSA	NTC
No	Yes	Yes	No	No	No	No	No	No	No

eDNA Assay Sensitivity Test

DNA (ɛg/L)	Detection Frequency (n=25)	Binomial Standard error (n=8)
5	100%	0%
1	100%	0%
0.2	100%	0%
0.04	96%	7%
0.008	92%	10%
0	0%	0%

Abbreviations

Rocky Mountain Tailed Frog (*Ascaphus montanus*)	ASMO	
Western Toad (*Anaxyrus (Bufo) boreas*)	ANBO-VI	Sourced from Vancouver Island (VI)
Western Toad (*Anaxyrus (Bufo) boreas*)	ANBO-YK	Sourced from Yukon, not great quality sample
Bullfrog (*Lithobates (Rana) catesbeiana*)	LICA	
Pacific Chorus Frog (*Pseudacris (Hyla) regilla*)	PSRE	
Northern Red-legged Frog (*Rana aurora*)	RAAU	
Oregon Spotted Frog (*Rana pretiosa*)	RAPR	
Rough-skinned Newt (*Taricha granulosa*)	TAGR	
Human (*Homo sapiens*)	HOSA	
qPCR no template control	NTC	
quantitative real-time polymerase chain reaction	qPCR	
environmental DNA	eDNA	

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V7B 0A2 Canada

Client Project #: **126231**
Site Location: **Crown Mountain**
C.O.C. #: **20190716**
Quote #: **N/A**

Report Date: **2019/07/26**
Report #: **DI20190726**
Version: **1**

ENVIRONMENTAL DNA - CERTIFICATE OF ANALYSIS

BV JOB #: **E20190716**
Received: **2019/07/16, 9:38 AM**

Sample Type: Cellulose Nitrate (CN) filter, preserved in silica
Samples Received: 42

Analyses (eDNA Isolation - Species)	Test Requested	Test Performed	Date eDNA Extracted	Date Analyzed IntegritE-DNA™	Date Analyzed Target Species	Laboratory Method	Analytical Method (qPCR Primer/Probe set)
eDNA Isolation and IntegritE-DNA™	42	42	2019/07/17 2019/07/22	2019/07/18 2019/07/23 2019/07/24	N/A	GUE SOP-00056	ePlant5
Western Toad (*Anaxyrus (Bufo) boreas*)	37	36	N/A	N/A	2019/07/24 2019/07/25	GUE SOP-00056	eANBO1

Remarks:

Bureau Veritas Laboratories (Animal DNA Department, DNA Services) is accredited to ISO17025:2017 for eDNA testing.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by industry professionals using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas Laboratories in writing). All data has met quality control and method performance criteria unless otherwise noted.

Bureau Veritas Laboratories' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas Laboratories has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas Laboratories unless otherwise agreed in writing. Bureau Veritas Laboratories is not responsible for the accuracy or any data impacts that result from the information provided by the customer or their agent.

Results relate to supplied samples tested. This Certificate should not be reproduced except in full, without the written approval of the laboratory.

eDNA tests are used to confirm presence of eDNA in samples for the targeted species / species groups.

Collected eDNA samples will contain eDNA at various stages of degradation, being subject to environmental forces that breakdown DNA, including microbial activity, ultraviolet radiation, heat, hydrolysis, and enzymatic activity. eDNA is first evaluated for eDNA quality and presence of qPCR assay inhibitors using the IntegritE-DNA™ assay before testing for target species or genera to confirm that the eDNA is of sufficient quality for testing and to identify and address qPCR inhibition (if present) to avoid false negatives.

SAMPLE RETENTION: Samples and DNA extracts generated from the samples will be retained by Bureau Veritas Laboratories for a period of 90 days after which time they will be discarded unless prearrangement has been made by client with Bureau Veritas Laboratories for longer storage.

Attention: **Jacqueline Huard**
Dillon Consulting Limited
3820 Cessna Drive, Suite 510
Richmond, BC V7B 0A2
V7B 0A2 Canada

Client Project #: **126231**
Site Location: **Crown Mountain**
C.O.C. #: **20190716**
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Report Date: **2019/07/26**
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ENVIRONMENTAL DNA - CERTIFICATE OF ANALYSIS

BV JOB #: **E20190716**
Received: **2019/07/16, 9:38 AM**

Methodology for Sample Analysis

Samples received to the laboratory are entered into the Laboratory Information Management System (LIMS) upon receipt. Samples were inspected and assessed for amount of silica beads, silica bead saturation level, coin envelope condition and number of coin envelopes in each bag. Samples were frozen at -20°C until processing in the laboratory. Sample analysis is completed within 5 or 10 business days (as indicated by the client on the COC) following receipt of samples by the testing laboratory.

eDNA isolation is completed using the DNeasy Blood & Tissue Kit™ (QIAGEN). A negative control is included as a blank filter sample with each batch of eDNA isolation to monitor for potential laboratory contamination during the eDNA isolation process.

Following eDNA isolation from the filter, the IntegritE-DNA™ assay[1] is used to avoid the potential of a false negative (Type II error) during target species or genera testing. The IntegritE-DNA™ assay evaluates the integrity of eDNA for suitability for qPCR and for presence of qPCR inhibitors which may reduce the effectiveness of the qPCR assay for target species or genera. This assay evaluates the quality of eDNA to assess whether it is amplifiable using a qPCR assay that targets the chloroplast genome derived from plants/algae that are ubiquitously found in fresh water systems. Four technical replicates per eDNA sample, four technical replicates of negative control (Ultrapure water), and two technical replicates of positive control are used for the IntegritE-DNA™ assay. The cut-off Ct (qPCR cycle threshold) value for the IntegritE-DNA™ assay is 30. If the IntegritE-DNA™ assay produces a positive detection frequency of Ó2 of the 4 technical replicates, this indicates that the eDNA for the target taxa is likely to be of sufficient quality to be detected (if present) with the target assay. If the IntegritE-DNA™ assay produces a positive detection frequency < 2 of the 4 technical replicates (eDNA is degraded or qPCR inhibitors are present), then sample cleanup is completed using the OneStep PCR Inhibitor Removal Kit™ (ZYMO Research) to remove potential qPCR assay inhibitors from the isolated eDNA. Subsequent to inhibitor removal, the IntegritE-DNA™ assay is repeated to re-assess whether the eDNA is of sufficient quality for qPCR. If a sample fails at the IntegritE-DNA™ assay for the second time the client will be informed that the quality of the sample is insufficient for the qPCR assay. eDNA indicator (IntegritE-DNA™) in the sample suggests that degradation has taken place and therefore the target species assay may be ineffective. Once a sample passes the IntegritE-DNA™ assay, then the target species or genera assay is performed. Eight technical replicates per eDNA sample, eight technical replicates of the negative control (Ultrapure water), and two technical replicates of positive control (total DNA or synthetic DNA) are used for the target species or genera assay to assess the detection or non-detection of DNA of the target species or genera. The cut-off Ct value for target species assay is 50.

[1] Hobbs J, Round JM, Allison MJ, Helbing CC (2019) Expansion of the known distribution of the coastal tailed frog, *Ascaphus truei*, in British Columbia, Canada, using robust eDNA detection methods. PLOS ONE 14(3): e0213849.

<Original signed by>

BECKY HENDERSON
Senior Customer Service Representative, Bureau Veritas Laboratories, DNA Services
Email: Becky.Henderson@bvlabs.com
Phone #: (519) 836 2400 Ext. 7067714

Please direct all questions regarding this Certificate of Analysis to your Customer Service Representative above.
==========
For Service Group specific validation please refer to the Validation Signature Page.

Total Cover Pages: 2

BV JOB #: E20190716
Report Date: 2019/07/26
Report #: DI20190726

Client Name: Dillon Consulting Limited
Client Project #: 126231
Site Location: Crown Mountain
Sampler Initials: JRH

RESULTS - Western Toad (*Anaxyrus (Bufo) boreas*)

Client Sample ID	BV Case ID	Sampling Date	Preservation Type	COC Number	IntegritE-DNA™ Positive detection (Ct≤30)[1]	QC Batch	Clean up required	IntegritE-DNA™ Positive detection (Ct≤30) after clean up	QC Batch	Analytical Method (qPCR Primer/Probe set)	Target Species eDNA Positive detection (Ct≤50)[2]	QC Batch
DI20190012	WL14A	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1[7]	0/8	190724Q2
DI20190013	WL14B	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q2
DI20190014	WL14C	2019/07/05	Silica	20190716	0/4[3]	190718Q4	Yes[3]	4/4[4]	190724Q1	eANBO1	0/8	190724Q2
DI20190015	WL18A	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q2
DI20190016	WL18B	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q2
DI20190017	WL18C	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q2
DI20190018	WL15A	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q2
DI20190019	WL15B	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q2
DI20190020	WL15C	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q2
DI20190021	WL17A	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q2
DI20190022	WL17B	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q3
DI20190023	WL17C	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q3
DI20190024	WL16A	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q3
DI20190025	WL16B	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q3
DI20190026	WL16C	2019/07/05	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q3
DI20190027	WLB_1	2019/07/05	Silica	20190716	0/4[3]	190718Q4	Yes[3]	0/4[5]	190724Q1	eANBO1	N/A	N/A
DI20190028	WL11A	2019/07/07	Silica	20190716	0/4[3]	190718Q4	Yes[3]	4/4[4]	190724Q1	eANBO1	0/8	190724Q3
DI20190029	WL11B	2019/07/07	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q3
DI20190030	WL11C	2019/07/07	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q3
DI20190031	WL12A	2019/07/07	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q3
DI20190032	WL12B	2019/07/07	Silica	20190716	4/4	190718Q4	No	N/A	N/A	eANBO1	0/8	190724Q3
DI20190033	WL12C	2019/07/07	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q1
DI20190034	WLB_2	2019/07/07	Silica	20190716	0/4[3]	190723Q1	Yes[3]	0/4[5]	190724Q1	eANBO1	N/A	N/A
DI20190035	WL5.2A	2019/07/08	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q1
DI20190036	WL5.2B	2019/07/08	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q1
DI20190037	WL5.2C	2019/07/08	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q1
DI20190038	WL5.3A	2019/07/08	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q1
DI20190039	WL5.3B	2019/07/08	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q1
DI20190040	WL5.3C	2019/07/08	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	2/8	190725Q1
DI20190041	WLB_3	2019/07/08	Silica	20190716	0/4[3]	190723Q1	Yes[3]	0/4[5]	190724Q1	eANBO1	N/A	N/A
DI20190042	WL4.1A	2019/07/09	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	1/8	190725Q1
DI20190043	WL4.1B	2019/07/09	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q2
DI20190044	WL4.1C	2019/07/09	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q2
DI20190045	WL21	2019/07/09	Silica	20190716	0/4[3]	190723Q1	Yes[3]	4/4[4]	190724Q1	eANBO1	8/8	190725Q2
DI20190046	WL2A	2019/07/09	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q2
DI20190047	WL2B	2019/07/09	Silica	20190716	0/4[3]	190723Q1	Yes[3]	0/4[6]	190724Q1	eANBO1	N/A	N/A
DI20190048	WL2C	2019/07/09	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q2
DI20190049	WLB_4	2019/07/09	Silica	20190716	0/4[3]	190723Q1	Yes[3]	0/4[5]	190724Q1	eANBO1	N/A	N/A
DI20190050	WLN2A	2019/07/10	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q2
DI20190051	WLN2B	2019/07/10	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q2
DI20190052	WLN2C	2019/07/10	Silica	20190716	4/4	190723Q1	No	N/A	N/A	eANBO1	0/8	190725Q2
DI20190053	WLB_5	2019/07/10	Silica	20190716	0/4[3]	190723Q1	Yes[3]	0/4[5]	190724Q1	eANBO1	N/A	N/A

[1] **IntegritE-DNA™ Assay:** Four technical replicates were assayed for each eDNA sample. The cut-off Ct value for IntegritE-DNA™ assay was 30. Results are reported as the number of positive detections (n) out of a total of 4 technical replicates, n/4.

[2] **Target Species Assay:** Eight technical replicates were assayed per eDNA sample. The cut-off Ct value for target species assay was 50. Results are reported as the number of positive detections (n) out of a total of 8 technical replicates, n/8.

[3] The IntegritE-DNATM assay failed and cleanup is required.

[4] These samples passed the IntegritE-DNA™ after the clean up.

[5] No amplification was detected on Blank samples.

[6] Quality of this sample is insufficient for the qPCR assay.

[7] eANBO1: qPCR primer/probe assay to assess the presence of Western Toad (*Anaxyrus (Bufo) boreas*)

BV JOB #: E20190716
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Client Name: Dillon Consulting Limited
Client Project #: 126231
Site Location: Crown Mountain
Sampler Initials: JRH

GENERAL COMMENTS

WL2B (BV Case ID DI20190047) failed at IntegritE-DNA™ after clean up. This sample does not have sufficient quality for the requested target species assay and it may produce false negative results.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			eDNA Isolation Negative Control[1]		qPCR Positive Controls[2]		qPCR Negative Controls[3]	
QC Batch	Parameter	Date	Detection at: Ct 30 (IntegritE-DNA™) Ct 50 (other assays)	Pass/Fail	Detection at: Ct 30 (IntegritE-DNA™) Ct 50 (other assays)	Pass/Fail	Detection at: Ct 30 (IntegritE-DNA™) Ct 50 (other assays)	Pass/Fail
190718Q4	IntegritE-DNA	2019/07/18	0 of 4 technical replicates	Pass	2 of 2 technical replicates	Pass	0 of 4 technical replicates	Pass
190723Q1	IntegritE-DNA	2019/07/23	0 of 4 technical replicates	Pass	2 of 2 technical replicates	Pass	0 of 4 technical replicates	Pass
190724Q1	IntegritE-DNA	2019/07/24	eDNA Isolation Negative Control is assessed using IntegritE-DNA™ only once for each extraction batch.	N/A	2 of 2 technical replicates	Pass	0 of 4 technical replicates	Pass
190724Q2	eANBO1	2019/07/24		N/A	2 of 2 technical replicates	Pass	0 of 4 technical replicates	Pass
190724Q3	eANBO1	2019/07/24		N/A	2 of 2 technical replicates	Pass	0 of 4 technical replicates	Pass
190725Q1	eANBO1	2019/07/25		N/A	2 of 2 technical replicates	Pass	0 of 4 technical replicates	Pass
190725Q2	eANBO1	2019/07/25		N/A	2 of 2 technical replicates	Pass	0 of 4 technical replicates	Pass

[1]**eDNA Isolation Negative Control:** Blank filters were included for each batch of eDNA extraction to monitor for laboratory contamination during eDNA isolation. eDNA Isolation Negative Control is assessed using IntegritE-DNA™ only. QC results show no eDNA was isolated from the negative control, therefore there was no indication of sample contamination during handling. Acceptance criteria: 0 of 4 technical replicates

[2]**qPCR Positive Controls:** Two technical replicates of isolated eDNA from freshwater sample were used as positive controls for IntegritE-DNA™. Two technical replicates of total DNA or synthetic DNA from the target species were used as positive controls for eDNA assays. Results show that 100% of the technical replicates amplified the positive control eDNA as expected, therefore an observation of negative result in eDNA samples is not related to the qPCR performance. Acceptance criteria: 2 of 2 technical replicates

[3]**qPCR Negative Controls (Ultrapure water):** Four technical replicates for IntegritE-DNA™ and eight technical replicates for target species or genera were used to monitor for laboratory contamination. Results show that 0% of the technical replicates in the negative controls had amplified eDNA, indicating no contamination was detected. Acceptance criteria: 0 of 4 technical replicates for IntegritE-DNA™, and 0 of 8 technical replicates for other assays.

LABORATORY RESULTS VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

<Original signed by>

Reporter: ALI MIRABZADEH, M.Sc.
Senior Analyst, Bureau Veritas Laboratories, DNA Services

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<Original signed by>

Reviewer: HEATHER ALLEN, M.Sc.
Supervisor, Bureau Veritas Laboratories, DNA Services

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Western Toad (*Anaxyrus (Bufo) boreas*) eDNA Assay Validation Information

eDNA assay Validation

All eDNA assays are validated through a rigorous multi-step evaluation protocol that includes tests of DNA target specificity and amplification sensitivity. All eDNA tests available at Bureau Veritas Laboratories have been validated for performance using interlaboratory verification.

General eDNA Assay Information

Target Species	Western Toad (*Anaxyrus (Bufo) boreas*)
Species Abbreviation	ANBO
eDNA qPCR Primer/Probe set	eANBO1
eDNA qPCR Format	TaqMan

eDNA Assay Specificity Tests

A. qPCR Activity: Multi-species analysis of eDNA assay efficiency

Multiple qPCR reactions (n=25) performed per target DNA. Detection within the standardized eDNA qPCR assay = Yes									
ASMO	ANBO-VI	ANBO-YK	LICA	PSRE	RAAU	RAPR	TAGR	HOSA	NTC
No	Yes	Yes	No	No	No	No	No	No	No

eDNA Assay Sensitivity Test

DNA (ɛg/L)	Detection Frequency (n=25)	Binomial Standard error (n=8)
5	100%	0%
1	100%	0%
0.2	100%	0%
0.04	96%	7%
0.008	92%	10%
0	0%	0%

Abbreviations

Rocky Mountain Tailed Frog (*Ascaphus montanus*)	ASMO	
Western Toad (*Anaxyrus (Bufo) boreas*)	ANBO-VI	Sourced from Vancouver Island (VI)
Western Toad (*Anaxyrus (Bufo) boreas*)	ANBO-YK	Sourced from Yukon, not great quality sample
Bullfrog (*Lithobates (Rana) catesbeiana*)	LICA	
Pacific Chorus Frog (*Pseudacris (Hyla) regilla*)	PSRE	
Northern Red-legged Frog (*Rana aurora*)	RAAU	
Oregon Spotted Frog (*Rana pretiosa*)	RAPR	
Rough-skinned Newt (*Taricha granulosa*)	TAGR	
Human (*Homo sapiens*)	HOSA	
qPCR no template control	NTC	
quantitative real-time polymerase chain reaction	qPCR	
environmental DNA	eDNA	

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BV JOB #: E20190716
Report Date: 2019/07/26
Report #: DI20190726

Client Name: Dillon Consulting Limited
Client Project #: 126231
Site Location: Crown Mountain
Sampler Initials: JRH

COC# 20190716

From Canada, send to:
BV Labs, DNA Services
335 Laird Rd #2
Guelph, ON N1G 4P7
eDNA@bvlabs.com

From USA, send to:
BV Labs
240 Portage Rd
Po Box 670, PMB 19
Lewiston NY 149092-1604

ENVIRONMENTAL DNA (eDNA) CHAIN OF CUSTODY RECORD

‹‹‹An incomplete or incorrect form may lead to delays in testing›››

1 Invoice Information (Required)		2 Report Information (if differs from invoice)		3 Project Information (where applicable)		4 Turnaround Time (TAT) (Required)
Company Name:	Dillon Consulting Limited	Company Name:	Dillon Consulting Limited	Quotation #:		Regular TAT (Most analyses)
Contact Name:	Jacqueline Huard	Contact Name:	Jacqueline Huard	P.O. #:		X 10 business days (Sample # ≤ 50)
Address:	3820 Cessna Drive, Suite 510	Address:	3820 Cessna Drive, Suite 510	Project #:	126231	15 business days (Sample # > 50)
	Richmond, BC V7B 0A2		Richmond, BC V7B 0A2	Site Location:	Crown Mountain	From date received
Phone:	604-278-7847 Fax: 604-278-7894	Phone:	604-278-7847 Fax: 604-278-7894	Sampled By:	JRH	PLEASE REQUEST RUSH FROM CUSTOMER SERVICE
Email:	jhuard@dillon.ca	Email:		Note: send reports to jhuard@dillon.ca and ldill		Rush TAT (Surcharges will be applied)
						5 business days (Sample # ≤ 50)
						10 business days (Sample # > 50)
						From date received

eDNA ANALYSIS

5 IMPORTANT INFORMATION

- Water samples should be kept cool and filtered as soon as possible (within 24 hours of collection).
- Cellulose Nitrate (CN) filter is recommended to use for eDNA test because of higher eDNA recovery.
- Preserve filter in self-indicating silica beads (2-4 mm diameter) or molecular grade ethanol (95 to 100%) immediately following sample filtration.

6 SPECIAL INSTRUCTIONS

Please send reports to ckwok@dillon.ca and skalyn@dillon.ca as well. Holding replicate "C" samples for two sites (elgdown and elgmid) pending results - expecting strong eDNA hits as fish presence confirmed via other techniques.

7 Number	Sample identification	8 Date Sampled (YYYY/MM/DD)	9 Date Filtered and Preserved (YYYY/MM/DD)	10 Filter Material	11 Filter Size (Diameter)	12 Filter Pore Size (µm)	13 Preservation Method (Ethanol / Silica)	14 Assays Requested[1]	15 Comments
1	WL14A	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
2	WL14B	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
3	WL14C	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
4	WL18A	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
5	WL18B	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
6	WL18C	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
7	WL15A	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
8	WL15B	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
9	WL15C	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
10	WL17A	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
11	WL17B	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
12	WL17C	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
13	WL16A	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
14	WL16B	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
15	WL16C	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
16	WLB	7/5/2019	7/5/2019	Cellulose Nitrate	47 mm	0.45	Silica	Blank	Blank
17	WL11A	7/7/2019	7/7/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
18	WL11B	7/7/2019	7/7/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
19	WL11C	7/7/2019	7/7/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
20	WL12A	7/7/2019	7/7/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
21	WL12B	7/7/2019	7/7/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
22	WL12C	7/7/2019	7/7/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
23	WLB	7/7/2019	7/7/2019	Cellulose Nitrate	47 mm	0.45	Silica	Blank	Blank
24	WL5.2A	7/8/2019	7/8/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
25	WL5.2B	7/8/2019	7/8/2020	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	

BV JOB #: E20190716
Report Date: 2019/07/26
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Client Name: Dillon Consulting Limited
Client Project #: 126231
Site Location: Crown Mountain
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received COC# 20190716 7 16 AM
20190716

26	WL5.2C	7/8/2019	7/8/2021	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
27	WL5.3A	7/8/2019	7/8/2022	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
28	WL5.3B	7/8/2019	7/8/2023	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
29	WL5.3C	7/8/2019	7/8/2024	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
30	WLB	7/8/2019	7/8/2024	Cellulose Nitrate	47 mm	0.45	Silica	Blank	Blank
31	WL4.1A	7/9/2019	7/9/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
32	WL4.1B	7/9/2019	7/9/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
33	WL4.1C	7/9/2019	7/9/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
34	WL21	7/9/2019	7/9/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
35	WL2A	7/9/2019	7/9/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
36	WL2B	7/9/2019	7/9/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
37	WL2C	7/9/2019	7/9/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
38	WLB	7/9/2019	7/9/2019	Cellulose Nitrate	47 mm	0.45	Silica	Blank	Bank
39	WLN2A	7/10/2019	7/10/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
40	WLN2B	7/10/2019	7/10/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
41	WLN2C	7/10/2019	7/10/2019	Cellulose Nitrate	47 mm	0.45	Silica	ANBO	
42	WLB	7/10/2019	7/10/2019	Cellulose Nitrate	47 mm	0.45	Silica	Blank	Blank

16 RELINQUISHED BY: (Signature/Print)	17 DATE: (YYYY/MM/DD)	18 TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	CASE RANGE
			For Lab Use Only			
Jacqueline Huard	7/11/1905	1345	NANCY HARRISON	2019/07/16	9:33Am	

[1] **Available Assays at Bureau Veritas Laboratories: AMMV**[2] (Western tiger salamander), **ANBO** (Western toad), **ASMO** (Rocky mountain tailed frog), **eFish**[3] (General fish assay), **LICA** (North American bullfrog), **ONCL** (Cutthroat trout), **ONKI** (Coho salmon), **ONMY** (Rainbow trout - Steelhead trout), **ONNE** (Sockeye Salmon), **ONTS** (Chinook salmon), **RAAU** (Northern red-legged frog), **RAPR** (Oregon spotted frog), **SOBE** (Pacific water shrew), **THAR** (Arctic grayling), **ASTR** (Pacific (Coastal) tailed frog)

[2] **AMMV** assay also detects *Ambystoma tigrinum* (AMTI) Tiger Salamander.

[3] **eFish** assay can detect DNA from 12 fish species (Sockeye salmon, Pink salmon, Chum salmon, Arctic grayling, Cutthroat trout, Rainbow trout, Chinook salmon, Coho salmon, Atlantic Salmon, Dolly Varden, Round Whitefish and Slimy Sculpin). This assay is designed to be non-specific. It may detect eDNA from other fish species in addition or instead of the specific species listed here, which the assay has been validated for.

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Appendix C

Amphibian Survey Data

DILLON CONSULTING

Date	Survey Site	Start Time	End Time	Person Hours	Notes	Survey Purpose	Weather Conditions					Total Amphibians Observed	Columbia Spotted Frog			Wood Frog			Western Toad				Long-toed Salamander			Unidentified		
							Weather	Cloud Cover (%)	Temperature (◦C)	Wind (BU)	Precipitation		Adult	Tadpole	Egg mass	Adult	Tadpole	Egg mass	Adult	Toadlet	Tadpole	Egg mass	Adult	Tadpole	Egg mass	WF/CSF	Adult	Tadpole
04-Jul-14	WL1	12:02:00 PM	12:40:00 PM	1:16	Appears high in calcium; Fish observed at edge of pond	PS	Sunny	0	25			2				1			1									
09-Jun-17	WL1	12:40:00 PM	1:15:00 PM	1:10		PS	Overcast	High ceiling, 50	15	2	Light rain at times	0																
22-Apr-18	WL1	4:00:00 PM	4:15:00 PM	0:30	Snow on edge; pool mostly open (not frozen); Early in the year for amphibians	PS	Overcast	High ceiling, 100	9	2-3	0	0																
03-May-18	WL1	2:00:00 PM	2:50:00 PM	1:40	Some snow on ground; mostly snow free, no ice present	PS	Sunny	100	12	3		0																
03-Jul-18	WL1	3:45:00 PM	4:00:00 PM	0:30		PS						0																
05-Jul-18	WL1	5:00:00 PM	5:30:00 PM	1:00		PS						0																
30-Jul-18	WL1	11:40:00 AM	11:50:00 AM	0:20		PS	Sunny	0				0																
25-May-19	WL1	6:27:00 AM	6:40:00 AM	0:26	VAST ARU deployed at south end	PS	Sunny		0			0																
13-Sep-19	WL1	7:40:00 AM	8:03:00 AM	0:46		ES		40	8	1	Light rain	0																
WL1Totals:				7:38								2				1			1									
08-May-19	WL2	5:50:00 PM	6:15:00 PM	0:50		PS		50		0-3		0																
10-Jul-19	WL2	1:15:00 PM	2:45:00 PM	3:00		PS		10	25	2		1	1															
WL2 Totals:				3:50								1	1															
29-Jul-18	WL3	11:30:00 AM	12:05:00 PM	1:10		PS						0																
08-May-19	WL3	5:22:00 PM	5:45:00 PM	0:46		PS		50		0-3		0																
10-Jul-19	WL3	5:15:00 PM	5:30:00 PM	0:30		PS		10	25	2		0																
WL3 Totals:				2:26								0																
07-Jun-14	WL4	11:00:00 AM	11:10:00 AM	0:20	Open pool with beaver damn	PS	Sunny	0				1	1															
06-Jun-17	WL4	9:00:00 AM	9:15:00 AM	0:30		B		0	3	1		0																
07-Jun-17	WL4	12:14:00 PM	1:40:00 PM	2:52		PS		0	3	1		11	1	10														
30-Jun-17	WL4	12:05:00 PM	12:20:00 PM	0:30		PS	Sunny	0	20	0	0	1	1															
06-Jul-17	WL4	1:15:00 PM	2:00:00 PM	1:30		PS	Sunny	0	30	0	0	5		5														
24-Apr-18	WL4	8:50:00 AM	9:00:00 AM	0:20	Wetland is completely covered in snow (>0.5m) no open water; early in the year for amphibians	PS	Sunny		9	1	0	0																
06-May-18	WL4	2:20:00 PM	2:45:00 PM	0:50		PS		0	19	2	0	0																
07-May-18	WL4	11:10:00 AM	11:20:00 AM	0:20		B						0																
09-May-18	WL4	9:00:00 AM	9:20:00 AM	0:40		PS	Overcast	100	8			11	3		8													
08-May-19	WL4	7:37:00 AM	7:47:00 AM	0:20		B		50		0-3		0																
08-May-19	WL4	3:22:00 PM	4:30:00 PM	2:16		PS		50		0-3		7	1		5			1										
22-May-19	WL4	7:09:00 AM	7:21:00 AM	0:24		B	Sunny	0	1	1-2		0																
22-May-19	WL4	12:00:00 PM	12:40:00 PM	1:20		PS	Sunny	0	12	1-2		17	4		9										4			
09-Jul-19	WL4	1:35:00 PM	1:50:00 PM	0:30		PS		10	25	2		3		3														
12-Sep-19	WL4	7:20:00 AM	7:27:00 AM	0:14		ES		40	5	0	0	0																
12-Sep-19	WL4	7:27:00 AM	8:05:00 AM	1:16		ES		40	5	0	0	0																
13-Sep-19	WL4	11:03:00 AM	11:15:00 AM	0:24		ES		60	10	4	Light rain	0																
13-Sep-19	WL4	11:15:00 AM	12:01:00 PM	1:32		ES		60	10	4	Light rain	1	1															
WL4 Totals:				16:08								57	12	18	22			1							4			
11-Jun-14	WL5.1	9:48:00 AM	9:58:00 AM	0:20	vent to snout length 2cm	B		High ceiling, 100	6	2		1								1								
07-Jun-17	WL5.1	10:05:00 AM	10:40:00 AM	1:10	Found trout	PS		0	3	1		0																
24-Apr-18	WL5.1	2:00:00 PM	2:15:00 PM	0:30		PS	Sunny		9	1	0	0																
06-May-18	WL5.1	1:43:00 PM	1:53:00 PM	0:20		PS		0	19	2	0	0																
08-May-19	WL5.1	8:36:00 AM	8:37:00 AM	0:02	Some snow in patches; mostly snow free; no ice	B		50		0-3		0																
08-May-19	WL5.1	2:54:00 PM	2:59:00 PM	0:10		PS		50		0-3		0																
22-May-19	WL5.1	8:35:00 AM	8:45:00 AM	0:20		B	Sunny	0	2	1-2		0																
08-Jul-19	WL5.1	4:20:00 PM	4:30:00 PM	0:20		PS	Sunny	0	25			0																
12-Sep-19	WL5.1	8:20:00 AM	8:30:00 AM	0:20		ES		40	6	0	0	0																
12-Sep-19	WL5.1	8:30:00 AM	8:43:00 AM	0:26		ES		40	6	0	0	0																
12-Sep-19	WL5.1	4:37:00 PM	4:50:00 PM	0:26		ES		90	13	2	0	0																
12-Sep-19	WL5.1	4:51:00 PM	5:15:00 PM	0:48		ES		90	13	2	0	0																
WL5.1 Totals:				5:12								1								1								
07-Jun-17	WL5.2	11:00:00 AM	11:20:00 AM	0:40		PS		0	3	1		1							1									

Date	Survey Site	Start Time	End Time	Person Hours	Notes	Survey Purpose	Weather Conditions					Total Amphibians Observed	Columbia Spotted Frog			Wood Frog			Western Toad				Long-toed Salamander			Unidentified		
							Weather	Cloud Cover (%)	Temperature (◦C)	Wind (BU)	Precipitation		Adult	Tadpole	Egg mass	Adult	Tadpole	Egg mass	Adult	Toadlet	Tadpole	Egg mass	Adult	Tadpole	Egg mass	WF/CSF	Adult	Tadpole
24-Apr-18	WL5.2	2:30:00 PM	2:45:00 PM	0:30		PS	Sunny		9	1	0	0																
08-May-19	WL5.2	8:53:00 AM	9:03:00 AM	0:20	Some snow in patches; mostly snow free; no ice	PS		50		0-3		0																
08-May-19	WL5.2	2:25:00 PM	2:53:00 PM	0:56		PS		50		0-3		0																
08-Jul-19	WL5.2	4:50:00 PM	5:15:00 PM	0:50		PS	Sunny	0	25			0																
12-Sep-19	WL5.2	4:15:00 PM	4:37:00 PM	0:44		ES		80	14	3	0	1	1															
WL5.2 Totals:				4:00								2	1						1									
02-Jul-14	WL5.3	1:30:00 PM	1:45:00 PM	0:30		PS		0	30	2		0																
07-Jun-17	WL5.3	10:40:00 AM	11:00:00 AM	0:40		PS		0	3	1		0																
24-Apr-18	WL5.3	2:30:00 PM	2:45:00 PM	0:30		PS	Sunny		9	1	0	0																
06-May-18	WL5.3	1:30:00 PM	1:40:00 PM	0:20		PS		0	18	2	0	0																
07-May-18	WL5.3	10:35:00 AM	10:45:00 AM	0:20		B						0																
08-May-19	WL5.3	9:05:00 AM	9:10:00 AM	0:10		B						0																
08-May-19	WL5.3	2:10:00 PM	2:19:00 PM	0:18		PS		50		0-3		0																
22-May-19	WL5.3	8:53:00 AM	9:03:00 AM	0:20		B	Sunny	0	4	1-2		0																
08-Jul-19	WL5.3	5:30:00 PM	5:50:00 PM	0:40		PS	Sunny	0	25			0																
12-Sep-19	WL5.3	8:43:00 AM	8:59:00 AM	0:32		ES		40	8	0	0	0																
12-Sep-19	WL5.3	4:01:00 PM	4:14:00 PM	0:26		ES		60	14	4	0	0																
WL5.3 Totals:				4:46								0																
02-Jul-14	WL5.4	1:10:00 PM	1:30:00 PM	0:40	No pooled water	PS		0	30	2		0																
06-May-18	WL5.4	11:15:00 AM	11:25:00 AM	0:20		B		0	15	2	0	0																
08-May-18	WL5.4	9:20:00 AM	9:30:00 AM	0:20	Some snow in patches; mostly snow free; no ice	PS		50		0-3		0																
22-May-19	WL5.4	9:03:00 AM	9:13:00 AM	0:20		B	Sunny	0	4	1-2		0																
12-Sep-19	WL5.4	8:59:00 AM	9:30:00 AM	1:02		ES		40	9	0	0	0																
12-Sep-19	WL5.4	3:36:00 PM	4:01:00 PM	0:50		ES		60	14	4	0	0																
WL5.4 Totals:				3:32								0																
07-Jun-14	WL6	8:40:00 AM	8:55:00 AM	0:30		B	Sunny	0	4	1		0																
06-Jun-17	WL6	1:30:00 PM	1:45:00 PM	0:30		PS		0	3	1		0																
30-Jun-17	WL6	11:00:00 AM	11:18:00 AM	0:36		PS	Sunny	0	20	0	0	1								1								
06-May-18	WL6	11:05:00 AM	11:15:00 AM	0:20	Snow on banks, no ice	B		0	9	2	0	0																
26-Jul-18	WL6	na	na	na		PS						0																
08-May-19	WL6	12:10:00 PM	12:33:00 PM	0:46		PS		50		0-3		0																
22-May-19	WL6	10:05:00 AM	10:15:00 AM	0:20	VAST came by to do an amphibian search	B	Sunny	0	4	1-2		0																
06-Jul-19	WL6	2:35:00 PM	2:50:00 PM	0:30		PS	Foggy; Overcast			2		0																
12-Sep-19	WL6	10:27:00 AM	10:40:00 AM	0:26		ES		40	9	0	0	0																
12-Sep-19	WL6	1:30:00 PM	2:17:00 PM	1:34	Many voles	ES		40	12	2	0	0																
12-Sep-19	WL6	1:30:00 PM	2:17:00 PM	1:34		ES		40	12	2	0	0																
WL6 Totals:				7:06								1								1								
12-Sep-19	WL6.1	2:26:00 PM	2:37:00 PM	0:22	Many voles	ES		40	14	3	0	0																
WL6.1 Totals:				0:22								0																
08-Jun-14	WL6.2	1:15:00 PM	1:25:00 PM	0:20		PS	Sunny	0				0																
30-Jun-17	WL6.2	11:28:00 AM	11:35:00 AM	0:14		PS	Sunny	0	20	0	0	0																
12-Sep-19	WL6.2	2:37:00 PM	2:53:00 PM	0:32		ES		40	14	3	0	3											3					
WL6.2 Totals:				1:06								3											3					
04-Jul-18	WL7	10:30:00 AM	11:00:00 AM	1:00		PS						0																
WL7 Totals:				1:00								0																
04-Jul-18	WL8.1	12:20:00 PM	12:40:00 PM	0:40		PS	Sunny	80		3		0																
26-Jul-18	WL8.1	9:30:00 AM	10:00:00 AM	1:00		PS	Overcast/Sunny	40		2		0																
10-Jul-19	WL8.1	7:00:00 AM	7:10:00 AM	0:20		B		30	10	3		0																
11-Jul-19	WL8.1	10:30:00 AM	10:40:00 AM	0:20		PS						0																
WL8.1 Totals:				2:20								0																
04-Jul-18	WL8.2	12:56:00 PM	1:15:00 PM	0:38		PS	Sunny	80		3		0																
26-Jul-18	WL8.2	10:20:00 AM	10:45:00 AM	0:50		PS	Overcast/Sunny	40		2		1							1									
10-Jul-19	WL8.2	7:10:00 AM	7:20:00 AM	0:20		B		30	10	3		0																
11-Jul-19	WL8.2	10:40:00 AM	11:00:00 AM	0:40		PS						0																
WL8.2 Totals:				2:28								1							1									
04-Jul-18	WL8.3	1:15:00 PM	1:30:00 PM	0:30		PS	Sunny	80		3		0																
26-Jul-18	WL8.3	10:45:00 AM	11:15:00 AM	1:00		PS	Overcast/Sunny	40		2		0																
10-Jul-19	WL8.3	7:20:00 AM	7:30:00 AM	0:20		B		30	10	3		0																

Date	Survey Site	Start Time	End Time	Person Hours	Notes	Survey Purpose	Weather Conditions					Total Amphibians Observed	Columbia Spotted Frog			Wood Frog			Western Toad				Long-toed Salamander			Unidentified		
							Weather	Cloud Cover (%)	Temperature (◦C)	Wind (BU)	Precipitation		Adult	Tadpole	Egg mass	Adult	Tadpole	Egg mass	Adult	Toadlet	Tadpole	Egg mass	Adult	Tadpole	Egg mass	WF/CSF	Adult	Tadpole
11-Jul-19	WL8.3	11:00:00 AM	11:10:00 AM	0:20		PS						0																
WL8.3 Totals:				2:10								0																
06-Jun-14	WL9	5:50:00 AM	6:00:00 AM	0:20		B		Overcast, Moderatly high ceiling, 100	2	2		0																
08-Jun-17	WL9	7:45:00 AM	8:00:00 AM	0:30		B		High ceiling, 50	7	0		0																
02-Jul-17	WL9	2:40:00 PM	3:56:00 PM	2:32		PS	Sunny	0	20	0	0	0																
03-Jul-17	WL9	3:03:00 PM	3:20:00 PM	0:34		PS	Sunny	0	30	0	0	5												5				
25-Apr-18	WL9	12:00:00 PM	12:10:00 PM	0:20	Snow and ice on banks and in shadows	PS		0	9	3		0																
05-May-18	WL9	10:47:00 AM	11:10:00 AM	0:46		B		0	9	2	0	0																
08-May-18	WL9	10:38:00 AM	10:49:00 AM	0:22		B		High ceiling, 70		0		0																
02-Jul-18	WL9	2:00:00 PM	2:10:00 PM	0:20		PS	Overcast	100		3-4	Light rain	0																
09-May-19	WL9	9:30:00 AM	9:40:00 AM	0:20		PS		50		0-3		0																
24-May-19	WL9	9:48:00 AM	9:58:00 AM	0:20		PS	Overcast	60	3	2		0																
07-Jul-19	WL9	4:15:00 PM	4:30:00 PM	0:30		PS	na					0																
10-Sep-19	WL9	1:31:00 PM	1:57:00 PM	0:52		ES		100	10	1	Light rain	0																
10-Sep-19	WL9	1:57:00 PM	2:06:00 PM	0:18		ES		100	10	1	Light rain	0																
WL9 Totals:				8:04								5												5				
05-May-18	WL10	11:10:00 AM	11:24:00 AM	0:28		PS		0	9	2	0	0																
09-May-18	WL10	9:40:00 AM	10:00:00 AM	0:40		PS		50		0-3		0																
10-Sep-19	WL10	12:54:00 PM	1:15:00 PM	0:42		ES		100	9	1	Light rain	0																
10-Sep-19	WL10	1:16:00 PM	1:24:00 PM	0:16		ES		100	9	1	Light rain	0																
WL10 Totals:				2:06								0																
05-Jun-14	WL11.1	2:50:00 PM	3:00:00 PM	0:20	Fish observed	PS	Sunny	0	Cold			0																
03-Jul-14	WL11.1	12:18:00 PM	2:00:00 PM	3:24	Fish observed	PS	Overcast	100	10	2-3	Light rain	9	7			1			1									
08-Jun-17	WL11.1	11:21:00 AM	11:45:00 AM	0:48		PS		High ceiling, 50	7	0		1							1							6		
06-Jul-17	WL11.1	4:30:00 PM	5:00:00 PM	1:00		PS	Sunny	0	30	0	0	1												1				
23-Apr-18	WL11.1	1:50:00 PM	2:00:00 PM	0:20	Mostly open (not frozen) water, snow and ice on edges; early in the year for amphibians	PS	Sunny		9	1	0	0																
02-Jul-18	WL11.1	3:30:00 PM	3:45:00 PM	0:30		PS	Overcast	100		3-4	Light rain	0																
23-May-19	WL11.1	2:40:00 PM	3:15:00 PM	1:10	Abundant fish observed; +50 present; sandbag dam between 11.1 and 11.2; must be man-made	PS	Sunny	0	5	2		0																
04-Jul-19	WL11.1	11:19:00 AM	11:46:00 AM	0:54		PS	Overcast	100	10	3	Rain at times (light and heavy)	3	2			1												
07-Jul-19	WL11.1	3:00:00 PM	3:25:00 PM	0:50		PS	Sunny	40	20			0																
10-Sep-19	WL11.1	11:35:00 AM	12:01:00 PM	0:52		ES		100	7	0	Light rain	0																
10-Sep-19	WL11.1	11:35:00 AM	12:01:00 PM	0:52		ES		100	7	0	Light rain	0																
WL11.1 Totals:				11:00								14	9			2			2					1		6		
05-Jun-14	WL11.2	1:00:00 PM	1:15:00 PM	0:30		PS	Sunny	0	Cold			0																
03-Jul-14	WL11.2	2:00:00 PM	2:30:00 PM	1:00		PS	Overcast	100	10	2-3	Light rain	3	2						1									
08-Jun-17	WL11.2	11:45:00 AM	12:10:00 PM	0:50		PS		High ceiling, 50	7	0		0														5		
23-Apr-18	WL11.2	2:00:00 PM	2:20:00 PM	0:40	Mixed open water (in deeper pools) and frozen on edges and in shade, likely freezes over night; early in the year for amphibians	PS	Sunny		9	1	0	0																
23-May-19	WL11.2	3:15:00 PM	3:35:00 PM	0:40		PS	Sunny	0	40	2		0																
04-Jul-19	WL11.2	11:46:00 AM	11:56:00 AM	0:20		PS	Overcast	100	10	4	Rain at times (light and heavy)	7	4			3												
WL11.2 Totals:				4:00								10	6			3			1							5		
23-Apr-18	WL11.3	2:20:00 PM	2:30:00 PM	0:20	Lake still frozen; march edge thaws during day, some limited open water in edges of lake along marsh; early in the year for amphibians	PS	Sunny		9	1	0	0																
23-May-19	WL11.3	3:35:00 PM	3:45:00 PM	0:20		PS	Sunny	0	10	3		0																

Date	Survey Site	Start Time	End Time	Person Hours	Notes	Survey Purpose	Weather Conditions					Total Amphibians Observed	Columbia Spotted Frog			Wood Frog			Western Toad				Long-toed Salamander			Unidentified		
							Weather	Cloud Cover (%)	Temperature (◦C)	Wind (BU)	Precipitation		Adult	Tadpole	Egg mass	Adult	Tadpole	Egg mass	Adult	Toadlet	Tadpole	Egg mass	Adult	Tadpole	Egg mass	WF/CSF	Adult	Tadpole
04-Jul-19	WL11.3	11:46:00 AM	12:24:00 PM	1:16		PS	Overcast	100	10	5	Rain at times (light and heavy)	0																
WL11.3 Totals:				1:56								0																
23-Apr-18	WL12	9:40:00 AM	10:10:00 AM	1:00	Mostly frozen water in body of wetland; little snow on edges; too early for amphibians	PS		High ceiling, 100	4	1	0	0																
08-May-18	WL12	9:00:00 AM	9:15:00 AM	0:30		PS		High ceiling, 70		0		0																
07-May-19	WL12	4:48:00 PM	4:58:00 PM	0:20	Water levels are very low; VAST ARU deployed in wetland	PS		50	14	3-4	Light rain	0																
09-May-19	WL12	12:28:00 PM	12:45:00 PM	0:34		PS		0	10	0		0																
24-May-19	WL12	12:45:00 PM	12:55:00 PM	0:20	Water levels are very low	PS	Overcast	60	16	3		0																
04-Jul-19	WL12	4:42:00 PM	5:43:00 PM	2:02		PS	Overcast	100	10	7	Rain at times (light and heavy)	1				1												
07-Jul-19	WL12	4:45:00 PM	5:05:00 PM	0:40		PS	Sunny	40	20			0																
WL12 Totals:				5:26								1				1												
29-Jun-14	WL13	12:40:00 PM	1:20:00 PM	1:20		PS	Sunny	40		2		5				1			2	2							2	
03-Jul-14	WL13	5:30:00 AM	5:45:00 AM	0:30		B		0	9	0		0																
08-Jun-17	WL13	5:20:00 AM	5:30:00 AM	0:20		B		High ceiling, 50	7	0		0																
08-Jun-17	WL13	12:50:00 PM	1:45:00 PM	1:50		PS		High ceiling, 50	7	0		5	1			3			1									
03-Jul-17	WL13	9:41:00 AM	10:15:00 AM	1:08		PS	Sunny	0	30	0	0	0																
23-Apr-18	WL13	10:58:00 AM	11:00:00 AM	0:04	Frozen in center pool; open water in outer ring (in the marsh);Early in the year for amphibians	PS		High ceiling, 100	5	1	0	0																
28-Apr-18	WL13	1:02:00 PM	12:00:00 AM	na	Leah-Anne from vast noted that she saw 3 wood frog egg masses and 1 Columbian spotted frog egg mass	PS						4	1					3										
08-May-18	WL13	8:06:00 AM	8:50:00 AM	1:28		B		High ceiling, 70		0		2				1				1								
08-May-18	WL13	2:00:00 PM	3:00:00 PM	2:00		PS		High ceiling, 70		0		5				1		2		2								
01-Jul-18	WL13	4:00:00 PM	na	na		PS		50	18	5		0																
30-Jul-18	WL13	9:00:00 AM	9:10:00 AM	0:20		PS	Sunny;	0				0																
07-May-19	WL13	3:40:00 PM	4:40:00 PM	2:00	Water levels are very low	PS		50	17	3-4	Light rain	0																
24-May-19	WL13	1:29:00 PM	1:43:00 PM	0:28	Water levels are very low	PS	Overcast	60	16	2		0																
04-Jul-19	WL13	2:10:00 PM	2:30:00 PM	0:40		PS	Overcast	100	10	6	Rain at times (light and heavy)	5				3			2									
WL13 Totals:				12:08								26	2			9		5	5	5							2	
04-May-18	WL14	11:20:00 AM	11:39:00 AM	0:38		B	Sunny	100	12	3		0																
04-Jul-18	WL14	4:15:00 PM	4:45:00 PM	1:00		PS		30	20	2		0																
09-May-19	WL14	12:03:00 PM	1:05:00 PM	2:04		PS		0	10	0		0															1	
23-May-19	WL14	9:40:00 AM	10:05:00 AM	0:50		PS	Sunny	0	5	0		0																
05-Jul-19	WL14	4:00:00 PM	4:15:00 PM	0:30		PS	Overcast/Sunny	100	12	2		0																
11-Sep-19	WL14	4:13:00 PM	4:34:00 PM	0:42		ES		30	15	1	0	0																
11-Sep-19	WL14	4:13:00 PM	4:34:00 PM	0:42		ES		30	15	1	0	0																
11-Sep-19	WL14	4:51:00 PM	4:54:00 PM	0:06		PS		30	15	1	0	0																
WL14 Totals:				6:32								0															1	
04-May-18	WL15	1:12:00 PM	1:55:00 PM	1:26		PS	Sunny	50	12	3		8				4		4										
05-May-18	WL15	3:20:00 PM	3:45:00 PM	0:50		PS		30	15	1		6						6										
03-Jul-18	WL15	5:15:00 PM	6:15:00 PM	2:00		PS						3					3											
09-May-19	WL15	1:18:00 PM	2:20:00 PM	2:04		PS		0	10	0		12				2		10										
05-Jul-19	WL15	10:45:00 AM	11:42:00 AM	1:54		PS	Overcast	100	5	2	Rain	3	1			2											2	
11-Sep-19	WL15	3:16:00 PM	3:43:00 PM	0:54		ES		40	15	1	0	0																
11-Sep-19	WL15	3:17:00 PM	3:43:00 PM	0:52		ES		30	15	1	0	0																
WL15 Totals:				10:00								32	1			8	3	20									2	
04-May-18	WL16	2:00:00 PM	2:20:00 PM	0:40		PS	Sunny	50	12	3		0																
05-May-18	WL16	3:55:00 PM	4:58:00 PM	2:06		PS		30	15	1		0																

Date	Survey Site	Start Time	End Time	Person Hours	Notes	Survey Purpose	Weather Conditions					Total Amphibians Observed	Columbia Spotted Frog			Wood Frog			Western Toad				Long-toed Salamander			Unidentified		
							Weather	Cloud Cover (%)	Temperature (◦C)	Wind (BU)	Precipitation		Adult	Tadpole	Egg mass	Adult	Tadpole	Egg mass	Adult	Toadlet	Tadpole	Egg mass	Adult	Tadpole	Egg mass	WF/CSF	Adult	Tadpole
09-May-19	WL16	2:20:00 PM	2:50:00 PM	1:00		PS	Overcast	50	10	2		14						11							3			
24-May-19	WL16	3:00:00 PM	4:18:00 PM	2:36	Difficult to see the long-toed salamander egg masses due to darkness of water, depth + glare; Sizes variable from 1-3 eggs to 10-20 eggs. All attached to rush stems at or near surface. Pool is 1-4ft deep. Rabid. Dark red to brown in colour. Own. Warm.	PS	Overcast	60	16	4-5		53													53			
05-Jul-19	WL16	9:40:00 AM	10:40:00 AM	2:00		PS	Overcast	100	8	2	Rain	11	1	6		4												
25-Jul-19	WL16	10:36:00 AM	11:50:00 AM	2:28	Dry	PS	Sunny	0	30	0	0	4												4				
11-Sep-19	WL16	2:12:00 PM	2:15:00 PM	0:06		ES		80	15	1	0	0																
11-Sep-19	WL16	2:12:00 PM	3:15:00 PM	2:06		ES		80	15	1	0	0																
WL16 Totals:				13:02								82	1	6		4		11						4	56			
29-Jun-14	WL17	11:53:00 AM	12:30:00 PM	1:14		PS	Sunny	40		2		0																47
03-Jul-14	WL17	2:34:00 PM	3:04:00 PM	1:00		PS	Sunny	0	20		Raied earlier in day	6		4		2												
09-Jun-17	WL17	10:15:00 AM	11:00:00 AM	1:30		PS	Overcast	High ceiling, 50	8	2	Light rain at times	3				3												
02-Jul-17	WL17	1:50:00 PM	2:20:00 PM	1:00		PS	Sunny	0	20	0	0	5		5														
06-Jul-17	WL17	5:20:00 PM	6:00:00 PM	1:20		PS	Sunny	0	30	0	0	6		6														
05-May-18	WL17	5:00:00 PM	5:20:00 PM	0:40		PS		30	15	1		35			8			27										
05-Jul-18	WL17	na	na	na		PS						0																1
09-May-19	WL17	3:30:00 PM	4:00:00 PM	1:00		PS	Overcast	100	10	2-3	Rain	40			24			2							14			
24-May-19	WL17	2:22:00 PM	2:50:00 PM	0:56	Difficult to see into water due to wind-wave action; all of the egg masses from the last trip (the CSF) are gone! No tadpoles observed.	PS	Overcast	60	16	4-5		35				1									34			
05-Jul-19	WL17	12:10:00 PM	1:30:00 PM	2:40		PS	Overcast	100	9	2	Rain	8	1		4	3												
10-Sep-19	WL17	6:04:00 PM	6:38:00 PM	1:08		ES		90	10	0	Light rain	0																
10-Sep-19	WL17	6:38:00 PM	6:58:00 PM	0:40		ES		90	10	0	Light rain	0																
10-Sep-19	WL17	5:30:00 PM	6:04:00 PM	1:08		ES		90	13	1	0	0																
WL17 Totals:				14:16								138	1	15	36	9		29							48			48
09-Jun-17	WL18	11:15:00 AM	11:30:00 AM	0:30		PS	Overcast	High ceiling, 50	8	2	Light rain at times	0																
06-May-18	WL18	7:41:00 PM	7:45:00 PM	0:08	Cattail culvert wetland along valley very turbid	RLS		0	10	0	Recent rain	0																
24-May-19	WL18	5:28:00 PM	5:37:00 PM	0:18		PS	Overcast	60	20	3		0																
05-Jul-19	WL18	2:20:00 PM	2:50:00 PM	1:00	Likely more tadpoles - difficult to see	PS	Sunny	100	9	2		30												30				
10-Sep-19	WL18	8:28:00 AM	8:37:00 AM	0:18		ES		100	6	0	Light rain	0																
10-Sep-19	WL18	8:56:00 AM	9:00:00 AM	0:08		ES		100	6	0	Light rain	0																
WL18 Totals:				2:22								30												30				
09-May-19	WL19	2:50:00 PM	3:00:00 PM	0:20		PS	Overcast	80	10	2-3	Light rain	0																
11-Sep-19	WL19	2:50:00 PM	3:03:00 PM	0:26		ES		80	15	1	0	0																
WL19 Totals:				0:46								0																
07-Jul-19	WL20	6:40:00 AM	6:55:00 AM	0:30		PS	Foggy		10	1		0																
WL20 Totals:				0:30								0																
09-Jul-19	WL21	12:00:00 PM	12:30:00 PM	1:00		PS		10	25	2		1							1									
13-Sep-19	WL21	9:06:00 AM	10:22:00 AM	2:32		ES		100	10	4	Light rain	0																
WL21 Totals:				3:32								1							1									
11-Jul-19	WL22	12:10:00 AM	12:11:00 AM	0:02		PS						0																
WL22 Totals:				0:02								0																
07-Jun-14	EPH4.2	11:00:00 AM	11:10:00 AM	0:20		PS	Sunny	0	4	1		0																
09-Jul-19	EPH4.2	1:40:00 PM	1:50:00 PM	0:20		PS		10	25	2		0																
EPH4.2 Totals:				0:40								0																
01-Jul-14	Field north of WL5.4	7:05:00 AM	7:15:00 AM	0:20	Adjacent to small stream	B		High ceiling, 25	7			0																
02-Jul-14	Field north of WL5.4	2:45:00 PM	3:10:00 PM	0:50	No open water	PS		0	30	2		0																
12-Sep-19	Field north of WL5.4	3:26:00 PM	3:35:00 PM	0:18		ES		60	14	4	0	0																
Field North of WL5.4 Totals:				1:28								0																
29-Jun-14	EPH100.1	11:36:00 AM	11:52:00 AM	0:32	Wetland Perimeter Searchof Black Creek FSR to Wetland 17 beaver dam	PS	Sunny	40		2		1				1												

Date	Survey Site	Start Time	End Time	Person Hours	Notes	Survey Purpose	Weather Conditions					Total Amphibians Observed	Columbia Spotted Frog			Wood Frog			Western Toad				Long-toed Salamander			Unidentified		
							Weather	Cloud Cover (%)	Temperature (◦C)	Wind (BU)	Precipitation		Adult	Tadpole	Egg mass	Adult	Tadpole	Egg mass	Adult	Toadlet	Tadpole	Egg mass	Adult	Tadpole	Egg mass	WF/CSF	Adult	Tadpole
06-May-18	EPH100.1	7:35:00 PM	7:39:00 PM	0:08	Pools and stream along road surrounded by mature mixed spruce aspen forest	RLS		0	10	0	Recent rain	0																
24-May-19	EPH100.1	4:35:00 PM	4:40:00 PM	0:10		PS	Overcast	60	20	4-5		1	1															
05-Jul-19	EPH100.1	1:35:00 PM	1:45:00 PM	0:20		PS	Overcast	100	9	2	Rain	1				1												
10-Sep-19	EPH100.1	5:06:00 PM	5:19:00 PM	0:26		ES		90	11	0	Light rain	1				1												
EPH100.1 Totals:				1:36								4	1			3												
24-May-19	EPH100.2	4:50:00 PM	5:16:00 PM	0:52		PS	Overcast	60	20	2		2	1						1									
05-Jul-19	EPH100.2	1:45:00 PM	2:00:00 PM	0:30		PS	Overcast	100	9	2	Rain	2	1			1												
10-Sep-19	EPH100.2	5:19:00 PM	5:30:00 PM	0:22		PS		90	11	0	Light rain	0																
EPH100.2 Totals:				1:44								4	2			1			1									
22-Apr-18	EPH101	12:00:00 PM	12:10:00 PM	0:20	Early in the year for amphibians - may freeze overnight, insect larvae present; Puddle; pool at side of forestry road near rail tracks (likely created as a result of); open aspen stand near rail tracks on Grave prairie; very small	PS	Sunny	High ceiling, 100	9	2-3	0	0																
22-Apr-18	EPH102	1:30:00 PM	1:50:00 PM	0:40	Early in the year for amphibians - may freeze overnight, insect larvae present; Puddle; pool at end of forestry road; open aspen stand near rail tracks on Grave prairie	PS	Sunny	High ceiling, 100	9	2-3	0	0																
04-May-18	EPH102	11:40:00 AM	11:50:00 AM	0:20	Dead moose carcass in puddle	PS	Sunny	50	12	3		0																
EPH102 Totals:				1:00								0																
07-Jun-14	EPH103	7:30:00 AM	7:40:00 AM	0:20	Ephemeral wetted area	PS	Sunny	0	Cold (Ice present)			0																
06-Jun-17	EPH103	1:00:00 PM	1:15:00 PM	0:30	Ephemeral/floodplain	PS	Overcast	100	Cool	1		0																
EPH103 Totals:				0:50								0																
06-Jun-17	EPH104.1	1:00:00 PM	1:10:00 PM	0:20	Ditch (across from WL6)	PS		0	3	1		0																
30-Jun-17	EPH104.1	11:19:00 AM	11:27:00 AM	0:16	Ditch across from WL6	PS	Sunny	0	20	0	0	0																
12-Sep-19	EPH104.1	1:17:00 PM	1:20:00 PM	0:06		ES		40	11	2	0	0																
EPH 104.1 Totals:				0:42								0																
12-Sep-19	EPH104.2	1:20:00 PM	1:24:00 PM	0:08	104.1-104.2	ES		40	11	2	0	0																
12-Sep-19	EPH104.2	1:24:00 PM	1:30:00 PM	0:12		ES		40	11	2	0	0																
EPH104.2 Totals:				0:20								0																
08-Jun-14	EPH105	12:51:00 PM	1:01:00 PM	0:20	Riparian flooded area	B		60	13	2-4		0																
06-May-18	EPH105	8:30:00 AM	8:40:00 AM	0:20		B	Sunny	0	6	0	0	0																
EPH105 Totals:				0:40								0																
07-Jun-14	EPH106	10:00:00 AM	10:15:00 AM	0:30	Ephemeral wetted area	PS	Sunny	0	4	1		0																
08-Jun-14	EPH106	7:25:00 AM	7:35:00 AM	0:20	Riparian flooded area; covered by ice	B		0	0	1		0																
EPH106 Totals:				0:50								0																
03-Jul-14	EPH112	11:32:00 AM	11:41:00 AM	0:18	Ephemeral, black spruce meadow; no standing water	PS	Overcast	100	10	3-4	Light rain	0																
08-May-18	EPH113	7:24:00 AM	7:34:00 AM	0:20		PS		High ceiling, 70		0		0																
05-May-18	EPH114	10:40:00 AM	10:50:00 AM	0:20	Roadside puddles	PS	Sunny	0	20	3-4		0																
05-May-18	EPH115	8:05:00 AM	8:15:00 AM	0:20	Culvert pool u/s side of FSR	PS	Sunny	0		1		0																
06-May-18	EPH1003	7:49:00 PM	7:53:00 PM	0:08	Roadside some ditches present	RLS		0	10	0	Recent rain	0																
06-May-18	EPH1004	7:53:00 PM	7:57:00 PM	0:08	Railroad side pool spruce stands	RLS		0	8	0	Recent rain	0																
06-May-18	EPH1005	8:07:00 PM	8:11:00 PM	0:08		RLS		0	8	0	Recent rain	0																
06-May-18	EPH1006	8:17:00 PM	8:21:00 PM	0:08	Mixed aspen and spruce open forest with pools along road side	RLS		0	8	0	Recent rain	0																
06-May-18	EPH1007	8:24:00 PM	8:28:00 PM	0:08	Wetland at road intersection	RLS		0	8	0	Recent rain	0																
06-May-18	EPH1008	8:37:00 PM	8:41:00 PM	0:08	Gate at Grave lake doughnut wetland some pooling water along road	RLS		0	8	0	Recent rain	0																

Date	Survey Site	Start Time	End Time	Person Hours	Notes	Survey Purpose	Weather Conditions					Total Amphibians Observed	Columbia Spotted Frog			Wood Frog			Western Toad				Long-toed Salamander			Unidentified		
							Weather	Cloud Cover (%)	Temperature (-C)	Wind (BU)	Precipitation		Adult	Tadpole	Egg mass	Adult	Tadpole	Egg mass	Adult	Toadlet	Tadpole	Egg mass	Adult	Tadpole	Egg mass	WF/CSF	Adult	Tadpole
06-May-18	EPH1009	8:51:00 PM	8:55:00 PM	0:08	Road side pool in cut block	RLS		0	8	0	Recent rain	0																
06-May-18	EPH1010	7:26:00 PM	7:30:00 PM	0:08	Road side pool in cut block	RLS		0	12	0	Recent rain	0																
10-Jul-19	I994	na	na	na	Transect, Incidental	I						1							1									
17-Jul-19	I995	na	na	na	Transect, Incidental	I						1							1									
07-Jul-19	I996	11:21:00 AM	na	na	Steep cutblock (mostly pine; fairly high elevation; recent re-planted (last 10 years), thick dead grass layer)	I	Sunny		25	4		1							1									
12-Sep-19	I997	na	na	na	Incidental - Willows, mature and young spruce higher up in the valley	I						1							1									
10-Jul-19	I998	8:08:00 AM	na	na	Upper West Alexander Valley in steeping wet meadow adjacent (50m) to creek in open area (no trees) under colt's foot.	I		30	10	3		1								1								
03-Jul-18	I999	na	na	na	From Badger transects	I						1							1									
Totals:				160:08:00								421	37	39	58	41	3	66	18	8	0	0	0	43	108	11	5	48

Notes:	Survey Type		Total Time	No. Surveys	Total Amphibians
B	Breeding Bird Survey		-	-	3
I	Incidental Visit		-	-	6
PS	Perimeter Search		127:50:00	157	406
RLS	Road Listening Survey		1:20:00	10	0
ES	Emergence Survey		30:58:00	43	6
	Totals		160:08:00	210	421
CC	Cloud Cover				
BU	Beaufort Wind Scale				
C	Degrees Celsius				

Appendix D

Amphibian eDNA Data

DILLON CONSULTING

Master Sort	BV Case ID	Client Sample Name	Location name	Collection date	Collected by	Test for (TT)	Amplifiable DNA Frequency	Amplifiable DNA Call	Clean-Up Required	Amplifiable DNA Frequency	Amplifiable DNA Call	ANBO Frequency	Filter Date	Sample Contents	Preservation Method	Project Number	Comments
1	DI20190012	WL14A	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
2	DI20190013	WL14B	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
3	DI20190014	WL14C	Crown Mountain	2019/07/05	GRH	ANBO	0/4	No	Yes	4/4	Yes	0/8	2019/07/05		Silica	126231	
4	DI20190015	WL18A	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
5	DI20190016	WL18B	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
6	DI20190017	WL18C	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
7	DI20190018	WL15A	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
8	DI20190019	WL15B	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
9	DI20190020	WL15C	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
10	DI20190021	WL17A	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
11	DI20190022	WL17B	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
12	DI20190023	WL17C	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
13	DI20190024	WL16A	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
14	DI20190025	WL16B	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
15	DI20190026	WL16C	Crown Mountain	2019/07/05	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/05		Silica	126231	
16	DI20190027	WLB_1	Crown Mountain	2019/07/05	GRH	IntegritE-DNA	0/4	No	Yes	0/4	No	Not Requested	2019/07/05		Silica	126231	Blank
17	DI20190028	WL11A	Crown Mountain	2019/07/07	GRH	ANBO	0/4	No	Yes	4/4	Yes	0/8	2019/07/07		Silica	126231	
18	DI20190029	WL11B	Crown Mountain	2019/07/07	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/07		Silica	126231	
19	DI20190030	WL11C	Crown Mountain	2019/07/07	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/07		Silica	126231	
20	DI20190031	WL12A	Crown Mountain	2019/07/07	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/07		Silica	126231	
21	DI20190032	WL12B	Crown Mountain	2019/07/07	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/07		Silica	126231	
22	DI20190033	WL12C	Crown Mountain	2019/07/07	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/07		Silica	126231	
23	DI20190034	WLB_2	Crown Mountain	2019/07/07	GRH	IntegritE-DNA	0/4	No	Yes	0/4	No	Not Requested	2019/07/07		Silica	126231	Blank
24	DI20190035	WL5.2A	Crown Mountain	2019/07/08	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/08		Silica	126231	
25	DI20190036	WL5.2B	Crown Mountain	2019/07/08	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/08		Silica	126231	
26	DI20190037	WL5.2C	Crown Mountain	2019/07/08	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/08		Silica	126231	
27	DI20190038	WL5.3A	Crown Mountain	2019/07/08	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/08		Silica	126231	
28	DI20190039	WL5.3B	Crown Mountain	2019/07/08	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/08		Silica	126231	
29	DI20190040	WL5.3C	Crown Mountain	2019/07/08	GRH	ANBO	4/4	Yes	No	N/A	N/A	2/8	2019/07/08		Silica	126231	
30	DI20190041	WLB_3	Crown Mountain	2019/07/08	GRH	IntegritE-DNA	0/4	No	Yes	0/4	No	Not Requested	2019/07/08		Silica	126231	Blank
31	DI20190042	WL4.1A	Crown Mountain	2019/07/09	GRH	ANBO	4/4	Yes	No	N/A	N/A	1/8	2019/07/09		Silica	126231	
32	DI20190043	WL4.1B	Crown Mountain	2019/07/09	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/09		Silica	126231	
33	DI20190044	WL4.1C	Crown Mountain	2019/07/09	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/09		Silica	126231	
34	DI20190045	WL21	Crown Mountain	2019/07/09	GRH	ANBO	0/4	No	Yes	4/4	Yes	8/8	2019/07/09		Silica	126231	
35	DI20190046	WL2A	Crown Mountain	2019/07/09	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/09		Silica	126231	
36	DI20190047	WL2B	Crown Mountain	2019/07/09	GRH	ANBO	0/4	No	Yes	0/4	No	IntegritE DNA failed	2019/07/09		Silica	126231	This sample was not processed for target species assay because of the IntegritE-DNA failure.
37	DI20190048	WL2C	Crown Mountain	2019/07/09	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/09		Silica	126231	
38	DI20190049	WLB_4	Crown Mountain	2019/07/09	GRH	IntegritE-DNA	0/4	No	Yes	0/4	No	Not Requested	2019/07/09		Silica	126231	Blank
39	DI20190050	WLN2A	Crown Mountain	2019/07/10	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/10		Silica	126231	
40	DI20190051	WLN2B	Crown Mountain	2019/07/10	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/10		Silica	126231	
41	DI20190052	WLN2C	Crown Mountain	2019/07/10	GRH	ANBO	4/4	Yes	No	N/A	N/A	0/8	2019/07/10		Silica	126231	
42	DI20190053	WLB_5	Crown Mountain	2019/07/10	GRH	IntegritE-DNA	0/4	No	Yes	0/4	No	Not Requested	2019/07/10		Silica	126231	Blank

Appendix E

Amphibian Tissue Data

						Tadpole		
					Sample ID	CSF-TP-WL7	CSF-TP-WL9	WET21
					Sample Date	2017-07-06	2017-07-06	2018-07-03
					Lab Report Number	L1955497	L1955497	L2125502
					2019 Location Name	4	17	15
					Location Type	Wetland	Wetland	Wetland
					Species	Columbia spotted frog	Columbia spotted frog	Wood frog

Parameters						Concentration (mg/kg dry wt)			Summary Statistics			
Chemical Group	Chemical Name	Units	EQL	USEPA 2016[1] (mg/kg dw)					Minimum	Maximum	Geometric Mean	Standard Deviation
General Chemistry	Phosphorus	mg/kg	2			13760.56	10620.69	6444.44	6444.44	13760.56	9802.23	3670.27
Metals	Aluminium	mg/kg	0.4			577.46	2420.69	1395.24	577.46	2420.69	1249.41	923.56
	Antimony	mg/kg	0.002			0.08	0.07	0.08	0.07	0.08	0.08	0.01
	Arsenic	mg/kg	0.004			5.72	1.00	0.52	0.52	5.72	1.44	2.87
	Barium	mg/kg	0.01			271.83	103.45	130.48	103.45	271.83	154.24	90.43
	Beryllium	mg/kg	0.002			0.04	0.12	0.07	0.04	0.12	0.07	0.04
	Bismuth	mg/kg	0.002			<DL	0.05	<DL	0.05	0.05	0.05	-
	Boron	mg/kg	0.2			7.89	8.14	23.02	7.89	23.02	11.39	8.66
	Cadmium	mg/kg	0.001			0.19	0.42	0.18	0.18	0.42	0.25	0.14
	Calcium	mg/kg	4			13492.96	27793.10	27301.59	13492.96	27793.10	21714.21	8118.03
	Cesium	mg/kg	0.001			0.13	0.28	0.40	0.13	0.40	0.25	0.13
	Chromium Total (III+VI)	mg/kg	0.01			1.83	2.92	4.37	1.83	4.37	2.86	1.27
	Cobalt	mg/kg	0.004			2.58	1.79	2.03	1.79	2.58	2.11	0.41
	Copper	mg/kg	0.02			4.06	7.31	8.38	4.06	8.38	6.29	2.25
	Iron	mg/kg	0.6			45352.11	3586.21	2253.97	2253.97	45352.11	7156.93	24507.20
	Lead	mg/kg	0.004			1.42	2.37	1.98	1.42	2.37	1.88	0.47
	Lithium	mg/kg	0.1			<DL	3.72	3.81	3.72	3.81	3.77	0.06
	Magnesium	mg/kg	0.4			2380.28	2013.79	3126.98	2013.79	3126.98	2465.60	567.31
	Manganese	mg/kg	0.01			1901.41	335.17	1373.02	335.17	1901.41	956.47	796.81
	Mercury	mg/kg	0.001			0.10	0.04	<DL	0.04	0.10	0.06	0.04
	Molybdenum	mg/kg	0.004			1.49	0.72	0.80	0.72	1.49	0.95	0.43
	Nickel	mg/kg	0.04			2.42	4.56	3.03	2.42	4.56	3.22	1.10
	Potassium	mg/kg	4			13098.59	9586.21	4428.57	4428.57	13098.59	8223.28	4360.95
	Rubidium	mg/kg	0.01			47.61	7.31	11.21	7.31	47.61	15.74	22.23
	Selenium	mg/kg	0.01	8.5		2.39	2.72	5.33	2.39	5.33	3.26	1.61
	Silver	mg/kg	0.001			0.04	0.06	0.27	0.04	0.27	0.08	0.13
	Sodium	mg/kg	4			22957.75	8896.55	8841.27	8841.27	22957.75	12177.42	8134.24
	Strontium	mg/kg	0.01			48.03	106.90	154.76	48.03	154.76	92.62	53.46
	Tellurium	mg/kg	0.004			<DL	<DL	<DL	0.00	0.00	-	-
	Thallium	mg/kg	0.0004			0.03	0.16	0.06	0.03	0.16	0.06	0.07
	Tin	mg/kg	0.02			1.37	0.50	3.14	0.50	3.14	1.29	1.35
	Titanium	mg/kg	0.02			8.39	14.90	34.92	8.39	34.92	16.35	13.83
	Uranium	mg/kg	0.0004			0.29	0.12	0.22	0.12	0.29	0.20	0.08
	Vanadium	mg/kg	0.02			2.13	7.24	2.90	2.13	7.24	3.55	2.76
	Zinc	mg/kg	0.1			114.51	117.24	179.37	114.51	179.37	134.03	36.68
	Zirconium	mg/kg	0.04			0.68	1.14	1.54	0.68	1.54	1.06	0.43

Comments:

[1] Chronic criteria

Laboratory reported concentrations in mg/kg ww. Concentrations expressed here as mg/kg dw accroding to moisture content of tissue

														Summary Statistics			
							Egg mass										
						Sample ID	18-WF-WL9	18-WF-WL9B	18-WF-WL10	10-CSF-WL07	CSF-W17-19	WF-WL15-19	CSF-WL4.1-19				
						Sample Date	2018-05-05	2018-05-05	2018-05-08	2018-05-09	2019-05-09	2019-05-09	2019-05-21				
						Lab Report Number	L2093242	L2093242	L2093242	L2093242	L2279917	L2279917	L2279917				
						2019 Location Name	17	15	13	4	17	15	4				
						Location Type	Wetland	Wetland	Wetland	Wetland	Wetland	Wetland	Wetland				
						Species	Wood frog	Wood frog	Wood frog	Columbia spotted frog	Columbia spotted frog	Wood frog	Columbia spotted frog				
Parameters				Amphibian Tissue Criteria (Egg Mass)													
Chemical Group	Chemical Name	Units	EQL	BC WQG 2014 (mg/kg dw)	USEPA 2016[1] (mg/kg dw)	Windward et al. (2014) (mg/kg dw)	Concentration (mg/kg dry wt)							Minimum	Maximum	Geometric Mean	Standard Deviation
General Chemistry	Phosphorus	mg/kg	2				5448.28	10396.83	9303.03	5942.86	11447.37	13260.87	9136.36	5448.28	13260.87	8876.90	2817.56
Metals	Aluminium	mg/kg	0.4				<DL	<DL	68.79	42.29	42.11	<DL	250.00	42.11	250.00	74.39	100.26
	Antimony	mg/kg	0.002				<DL	<DL	<DL	<DL	0.06	<DL	<DL	0.06	0.06	0.06	-
	Arsenic	mg/kg	0.004				<DL	<DL	<DL	<DL	0.28	<DL	0.93	0.28	0.93	0.51	0.46
	Barium	mg/kg	0.01				6.31	3.16	16.45	33.43	31.84	6.02	60.45	3.16	60.45	14.38	20.78
	Beryllium	mg/kg	0.002				<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	-	-
	Bismuth	mg/kg	0.002				<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	-	-
	Boron	mg/kg	0.2				<DL	3.49	<DL	<DL	10.00	5.22	<DL	3.49	10.00	5.67	3.37
	Cadmium	mg/kg	0.001				<DL	<DL	<DL	0.04	<DL	<DL	<DL	0.04	0.04	0.04	-
	Calcium	mg/kg	4				7344.83	3809.52	3727.27	5457.14	19605.26	7695.65	14863.64	3727.27	19605.26	7452.10	6035.37
	Cesium	mg/kg	0.001				<DL	0.02	<DL	<DL	<DL	0.02	0.06	0.02	0.06	0.03	0.02
	Chromium Total (III+VI)	mg/kg	0.01			12.7	0.52	<DL	<DL	<DL	<DL	<DL	<DL	0.52	0.52	0.52	-
	Cobalt	mg/kg	0.004				<DL	<DL	<DL	0.14	1.04	<DL	0.75	0.14	1.04	0.48	0.46
	Copper	mg/kg	0.02				3.79	6.56	5.06	4.86	6.50	5.50	9.23	3.79	9.23	5.73	1.74
	Iron	mg/kg	0.6				131.72	66.67	113.64	188.29	1157.89	54.35	8136.36	54.35	8136.36	266.79	2993.24
	Lead	mg/kg	0.004				<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	-	-
	Lithium	mg/kg	0.1				<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	-	-
	Magnesium	mg/kg	0.4				1986.21	1603.17	1545.45	1565.71	3210.53	2165.22	2563.64	1545.45	3210.53	2020.17	619.78
	Manganese	mg/kg	0.01				20.31	3.68	12.82	605.71	507.89	21.02	442.27	3.68	605.71	59.82	273.70
	Mercury	mg/kg	0.001				<DL	0.10	0.03	0.03	<DL	<DL	<DL	0.03	0.10	0.05	0.04
	Molybdenum	mg/kg	0.004				0.29	<DL	<DL	0.16	1.15	0.21	0.69	0.16	1.15	0.38	0.42
	Nickel	mg/kg	0.04				<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	-	-
	Potassium	mg/kg	4				868.97	3111.11	2309.09	1045.71	631.58	2030.43	1100.00	631.58	3111.11	1373.22	912.83
	Rubidium	mg/kg	0.01				<DL	1.73	1.39	0.57	0.42	1.85	3.14	0.42	3.14	1.22	0.99
	Selenium	mg/kg	0.01	6	15.1		1.86	2.59	2.09	2.17	5.00	3.57	3.77	1.86	5.00	2.83	1.15
	Silver	mg/kg	0.001				<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	-	-
	Sodium	mg/kg	4				744.83	1619.05	1081.82	431.43	718.42	1193.48	390.91	390.91	1619.05	787.99	441.58
	Strontium	mg/kg	0.01				62.41	34.76	7.48	19.23	107.63	60.22	45.91	7.48	107.63	36.89	33.07
	Tellurium	mg/kg	0.004				<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	-	-
	Thallium	mg/kg	0.0004				<DL	0.01	<DL	0.01	0.03	<DL	0.02	0.01	0.03	0.02	0.01
	Tin	mg/kg	0.02				<DL	<DL	<DL	0.60	1.29	<DL	<DL	0.60	1.29	0.88	0.49
	Titanium	mg/kg	0.02				<DL	<DL	2.09	1.14	1.29	0.54	5.00	0.54	5.00	1.53	1.76
	Uranium	mg/kg	0.0004				<DL	0.02	0.04	0.04	0.12	0.08	0.19	0.02	0.19	0.06	0.06
	Vanadium	mg/kg	0.02			6.5	<DL	<DL	0.70	<DL	<DL	<DL	0.95	0.70	0.95	0.82	0.18
	Zinc	mg/kg	0.1				101.72	131.27	145.76	88.86	151.58	131.74	225.45	88.86	225.45	134.07	44.15
	Zirconium	mg/kg	0.04				<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	-	-

DILLON CONSULTING LIMITED
ATTN: Stacie Kalyn
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Date Received: 09-JUL-17
Report Date: 20-SEP-17 12:17 (MT)
Version: FINAL

Client Phone: 604-278-7847

Certificate of Analysis

Lab Work Order #: L1955497

Project P.O. #: NOT SUBMITTED
Job Reference: 126231
C of C Numbers: 15-602165
Legal Site Desc:

<Original signed by>

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1955497-1 Egg 04-JUL-17 15:36 SPSA-E-HCR	L1955497-2 Egg 30-JUN-17 12:30 SPSA-E-MACR	L1955497-3 Egg 06-JUL-17 16:05 SPSA-E-VACR	L1955497-4 Tadpoles 06-JUL-17 17:30 CSF-TP-WL9	L1955497-5 Tadpoles 06-JUL-17 18:00 CSF-TP-WL7
TISSUE						
Physical Tests	% Moisture (%)	70.3	68.6	72.0	85.5	92.9
Metals	Aluminum (Al)-Total (mg/kg wwt)	2.8	1.2	1.2	351	41.0
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0095	0.0059
	Arsenic (As)-Total (mg/kg wwt)	0.0069	0.0071	0.0092	0.145	0.406
	Barium (Ba)-Total (mg/kg wwt)	4.83	19.9	15.4	15.0	19.3
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0177	0.0030
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0066	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	1.18	0.56
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0613	0.0136
	Calcium (Ca)-Total (mg/kg wwt)	20000	27700	21100	4030	958
	Cesium (Cs)-Total (mg/kg wwt)	<0.0010	0.0011	0.0012	0.0408	0.0094
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.424	0.130
	Cobalt (Co)-Total (mg/kg wwt)	0.0230	0.0411	0.0635	0.259	0.183
	Copper (Cu)-Total (mg/kg wwt)	1.11	1.09	1.23	1.06	0.288
	Iron (Fe)-Total (mg/kg wwt)	23.0	25.8	32.6	520	3220
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	0.343	0.101
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	0.54	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	259	309	320	292	169
	Manganese (Mn)-Total (mg/kg wwt)	1.08	0.711	0.559	48.6	135
	Mercury (Hg)-Total (mg/kg wwt)	0.0257	0.0310	0.0434	0.0052	0.0069
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0273	0.0276	0.0327	0.104	0.106
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.661	0.172
	Phosphorus (P)-Total (mg/kg wwt)	3040	3120	3190	1540	977
	Potassium (K)-Total (mg/kg wwt)	1600	1650	1560	1390	930
	Rubidium (Rb)-Total (mg/kg wwt)	0.516	0.496	0.497	1.06	3.38
	Selenium (Se)-Total (mg/kg wwt)	4.15	0.879	0.871	0.395	0.170
	Silver (Ag)-Total (mg/kg wwt)	0.0031	0.0074	0.0098	0.0083	0.0026
	Sodium (Na)-Total (mg/kg wwt)	1560	1540	1870	1290	1630
	Strontium (Sr)-Total (mg/kg wwt)	10.4	50.3	33.8	15.5	3.41
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	0.0050	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0137	0.0176	0.0185	0.0234	0.00205
	Tin (Sn)-Total (mg/kg wwt)	0.046	<0.020	0.088	0.072	0.097
	Titanium (Ti)-Total (mg/kg wwt)	0.033	<0.020	0.020	2.16	0.596
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.0179	0.0207
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	1.05	0.151
	Zinc (Zn)-Total (mg/kg wwt)	13.2	14.3	13.0	17.0	8.13
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.166	0.048

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-WET-CCMS-N-VA	Tissue	Silver in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

MET-WET-CCMS-MID-VA	Tissue	Metals in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-MICR-VA	Tissue	Moisture in Tissue	Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at <60 deg. C.

TI-WET-CCMS-N-VA	Tissue	Ti in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-602165

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1955497-COFC

COC Number: 15 - 602165

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Dillon Consulting
Contact:	Stacie Kalyn / Richard Pope
Phone:	
Company address below will appear on the final report	
Street:	
City/Province:	
Postal Code:	
Invoice To	Same as Report To? [X] YES [ ] NO
	Copy of Invoice with Report [ ] YES [ ] NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: [ ] PDF [X] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report [X] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax: SKalyn@dillon.ca
Email 2: jhuard@dillon.ca
Email 3: rpope@dillon.ca

Invoice Distribution

Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax:
Email 2:

Project Information

ALS Account # / Quote #:
Job #: TBD 126251
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#:
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Jasmeen **Sampler:**

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] [ ] | 3 day [P3] [ ] | 2 day [P2] [ ]

EMERGENCY: 1 Business day [E1] [ ] | Same Day, Weekend or Statutory holiday [E0] [ ]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals in Tissues	Number of Containers
	SPSA-E-HGR	June 30 2017	1230	egg	X	1
	SPSA-E-MACR	Jul 4, 2017	1536	"	X	1
	SPSA-E-VACR	July 6, 2017	1605	"	X	1
	CSF-TP-WL9	"	1530	tadpoles	X	1
	CSF-TP-WL7	"	1800	"	X	1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [X] NO

Are samples for human drinking water use? [ ] YES [X] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] | SIF Observations Yes [ ] No [ ]
Ice Packs [ ] Ice Cubes [X] | Custody seal intact Yes [ ] No [ ]
Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C	
4.8	10.1		

SHIPMENT RELEASE (client use)

Released by: <Original signed by> Date: July 6 17 Time: 1600

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: RC Date: Jul 9, 2017 Time: 3:15pm

FINAL SHIPMENT RECEPTION (lab use only)

Received by: Date: Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

DILLON CONSULTING LIMITED
ATTN: Richard Pope
510 - 3820 Cessna Drive
Richmond BC V7B 0A2

Date Received: 11-MAY-18
Report Date: 27-JUN-18 15:01 (MT)
Version: FINAL

Client Phone: 604-278-7847

Certificate of Analysis

Lab Work Order #: L2093242

Project P.O. #: NOT SUBMITTED
Job Reference: 126231
C of C Numbers:
Legal Site Desc:

<Original signed by>

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2093242-1 Tissues 05-MAY-18 10:00 18-WF-WL9B	L2093242-2 Tissues 05-MAY-18 17:00 18-WF-WL9	L2093242-3 Tissues 05-MAY-18 10:00 18-WF-WL10	L2093242-4 Tissues 05-MAY-18 10:00 10-CSF-WL07	
	Sample ID **Description** **Sampled Date** **Sampled Time** **Client ID**					
TISSUE						
Physical Tests	% Moisture (%)	93.7	97.1	96.7	96.5	
Metals	Aluminum (Al)-Total (mg/kg wwt)	<1.0	<0.40	2.27	1.48	
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Arsenic (As)-Total (mg/kg wwt)	<0.0060	<0.0040	<0.0040	<0.0040	
	Barium (Ba)-Total (mg/kg wwt)	0.199	0.183	0.543	1.17	
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Boron (B)-Total (mg/kg wwt)	0.22	<0.20	<0.20	<0.20	
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020	<0.0010	<0.0010	0.0013	
	Calcium (Ca)-Total (mg/kg wwt)	240	213	123	191	
	Cesium (Cs)-Total (mg/kg wwt)	0.0012	<0.0010	<0.0010	<0.0010	
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	0.015	<0.010	<0.010	
	Cobalt (Co)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0048	
	Copper (Cu)-Total (mg/kg wwt)	0.413	0.110	0.167	0.170	
	Iron (Fe)-Total (mg/kg wwt)	4.2	3.82	3.75	6.59	
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.0040	<0.0040	<0.0040	
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	
	Magnesium (Mg)-Total (mg/kg wwt)	101	57.6	51.0	54.8	
	Manganese (Mn)-Total (mg/kg wwt)	0.232	0.589	0.423	21.2	
	Mercury (Hg)-Total (mg/kg wwt)	0.0061	<0.0010	0.0011	0.0012	
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0080	0.0085	<0.0040	0.0057	
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	
	Phosphorus (P)-Total (mg/kg wwt)	655	158	307	208	
	Potassium (K)-Total (mg/kg wwt)	196	25.2	76.2	36.6	
	Rubidium (Rb)-Total (mg/kg wwt)	0.109	<0.010	0.046	0.020	
	Selenium (Se)-Total (mg/kg wwt)	0.163	0.054	0.069	0.076	
	Silver (Ag)-Total (mg/kg wwt)	<0.0010	<0.0010	<0.0010	<0.0010	
	Sodium (Na)-Total (mg/kg wwt)	102	21.6	35.7	15.1	
	Strontium (Sr)-Total (mg/kg wwt)	2.19	1.81	0.247	0.673	
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	
	Thallium (Tl)-Total (mg/kg wwt)	0.00074	<0.00040	<0.00040	0.00045	
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.021	
	Titanium (Ti)-Total (mg/kg wwt)	<0.10	<0.020	0.069	0.040	
	Uranium (U)-Total (mg/kg wwt)	0.00116	<0.00040	0.00147	0.00137	
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	0.023	<0.020	
	Zinc (Zn)-Total (mg/kg wwt)	8.27	2.95	4.81	3.11	
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Mercury (Hg)-Total	B	L2093242-1
Method Blank	Uranium (U)-Total	B	L2093242-2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-WET-CCMS-N-VA	Tissue	Silver in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

AG-WET-MICR-HRMS-VA	Tissue	Silver in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

HG-WET-CVAFS-N-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

MET-WET-CCMS-N-VA	Tissue	Metals in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MET-WET-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-MICR-VA	Tissue	Moisture in Tissue	Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at <60 deg. C.

MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

TI-WET-CCMS-N-VA	Tissue	Ti in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals.

Reference Information

Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered

TI-WET-MICR-HRMS-VA Tissue Ti in Tissue by HR-ICPMS Micro (WET) EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2093242-COFC

COC Number: 17 -

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Dillon Consulting limited
Contact:	Richard Pope, Laura Dilley
Phone:	604 278 7846
	Company address below will appear on the final report
Street:	3820 Cessna Drive
City/Province:	Richmond BC
Postal Code:	V7B 0A2
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: rpope@dillon.ca
Email 2: Ldilley@dillon.ca
Email 3: mmcdougall@dillon.ca

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: rpope@dillon.ca
Email 2: salmeida@dillon.ca

Project Information

ALS Account # / Quote #:
Job #: 126231
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#
Major/Minor Code: Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only):

ALS Contact: Brent Mack **Sampler:** Jacqueline Hua

Turnaround Time (TAT) Option - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days): 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%] ☐

Emergency: 1 Business day [E1 - 100%] ☐ Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals in tissues	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
	18-WF-WL9B	05-05-18	1000	Tissues	X			1
	18-WF-WL9	05-05-18	1700	Tissues	X			1
	18-WF-WL10	05-08-18	1000	Tissues	X			1
	18-CSF-WL07	05-09-18	1000	Tissues	X			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO
Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
	2.3

SHIPMENT RELEASE (client use)

Released by: <Original signed by> Date: May 10, 2018 Time: 1700

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: Date: Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by: Date: May 11th 2018 Time: 13:00 PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

SEPT 2017 FR

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

Dillon Consulting Ltd.
ATTN: Mike Russum
200 - 334 11 Ave SE
Calgary AB T2G 0Y2

Date Received: 07-JUL-18
Report Date: 09-AUG-18 17:48 (MT)
Version: FINAL

Client Phone: 403-215-8885

Certificate of Analysis

Lab Work Order #: L2125502

Project P.O. #: NOT SUBMITTED
Job Reference: CROWN MOUNTAIN TISSUE SAMPLING
C of C Numbers: 17-635882
Legal Site Desc:

<Original signed by>

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2125502-1	L2125502-2			
	Description	TADPOLES	EGG (BIRD)			
	Sampled Date	04-JUL-18	04-JUL-18			
	Sampled Time	18:00	18:00			
	Client ID	WET21	WL1			
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	93.7	73.1			
Metals	Aluminum (Al)-Total (mg/kg wwt)	87.9	<1.0			
	Antimony (Sb)-Total (mg/kg wwt)	0.0052	<0.0020			
	Arsenic (As)-Total (mg/kg wwt)	0.0328	0.0069			
	Barium (Ba)-Total (mg/kg wwt)	8.22	2.05			
	Beryllium (Be)-Total (mg/kg wwt)	0.0041	<0.0020			
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020			
	Boron (B)-Total (mg/kg wwt)	1.45	<0.20			
	Cadmium (Cd)-Total (mg/kg wwt)	0.0116	<0.0020			
	Calcium (Ca)-Total (mg/kg wwt)	1720	881			
	Cesium (Cs)-Total (mg/kg wwt)	0.0249	<0.0010			
	Chromium (Cr)-Total (mg/kg wwt)	0.275	<0.040			
	Cobalt (Co)-Total (mg/kg wwt)	0.128	0.0546			
	Copper (Cu)-Total (mg/kg wwt)	0.528	1.24			
	Iron (Fe)-Total (mg/kg wwt)	142	29.5			
	Lead (Pb)-Total (mg/kg wwt)	0.125	<0.010			
	Lithium (Li)-Total (mg/kg wwt)	0.24	<0.10			
	Magnesium (Mg)-Total (mg/kg wwt)	197	98.7			
	Manganese (Mn)-Total (mg/kg wwt)	86.5	0.557			
	Mercury (Hg)-Total (mg/kg wwt)	<0.016	0.0264			
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0503	0.0369			
	Nickel (Ni)-Total (mg/kg wwt)	0.191	<0.040			
	Phosphorus (P)-Total (mg/kg wwt)	406	2430			
	Potassium (K)-Total (mg/kg wwt)	279	1690			
	Rubidium (Rb)-Total (mg/kg wwt)	0.706	0.467			
	Selenium (Se)-Total (mg/kg wwt)	0.336	1.03			
	Silver (Ag)-Total (mg/kg wwt)	0.0170	0.0071			
	Sodium (Na)-Total (mg/kg wwt)	557	1600			
	Strontium (Sr)-Total (mg/kg wwt)	9.75	0.996			
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040			
	Thallium (Tl)-Total (mg/kg wwt)	0.00360	0.00282			
	Tin (Sn)-Total (mg/kg wwt)	0.198	<0.020			
	Titanium (Ti)-Total (mg/kg wwt)	2.20	<0.10			
	Uranium (U)-Total (mg/kg wwt)	0.0138	<0.00040			
	Vanadium (V)-Total (mg/kg wwt)	0.183	<0.020			
	Zinc (Zn)-Total (mg/kg wwt)	11.3	12.8			
	Zirconium (Zr)-Total (mg/kg wwt)	0.097	<0.040			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Silver (Ag)-Total	B	L2125502-1, -2
Method Blank	Manganese (Mn)-Total	B	L2125502-2
Method Blank	Thallium (Tl)-Total	B	L2125502-2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-WET-MICR-HRMS-VA	Tissue	Silver in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

MET-WET-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-MICR-VA	Tissue	Moisture in Tissue	Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at <60 deg. C.

TI-WET-MICR-HRMS-VA	Tissue	Ti in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-635882

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2125502-COFC

COC Number: 17 - 635882

Page of

Report To	Contact and company name below will appear on the final report
Company:	Dillon Consulting Ltd.
Contact:	Mike Russum
Phone:	403 - 215 - 8885
	Company address below will appear on the final report
Street:	200 - 3rd 11 Ave SE
City/Province:	Calgary AB
Postal Code:	T2G 0Y2
Invoice To	Same as Report To [Y] YES [ ] NO
	Copy of Invoice with Report [Y] YES [ ] NO
Company:	Dillon Consulting Ltd.
Contact:	Laura Dilley (ldilley@dillon.ca) 604-295-7070

Report Format / Distribution

Select Report Format: [Y] PDF [Y] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report [Y] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: [Y] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax: ldilley@dillon.ca
Email 2: mrussum@dillon.ca
Email 3:

Invoice Distribution

Select Invoice Distribution: [Y] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax: ldilley@dillon.ca
Email 2:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R]: [Y] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4-20%] [ ]		1 Business day [E-100%] [ ]
	3 day [P3-25%] [ ]		Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] [ ]
	2 day [P2-50%] [ ]		

[redacted] Date and Time Required for all E&P TATs: [redacted] dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information		[redacted] Oil and Gas Required Fields (client use) [redacted]	
ALS Account # / Quote #:	10159	AFE/Cost Center:	PO#:
Job #:	BRZ17791 Crown Mountain Tissue Sampling	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Sample Handling + Disposal	Silver in Tissue (HR-ICPMS)	Mercury in Tissue (CVAFS)	Metals in Tissue (HR-ICPMS)	Moisture in Tissue	Tissue Micro Prep	Ti in Tissue (HR-ICPMS)	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	WET21	04-07-2018	18:60	tadpoles	P	(Frozen)								1
	WL1	05-07-2018	17:25	egg (bird)	P	(Frozen)								1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [Y] NO

Are samples for human consumption/ use? [ ] YES [Y] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]
Ice Packs [ ] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]
Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C			
	0.5°C				

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released: <Original signed by>	Date: July 7, 2018	Time:	Received by:	Date: July 7th	Time: 1pm	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

DILLON CONSULTING LIMITED
ATTN: Jacqueline Huard
510 - 3820 Cessna Drive
Richmond BC V7B 0A2

Date Received: 27-MAY-19
Report Date: 24-JUN-19 13:05 (MT)
Version: FINAL

Client Phone: 604-278-7847

Certificate of Analysis

Lab Work Order #: L2279917

Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: 17-701631
Legal Site Desc:

<Original signed by>

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2279917-1	L2279917-2	L2279917-3		
	Description	Eggs	Eggs	Eggs		
	Sampled Date	09-MAY-19	09-MAY-19	21-MAY-19		
	Sampled Time	12:00	13:45	14:00		
	Client ID	CSF-W17-19	WF-WL15-19	CSF-WL4.1-19		
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	96.2	95.4	97.8		
Metals	Aluminum (Al)-Total (mg/kg wwt)	1.6	<1.0	5.5		
	Antimony (Sb)-Total (mg/kg wwt)	0.0022	<0.0020	<0.0020		
	Arsenic (As)-Total (mg/kg wwt)	0.0105	<0.0060	0.0205		
	Barium (Ba)-Total (mg/kg wwt)	1.21	0.277	1.33		
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Boron (B)-Total (mg/kg wwt)	0.38	0.24	<0.20		
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Calcium (Ca)-Total (mg/kg wwt)	745	354	327		
	Cesium (Cs)-Total (mg/kg wwt)	<0.0010	0.0011	0.0014		
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040		
	Cobalt (Co)-Total (mg/kg wwt)	0.0397	<0.0040	0.0166		
	Copper (Cu)-Total (mg/kg wwt)	0.247	0.253	0.203		
	Iron (Fe)-Total (mg/kg wwt)	44.0	2.5	179		
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.010	<0.010		
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10		
	Magnesium (Mg)-Total (mg/kg wwt)	122	99.6	56.4		
	Manganese (Mn)-Total (mg/kg wwt)	19.3	0.967	9.73		
	Mercury (Hg)-Total (mg/kg wwt)	<0.0010	<0.0010	<0.0010		
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0438	0.0097	0.0151		
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.040	<0.040		
	Phosphorus (P)-Total (mg/kg wwt)	435	610	201		
	Potassium (K)-Total (mg/kg wwt)	24.0	93.4	24.2		
	Rubidium (Rb)-Total (mg/kg wwt)	0.016	0.085	0.069		
	Selenium (Se)-Total (mg/kg wwt)	0.190	0.164	0.083		
	Silver (Ag)-Total (mg/kg wwt)	<0.0010	<0.0010	<0.0010		
	Sodium (Na)-Total (mg/kg wwt)	27.3	54.9	8.6		
	Strontium (Sr)-Total (mg/kg wwt)	4.09	2.77	1.01		
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040		
	Thallium (Tl)-Total (mg/kg wwt)	0.00113	<0.00040	0.00053		
	Tin (Sn)-Total (mg/kg wwt)	0.049	<0.020	<0.020		
	Titanium (Ti)-Total (mg/kg wwt)	0.049	0.025	0.110		
	Uranium (U)-Total (mg/kg wwt)	0.00453	0.00371	0.00409		
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	0.021		
	Zinc (Zn)-Total (mg/kg wwt)	5.76	6.06	4.96		
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040		

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-WET-CCMS-MID-VA	Tissue	Silver in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

MET-WET-CCMS-MID-VA	Tissue	Metals in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-MICR-VA	Tissue	Moisture in Tissue	Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at <60 deg. C.

TI-WET-CCMS-MID-VA	Tissue	Ti in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-701631

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2279917-COFC

COC Number: 17 - 701631

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Turnaround Time (TAT) Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Dillon Consulting Limited	Select Report Format: [X] PDF [X] EXCEL [ ] EDD (DIGITAL)	Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Jacqueline Huard	Quality Control (QC) Report with Report [X] YES [ ] NO	PRIORITY (Business Days): 4 day [P4-20%] [ ] / 3 day [P3-25%] [ ] / 2 day [P2-50%] [ ]
Phone:	778 678 0637	[ ] Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E-100%] [ ] / Same Day, Weekend or Statutory holiday [E2-200%] (Laboratory opening fees may apply)] [ ]
	Company address below will appear on the final report	Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
Street:	3320 Cessna Drive	Email 1 or Fax: jhuard@dillon.ca	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Richmond BC	Email 2: LDillege@dillon.ca	
Postal Code:	V7B 0A2	Email 3: RPope@dillon.ca	
Invoice To	Same as Report To [X] YES [ ] NO	**Invoice Distribution**	
	Copy of Invoice with Report [X] YES [ ] NO	Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX	
Company:	D.llon	Email 1 or Fax: Salmeida@dillon.ca	
Contact:		Email 2:	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Jasmeen	Sampler: JRH

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals in tissues	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	~~Metals in tissues~~ CSF-WL7-19	09-May-19	1200	Eggs	X			1
	WF-WL15-19	09-May-19	1345	"	X			1
	CSF-WL4.1-19	21-May-19	1400	"	X			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? [ ] YES [X] NO	
Are samples for human consumption/ use? [ ] YES [X] NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	[ ]	SIF Observations	Yes [ ]	No	[ ]
Ice Packs [ ]	Ice Cubes [ ]	Custody seal intact	Yes [ ]	No	[ ]
Cooling Initiated [ ]					

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: <Original signed by>	Date: May 27, 2019	Time:	Received by:	Date:	Time:	Received by: HA	Date: 5/27	Time: 7:40P

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Appendix F

Water Quality Data

DILLON CONSULTING

							Sample Date	2018-05-05	2018-05-05	2018-05-08	2018-05-09
							Location Code	18-WF-WL9B	18-WL9	18-WF-10	18-CSF-07
							2019 Location Name	15	17	13	4
							Lab Report Number	B835235	B835235	B835678	B835678
Chemical Group	Chemical Name	Units	EQL	BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term				
General Chemistry	Bicarbonate	mg/L	1					317	297	238	166
	Carbonate	mg/L	1					7.8	6.7	<1	<1
	Hydroxide	mg/L	1					<1	<1	<1	<1
	Alkalinity (total) as CaCO3	mg/L	1					273	255	195	136
	Phenolphthalein Alkalinity	mg/L	1					6.5	5.6	<1	<1
	Ammonia	mg/L	0.02			Range*		0.11	0.074	0.048	<0.02
	Ammonia (as N)	mg/L	0.005	Range*				-	-	-	-
	Nitrate (as N)	mg/L	0.005	32.8				<0.02	<0.02	<0.02	0.241
	Nitrate (as N) (Filtered)	mg/L	0.01	32.8				-	-	-	-
	Nitrate (as NO3-) (Filtered)	mg/L	0.044			13	550	-	-	-	-
	Nitrate + Nitrite (as N)	mg/L	0.0051					<0.02	<0.02	<0.02	0.241
	Nitrite (as N)	mg/L	0.001	Range*				<0.005	<0.005	<0.005	<0.005
	Nitrite (as N) (Filtered)	mg/L	0.01	Range*				-	-	-	-
	Nitrite (as NO2-) (Filtered)	mg/L	0.033			0.197		-	-	-	-
	Phosphorus	mg/L	0.002					0.0175	0.0388	0.11	0.0229
	Ortho Phosphorus (as P)	mg/L	0.003					0.0078	0.0134	0.0454	<0.005
	Ortho Phosphorus (as P) (Filtered)	mg/L	0.001					-	-	-	-
	Electrical conductivity (lab)	µS/cm	2					806	735	358	286
	Chloride	mg/L	0.5	600		120	640	-	-	-	-
	Chloride (Filtered)	mg/L	1	600		120	640	4.9	2.4	1.6	<1
	Fluoride	mg/L	0.02	Range*		0.12		0.23	0.19	0.27	0.13
	Bromide	mg/L	0.05					-	-	-	-
	Bromide (Filtered)	mg/L	0.01					0.035	0.026	<0.01	<0.01
	Dissolved Organic Carbon (Filtered)	mg/L	0.5					17.2	13.7	13.4	2.86
	Total Organic Carbon (TOC)	mg/L	0.5					18.2	15	15.9	1.81
	pH (Lab)	pH Unit	0.1			6.5-9		8.41	8.41	8.24	8.23
	Sulphate (SO4)	mg/L	0.3	Range*				-	-	-	-
	Sulphate (SO4) (Filtered)	mg/L	1	Range*				183	157	<1	17.1
	Hardness, Total	mg/L	0.5					403	364	189	145
	Total Suspended Solids (TSS)	mg/L	1					3	7.4	4	2.5
	Turbidity	NTU	0.1					1.56	1.48	1.69	0.97
Calculated Parameters	Alkalinity (Bicarbonate as CaCO3)	mg/L	1					-	-	-	-
	Alkalinity (Carbonate as CaCO3)	mg/L	1					-	-	-	-
	Hardness (as CaCO3)	mg/L	0.5					-	-	-	-
	Hardness (as CaCO3) (Filtered)	mg/L	0.5					429	393	183	151
	Alkalinity (Hydroxide) as CaCO3	mg/L	1					-	-	-	-
	1-Methylnaphthalene	mg/L	0.00005					<0.00005	<0.00005	<0.00005	<0.00005
	2-Methylnaphthalene	mg/L	0.00002					<0.0001	<0.0001	<0.0001	<0.0001
	Acenaphthene	mg/L	0.00001	0.006		0.0058		<0.00005	<0.00005	<0.00005	<0.00005

						Sample Date	2018-05-05	2018-05-05	2018-05-08	2018-05-09
						Location Code	18-WF-WL9B	18-WL9	18-WF-10	18-CSF-07
						2019 Location Name	15	17	13	4
						Lab Report Number	B835235	B835235	B835678	B835678
Chemical Group	Chemical Name	Units	EQL	BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term			
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthylene	mg/L	0.00001					<0.00005	<0.00005	<0.00005	<0.00005
	Acridine	mg/L	0.00001	0.003		0.0044		<0.00005	<0.00005	<0.00005	<0.00005
	Anthracene	mg/L	0.00001	0.004		0.000012		<0.00001	<0.00001	<0.00001	<0.00001
	Benzo(a)anthracene	mg/L	0.00001	0.0001		0.000018		<0.00001	<0.00001	<0.00001	<0.00001
	Benzo(a) pyrene	mg/L	0.000005	0.00001		0.000015		<0.000005	<0.000005	<0.000005	<0.000005
	Benzo(b+j)fluoranthene	mg/L	0.00001					<0.00003	<0.00003	<0.00003	<0.00003
	Benzo(g,h,i)perylene	mg/L	0.00001					<0.00005	<0.00005	<0.00005	<0.00005
	Benzo(k)fluoranthene	mg/L	0.00001					<0.00005	<0.00005	<0.00005	<0.00005
	Chrysene	mg/L	0.00001					<0.00002	<0.00002	<0.00002	<0.00002
	Dibenz(a,h)anthracene	mg/L	0.000003					<0.000003	<0.000003	<0.000003	<0.000003
	Fluoranthene	mg/L	0.00001	0.004		0.00004		<0.00002	<0.00002	<0.00002	<0.00002
	Fluorene	mg/L	0.00001	0.012		0.003		<0.00005	<0.00005	<0.00005	<0.00005
	Indeno(1,2,3-c,d)pyrene	mg/L	0.00001					<0.00005	<0.00005	<0.00005	<0.00005
	Naphthalene	mg/L	0.00002	0.001		0.0011		<0.0001	<0.0001	<0.0001	<0.0001
	Phenanthrene	mg/L	0.00002	0.0003		0.0004		<0.00005	<0.00005	<0.00005	<0.00005
	Pyrene	mg/L	0.00001	0.00002		0.000025		<0.00002	<0.00002	<0.00002	<0.00002
	Quinoline	mg/L	0.00002		0.0034	0.0034		<0.00002	<0.00002	0.000022	<0.00002
	Light Molecular Weight (PAH Sum)	mg/L	0.0001					<0.0001	<0.0001	<0.0001	<0.0001
	Heavy Molecular Weight (PAH Sum)	mg/L	0.00005					<0.00005	<0.00005	<0.00005	<0.00005
	PAHs (Sum of total)	mg/L	0.0001					<0.0001	<0.0001	<0.0001	<0.0001
	Aluminium	mg/L	0.003			0.1		0.0187	0.01	0.0108	0.0127
	Aluminium (Filtered)	mg/L	0.0005	0.05		0.1		0.00463	0.00331	0.0048	0.0048
	Antimony	mg/L	0.00002		0.009			0.000115	0.000109	0.000158	0.000024
	Antimony (Filtered)	mg/L	0.00002		0.009			0.000118	0.000112	0.00015	0.000028
	Arsenic	mg/L	0.00002	0.005		0.005		0.000496	0.000507	0.000575	0.000105
	Barium	mg/L	0.00005		1			0.0956	0.07	0.168	0.0433
	Barium (Filtered)	mg/L	0.00002		1			0.0955	0.0687	0.172	0.0541
	Beryllium	mg/L	0.00001		0.00013			<0.00001	<0.00001	<0.00001	<0.00001
	Beryllium (Filtered)	mg/L	0.00001		0.00013			<0.00001	<0.00001	<0.00001	<0.00001
	Bismuth	mg/L	0.00001					<0.00001	<0.00001	<0.00001	<0.00001
	Bismuth (Filtered)	mg/L	0.000005					<0.000005	<0.000005	<0.000005	<0.000005
	Boron	mg/L	0.01	1.2		1.5	29	0.107	0.092	<0.01	<0.01
	Boron (Filtered)	mg/L	0.01	1.2		1.5	29	0.131	0.109	<0.01	<0.01
	Cadmium (Filtered)	mg/L	0.000005	Range*		Range*	Range*	<0.000005	<0.000005	0.0000281	0.000174
	Calcium	mg/L	0.05					116	103	51.9	38.3
	Calcium (Filtered)	mg/L	0.05					120	108	50.4	41.1
	Chromium Total (III+VI)	mg/L	0.0001		0.0089			<0.0001	<0.0001	<0.0001	0.0002
	Chromium Total (III+VI) (Filtered)	mg/L	0.0001		0.0089			<0.0001	<0.0001	<0.0001	0.00015
	Cobalt	mg/L	0.00001	0.004				0.000104	0.000163	0.000074	0.000017

							Sample Date	2018-05-05	2018-05-05	2018-05-08	2018-05-09
							Location Code	18-WF-WL9B	18-WL9	18-WF-10	18-CSF-07
							2019 Location Name	15	17	13	4
							Lab Report Number	B835235	B835235	B835678	B835678
Chemical Group	Chemical Name	Units	EQL	BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term				
Metals	Cobalt (Filtered)	mg/L	0.000005	0.11				0.0000937	0.0000999	0.0000687	0.0000283
	Copper	mg/L	0.0001	Range*		0.002		0.00038	0.00024	0.00102	0.0003
	Copper (Filtered)	mg/L	0.00005	0.002		0.002		0.000405	0.00017	0.000976	0.000174
	Iron	mg/L	0.005	1		0.3		0.0695	0.212	0.0324	0.0341
	Iron (Filtered)	mg/L	0.001	0.35		0.3		0.0542	0.0944	0.025	0.0228
	Lead	mg/L	0.00002	Range*		Range*		0.000031	0.000031	0.000029	<0.00002
	Lead (Filtered)	mg/L	0.000005	0.003		0.001		0.0000194	0.0000076	0.0000174	0.0000067
	Lithium	mg/L	0.0005		0.87			0.0543	0.0384	0.00374	0.00503
	Lithium (Filtered)	mg/L	0.0005		0.87			0.0613	0.0445	0.00364	0.00477
	Magnesium	mg/L	0.005					27.7	26	14.4	12
	Magnesium (Filtered)	mg/L	0.005					31.3	29.9	13.8	11.8
	Manganese	mg/L	0.0001	Range*				0.00793	0.0692	0.00875	0.005
	Mercury	mg/L	0.000002			0.000026		<0.000002	<0.000002	0.0000021	<0.000002
	Mercury (Filtered)	mg/L	0.000002			0.000026		<0.000002	<0.000002	0.0000026	<0.000002
	Molybdenum	mg/L	0.00005	2		0.073		0.00163	0.00408	0.00128	0.000832
	Molybdenum (Filtered)	mg/L	0.00005	2		0.073		0.00181	0.00424	0.00125	0.000835
	Nickel	mg/L	0.0001		Range*	Range*		0.00055	0.00071	0.00083	0.00014
	Potassium	mg/L	0.05		373			2.84	2.76	1.64	0.48
	Potassium (Filtered)	mg/L	0.05		373			2.84	2.79	1.6	0.747
	Selenium	mg/L	0.00004	0.002		0.001		0.000335	0.000255	0.000383	0.000247
	Selenium (Filtered)	mg/L	0.00004	0.002		0.001		0.000307	0.000258	0.000388	0.000202
	Silicon	mg/L	0.05					10.5	7.51	10.7	2.01
	Silicon (Filtered)	mg/L	0.05					10.5	7.6	10.3	2.88
	Silver	mg/L	0.00001	Range*		Range*		<0.00001	<0.00001	<0.00001	<0.00001
	Silver (Filtered)	mg/L	0.000005	0.0001		0.00025		<0.000005	<0.000005	<0.000005	<0.000005
	Sodium	mg/L	0.05					18	10.8	2.1	1.74
	Sodium (Filtered)	mg/L	0.05					19.9	12.7	2.03	1.83
	Strontium	mg/L	0.00005					1.29	1.01	0.118	0.168
	Strontium (Filtered)	mg/L	0.00005					1.33	1.07	0.118	0.171
	Sulphur (as S)	mg/L	3					53.5	47.9	<3	5.1
	Sulphur (as S) (Filtered)	mg/L	3					57.4	50.4	<3	4.8
	Thallium	mg/L	0.000002		0.0008	0.0008		0.0000034	0.0000032	<0.000002	<0.000002
	Thallium (Filtered)	mg/L	0.000002		0.0008	0.0008		0.0000032	0.0000028	<0.000002	<0.000002
	Tin	mg/L	0.0001					<0.0002	<0.0002	<0.0002	<0.0002
	Tin (Filtered)	mg/L	0.0001					<0.0002	<0.0002	<0.0002	<0.0002
	Titanium	mg/L	0.0003		2			<0.002	<0.002	<0.002	<0.002
	Titanium (Filtered)	mg/L	0.0003		2			<0.0005	<0.0005	<0.0005	<0.0005
	Uranium	mg/L	0.000005		0.0085	0.015	0.033	0.000713	0.000468	0.000422	0.000337
	Uranium (Filtered)	mg/L	0.000002		0.0085	0.015	0.033	0.000758	0.000505	0.000435	0.000322

								Sample Date	2018-05-05	2018-05-05	2018-05-08	2018-05-09
								Location Code	18-WF-WL9B	18-WL9	18-WF-10	18-CSF-07
								2019 Location Name	15	17	13	4
								Lab Report Number	B835235	B835235	B835678	B835678
Chemical Group	Chemical Name	Units	EQL	BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term					
	Vanadium	mg/L	0.0002						<0.0002	<0.0002	0.00048	<0.0002
	Vanadium (Filtered)	mg/L	0.0002						<0.0002	<0.0002	0.00045	<0.0002
	Zinc	mg/L	0.001	Range*		0.03			0.0041	0.0025	0.0019	0.0025
	Zinc (Filtered)	mg/L	0.0001	0.033		Range*			0.017	0.0015	0.00159	0.00424
	Zirconium	mg/L	0.0001						<0.0001	<0.0001	0.00018	<0.0001
	Zirconium (Filtered)	mg/L	0.0001						<0.0001	<0.0001	0.00027	<0.0001

*WQGs are dependent on sample-specific parameters. See Appendix G for WQG calculations.

							Sample Date	2018-07-04	2019-05-09	2019-05-09	2019-05-21
							Location Code	WET21	WF-WL15-19	CSF-WL17-19	CSF - 4.1-19
							2019 Location Name	15	15	17	4
							Lab Report Number	B855658	L2271768	L2271768	L2278661
Chemical Group	Chemical Name	Units	EQL	BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term				
General Chemistry	Bicarbonate	mg/L	1					404	-	-	-
	Carbonate	mg/L	1					<1	-	-	-
	Hydroxide	mg/L	1					<1	-	-	-
	Alkalinity (total) as CaCO3	mg/L	1					331	249	335	211
	Phenolphthalein Alkalinity	mg/L	1					<1	2.4	4	<2
	Ammonia	mg/L	0.02			Range*		0.042	-	-	-
	Ammonia (as N)	mg/L	0.005	Range*				-	0.0673	0.262	0.0984
	Nitrate (as N)	mg/L	0.005	32.8				-	0.081	<0.025	<0.005
	Nitrate (as N) (Filtered)	mg/L	0.01	32.8				<0.01	-	-	-
	Nitrate (as NO3-) (Filtered)	mg/L	0.044			13	550	<0.044	-	-	-
	Nitrate + Nitrite (as N)	mg/L	0.0051					<0.014	0.081	<0.025	<0.0051
	Nitrite (as N)	mg/L	0.001	Range*				-	<0.005	<0.005	<0.001
	Nitrite (as N) (Filtered)	mg/L	0.01	Range*				<0.01	-	-	-
	Nitrite (as NO2-) (Filtered)	mg/L	0.033			0.197		<0.033	-	-	-
	Phosphorus	mg/L	0.002					0.0107	0.0127	0.0483	0.0155
	Ortho Phosphorus (as P)	mg/L	0.003					0.0069	-	-	-
	Ortho Phosphorus (as P) (Filtered)	mg/L	0.001					-	<0.001	0.0137	0.0019
	Electrical conductivity (lab)	µS/cm	2					750	1010	660	399
	Chloride	mg/L	0.5	600		120	640	-	11.7	<2.5	<0.5
	Chloride (Filtered)	mg/L	1	600		120	640	5.6	-	-	-
	Fluoride	mg/L	0.02	Range*		0.12		0.26	0.21	0.23	0.11
	Bromide	mg/L	0.05					-	<0.25	<0.25	<0.05
	Bromide (Filtered)	mg/L	0.01					<0.01	-	-	-
	Dissolved Organic Carbon (Filtered)	mg/L	0.5					24	25	21.2	10.1
	Total Organic Carbon (TOC)	mg/L	0.5					24	25.2	21.7	10.5
	pH (Lab)	pH Unit	0.1			6.5-9		8.06	8.35	8.37	8.16
	Sulphate (SO4)	mg/L	0.3	Range*				-	332	128	9.43
	Sulphate (SO4) (Filtered)	mg/L	1	Range*				103	-	-	-
	Hardness, Total	mg/L	0.5					402	-	-	-
	Total Suspended Solids (TSS)	mg/L	1					<4	<1	5.7	1.6
	Turbidity	NTU	0.1					0.82	0.54	3.26	1.16
Calculated Parameters	Alkalinity (Bicarbonate as CaCO3)	mg/L	1					-	244	327	211
	Alkalinity (Carbonate as CaCO3)	mg/L	1					-	4.8	8	<1
	Hardness (as CaCO3)	mg/L	0.5					-	529	424	204
	Hardness (as CaCO3) (Filtered)	mg/L	0.5					411	-	-	-
	Alkalinity (Hydroxide) as CaCO3	mg/L	1					-	<1	<1	<1
	1-Methylnaphthalene	mg/L	0.00005					<0.00005	<0.00005	<0.00005	<0.00005
	2-Methylnaphthalene	mg/L	0.00002					<0.0001	<0.00002	<0.00002	<0.00002
	Acenaphthene	mg/L	0.00001	0.006		0.0058		<0.00005	<0.00001	<0.00001	<0.00001

							Sample Date	2018-07-04	2019-05-09	2019-05-09	2019-05-21
							Location Code	WET21	WF-WL15-19	CSF-WL17-19	CSF - 4.1-19
							2019 Location Name	15	15	17	4
							Lab Report Number	B855658	L2271768	L2271768	L2278661
Chemical Group	Chemical Name	Units	EQL	BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term				
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthylene	mg/L	0.00001					<0.00005	<0.00001	<0.00001	<0.00001
	Acridine	mg/L	0.00001	0.003		0.0044		<0.00005	<0.00001	<0.00001	<0.00001
	Anthracene	mg/L	0.00001	0.004		0.000012		<0.00001	<0.00001	<0.00001	<0.00001
	Benzo(a)anthracene	mg/L	0.00001	0.0001		0.000018		<0.00001	<0.00001	<0.00001	<0.00001
	Benzo(a) pyrene	mg/L	0.000005	0.00001		0.000015		<0.000005	<0.000005	<0.000005	<0.000005
	Benzo(b+j)fluoranthene	mg/L	0.00001					<0.00003	<0.00001	<0.00001	<0.00001
	Benzo(g,h,i)perylene	mg/L	0.00001					<0.00005	<0.00001	<0.00001	<0.00001
	Benzo(k)fluoranthene	mg/L	0.00001					<0.00005	<0.00001	<0.00001	<0.00001
	Chrysene	mg/L	0.00001					<0.00002	<0.00001	<0.00001	<0.00001
	Dibenz(a,h)anthracene	mg/L	0.000003					<0.000003	<0.000005	<0.000005	<0.000005
	Fluoranthene	mg/L	0.00001	0.004		0.00004		<0.00002	<0.00001	<0.00001	<0.00001
	Fluorene	mg/L	0.00001	0.012		0.003		<0.00005	<0.00001	<0.00001	<0.00001
	Indeno(1,2,3-c,d)pyrene	mg/L	0.00001					<0.00005	<0.00001	<0.00001	<0.00001
	Naphthalene	mg/L	0.00002	0.001		0.0011		<0.0001	<0.00002	<0.00002	<0.00002
	Phenanthrene	mg/L	0.00002	0.0003		0.0004		<0.00005	<0.00002	<0.00002	<0.00002
	Pyrene	mg/L	0.00001	0.00002		0.000025		<0.00002	<0.00001	<0.00001	<0.00001
	Quinoline	mg/L	0.00002		0.0034	0.0034		<0.00002	<0.00005	<0.00005	<0.00005
	Light Molecular Weight (PAH Sum)	mg/L	0.0001					<0.0001	-	-	-
	Heavy Molecular Weight (PAH Sum)	mg/L	0.00005					<0.00005	-	-	-
	PAHs (Sum of total)	mg/L	0.0001					<0.0001	-	-	-
	Aluminium	mg/L	0.003			0.1		0.0065	<0.015	<0.015	0.0032
	Aluminium (Filtered)	mg/L	0.0005	0.05		0.1		0.0044	0.0073	<0.005	0.0012
	Antimony	mg/L	0.00002		0.009			<0.0005	<0.0005	<0.0005	<0.0001
	Antimony (Filtered)	mg/L	0.00002		0.009			<0.0005	<0.0005	<0.0005	<0.0001
	Arsenic	mg/L	0.00002	0.005		0.005		0.00047	0.0005	0.00084	0.00032
	Barium	mg/L	0.00005		1			0.0642	0.0854	0.0704	0.0848
	Barium (Filtered)	mg/L	0.00002		1			0.0643	0.0894	0.0742	0.0774
	Beryllium	mg/L	0.00001		0.00013			<0.0001	<0.0005	<0.0005	<0.0001
	Beryllium (Filtered)	mg/L	0.00001		0.00013			<0.0001	<0.0005	<0.0005	<0.0001
	Bismuth	mg/L	0.00001					<0.001	-	-	-
	Bismuth (Filtered)	mg/L	0.000005					<0.001	-	-	-
	Boron	mg/L	0.01	1.2		1.5	29	0.133	0.12	0.074	0.013
	Boron (Filtered)	mg/L	0.01	1.2		1.5	29	0.127	0.124	0.073	0.015
	Cadmium (Filtered)	mg/L	0.000005	Range*		Range*	Range*	<0.00001	<0.000025	<0.000025	<0.000005
	Calcium	mg/L	0.05					112	141	116	71.5
	Calcium (Filtered)	mg/L	0.05					114	148	118	59
	Chromium Total (III+VI)	mg/L	0.0001		0.0089			<0.001	<0.0005	<0.0005	0.00013
	Chromium Total (III+VI) (Filtered)	mg/L	0.0001		0.0089			<0.001	<0.0005	<0.0005	0.00017
	Cobalt	mg/L	0.00001	0.004				<0.0002	<0.0005	0.00054	0.00015

						Sample Date	2018-07-04	2019-05-09	2019-05-09	2019-05-21
						Location Code	WET21	WF-WL15-19	CSF-WL17-19	CSF - 4.1-19
						2019 Location Name	15	15	17	4
						Lab Report Number	B855658	L2271768	L2271768	L2278661
Chemical Group	Chemical Name	Units	EQL	BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term				
Metals	Cobalt (Filtered)	mg/L	0.000005	0.11				<0.0002	<0.0005	0.00056	0.00013
	Copper	mg/L	0.0001	Range*		0.002		<0.0005	<0.0025	<0.0025	<0.0005
	Copper (Filtered)	mg/L	0.00005	0.002		0.002		0.00031	<0.001	<0.001	<0.0002
	Iron	mg/L	0.005	1		0.3		0.061	<0.05	0.908	0.669
	Iron (Filtered)	mg/L	0.001	0.35		0.3		0.0575	<0.05	0.413	0.348
	Lead	mg/L	0.00002	Range*		Range*		<0.0002	0.00035	<0.00025	<0.00005
	Lead (Filtered)	mg/L	0.000005	0.003		0.001		<0.0002	<0.00025	<0.00025	<0.00005
	Lithium	mg/L	0.0005		0.87			0.0687	0.064	0.0349	0.0057
	Lithium (Filtered)	mg/L	0.0005		0.87			0.065	0.0659	0.0357	0.0069
	Magnesium	mg/L	0.005					29.9	38.3	32	16.4
	Magnesium (Filtered)	mg/L	0.005					30.6	38.4	31.5	13.8
	Manganese	mg/L	0.0001	Range*				0.0036	0.00209	0.124	0.227
	Mercury	mg/L	0.000002			0.000026		<0.000002	<0.000025	<0.000025	<0.000005
	Mercury (Filtered)	mg/L	0.000002			0.000026		<0.000002	<0.000025	<0.000025	<0.000005
	Molybdenum	mg/L	0.00005	2		0.073		<0.001	0.00375	0.00568	0.000892
	Molybdenum (Filtered)	mg/L	0.00005	2		0.073		<0.001	0.00394	0.0059	0.000835
	Nickel	mg/L	0.0001		Range*	Range*		<0.001	<0.0025	<0.0025	<0.0005
	Potassium	mg/L	0.05		373			2.2	2.75	2.15	0.814
	Potassium (Filtered)	mg/L	0.05		373			2.37	2.83	2.19	0.744
	Selenium	mg/L	0.00004	0.002		0.001		0.00055	0.00031	<0.00025	0.000081
	Selenium (Filtered)	mg/L	0.00004	0.002		0.001		0.00053	<0.00025	<0.00025	0.000115
	Silicon	mg/L	0.05					7.53	-	-	-
	Silicon (Filtered)	mg/L	0.05					7.93	-	-	-
	Silver	mg/L	0.00001	Range*		Range*		<0.00002	<0.00005	<0.00005	<0.00001
	Silver (Filtered)	mg/L	0.000005	0.0001		0.00025		<0.00002	<0.00005	<0.00005	<0.00001
	Sodium	mg/L	0.05					16.4	19	13.4	2.68
	Sodium (Filtered)	mg/L	0.05					17.4	19.3	12.7	2.49
	Strontium	mg/L	0.00005					1.13	-	-	-
	Strontium (Filtered)	mg/L	0.00005					1.11	-	-	-
	Sulphur (as S)	mg/L	3					28.8	-	-	-
	Sulphur (as S) (Filtered)	mg/L	3					31.1	-	-	-
	Thallium	mg/L	0.000002		0.0008	0.0008		<0.00001	<0.00005	<0.00005	<0.00001
	Thallium (Filtered)	mg/L	0.000002		0.0008	0.0008		<0.00001	<0.00005	<0.00005	<0.00001
	Tin	mg/L	0.0001					<0.005	<0.0005	<0.0005	<0.0001
	Tin (Filtered)	mg/L	0.0001					<0.005	<0.0005	<0.0005	<0.0001
	Titanium	mg/L	0.0003		2			<0.005	<0.0015	<0.0015	<0.0003
	Titanium (Filtered)	mg/L	0.0003		2			<0.005	<0.0015	<0.0015	<0.0003
	Uranium	mg/L	0.000005		0.0085	0.015	0.033	0.0003	0.00197	0.000662	0.000299
	Uranium (Filtered)	mg/L	0.000002		0.0085	0.015	0.033	0.00027	0.00198	0.000647	0.000229

							Sample Date	2018-07-04	2019-05-09	2019-05-09	2019-05-21
							Location Code	WET21	WF-WL15-19	CSF-WL17-19	CSF - 4.1-19
							2019 Location Name	15	15	17	4
							Lab Report Number	B855658	L2271768	L2271768	L2278661
Chemical Group	Chemical Name	Units	EQL	BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term				
	Vanadium	mg/L	0.0002					<0.005	<0.0025	<0.0025	<0.0005
	Vanadium (Filtered)	mg/L	0.0002					<0.005	<0.0025	<0.0025	<0.0005
	Zinc	mg/L	0.001	Range*		0.03		<0.005	<0.015	<0.015	<0.003
	Zinc (Filtered)	mg/L	0.0001	0.033		Range*		<0.005	<0.005	<0.005	<0.001
	Zirconium	mg/L	0.0001					<0.0001	-	-	-
	Zirconium (Filtered)	mg/L	0.0001					<0.0001	-	-	-

*WQGs are dependent on sample-specific parameters. See Appendix G for WQG calculations.

				Sample Date							
				Location Code							
				2019 Location Name							
				Lab Report Number							
				BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term	Summary Statistics			
Chemical Group	Chemical Name	Units	EQL					Minimum	Maximum	Average	Standard Deviation
General Chemistry	Bicarbonate	mg/L	1					166	404	284.40	89.019
	Carbonate	mg/L	1					<1	7.8	7.25	0.778
	Hydroxide	mg/L	1					<1	0	-	-
	Alkalinity (total) as CaCO3	mg/L	1					136	335	248.13	67.459
	Phenolphthalein Alkalinity	mg/L	1					<1	6.5	4.63	1.808
	Ammonia	mg/L	0.02			Range*		0.042	0.11	0.07	0.031
	Ammonia (as N)	mg/L	0.005	Range*				0.0673	0.262	0.14	0.105
	Nitrate (as N)	mg/L	0.005	32.8				0.081	0.241	0.16	0.113
	Nitrate (as N) (Filtered)	mg/L	0.01	32.8				<0.01	<0.01	-	-
	Nitrate (as NO3-) (Filtered)	mg/L	0.044			13	550	<0.044	<0.044	-	-
	Nitrate + Nitrite (as N)	mg/L	0.0051					<0.02	0.241	0.16	0.113
	Nitrite (as N)	mg/L	0.001	Range*				<0.001	<0.005	-	-
	Nitrite (as N) (Filtered)	mg/L	0.01	Range*				<0.01	<0.01	-	-
	Nitrite (as NO2-) (Filtered)	mg/L	0.033			0.197		<0.033	<0.033	-	-
	Phosphorus	mg/L	0.002					0.0107	0.11	0.03	0.033
	Ortho Phosphorus (as P)	mg/L	0.003					0.0069	0.0454	0.02	0.018
	Ortho Phosphorus (as P) (Filtered)	mg/L	0.001					0.0019	0.0137	0.01	0.008
	Electrical conductivity (lab)	µS/cm	2					286	1010	625.50	252.762
	Chloride	mg/L	0.5	600		120	640	<0.5	11.7	11.70	-
	Chloride (Filtered)	mg/L	1	600		120	640	<1	5.6	3.63	1.926
	Fluoride	mg/L	0.02	Range*		0.12		0.11	0.27	0.20	0.058
	Bromide	mg/L	0.05					<0.05	<0.25	-	-
	Bromide (Filtered)	mg/L	0.01					<0.01	0.035	0.03	0.006
	Dissolved Organic Carbon (Filtered)	mg/L	0.5					2.86	25	15.93	7.493
	Total Organic Carbon (TOC)	mg/L	0.5					1.81	25.2	16.54	7.711
	pH (Lab)	pH Unit	0.1			6.5-9		8.06	8.41	8.28	0.127
	Sulphate (SO4)	mg/L	0.3	Range*				9.43	332	156.48	163.160
	Sulphate (SO4) (Filtered)	mg/L	1	Range*				<1	183	115.03	73.295
	Hardness, Total	mg/L	0.5					145	403	300.60	123.949
	Total Suspended Solids (TSS)	mg/L	1					<1	7.4	4.03	2.166
	Turbidity	NTU	0.1					0.54	3.26	1.44	0.835
Calculated Parameters	Alkalinity (Bicarbonate as CaCO3)	mg/L	1					211	327	260.67	59.769
	Alkalinity (Carbonate as CaCO3)	mg/L	1					<1	8	6.40	2.263
	Hardness (as CaCO3)	mg/L	0.5					204	529	385.67	165.856
	Hardness (as CaCO3) (Filtered)	mg/L	0.5					151	429	313.40	134.725
	Alkalinity (Hydroxide) as CaCO3	mg/L	1					<1	<1	-	-
	1-Methylnaphthalene	mg/L	0.00005					<0.00005	<0.00005	-	-
	2-Methylnaphthalene	mg/L	0.00002					<0.00002	<0.001	-	-
	Acenaphthene	mg/L	0.00001	0.006		0.0058		<0.00001	<0.00005	-	-

				Sample Date							
				Location Code							
				2019 Location Name							
				Lab Report Number							
				BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term	Summary Statistics			
Chemical Group	Chemical Name	Units	EQL					Minimum	Maximum	Average	Standard Deviation
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthylene	mg/L	0.00001					<0.00001	<0.00005	-	-
	Acridine	mg/L	0.00001	0.003		0.0044		<0.00001	<0.00005	-	-
	Anthracene	mg/L	0.00001	0.004		0.000012		<0.00001	<0.00001	-	-
	Benzo(a)anthracene	mg/L	0.00001	0.0001		0.000018		<0.00001	<0.00001	-	-
	Benzo(a) pyrene	mg/L	0.000005	0.00001		0.000015		<0.000005	<0.000005	-	-
	Benzo(b+j)fluoranthene	mg/L	0.00001					<0.00001	<0.00003	-	-
	Benzo(g,h,i)perylene	mg/L	0.00001					<0.00001	<0.00005	-	-
	Benzo(k)fluoranthene	mg/L	0.00001					<0.00001	<0.00005	-	-
	Chrysene	mg/L	0.00001					<0.00001	<0.00002	-	-
	Dibenz(a,h)anthracene	mg/L	0.000003					<0.000003	<0.000005	-	-
	Fluoranthene	mg/L	0.00001	0.004		0.00004		<0.00001	<0.00002	-	-
	Fluorene	mg/L	0.00001	0.012		0.003		<0.00001	<0.00005	-	-
	Indeno(1,2,3-c,d)pyrene	mg/L	0.00001					<0.00001	<0.00005	-	-
	Naphthalene	mg/L	0.00002	0.001		0.0011		<0.0001	<0.00002	-	-
	Phenanthrene	mg/L	0.00002	0.0003		0.0004		<0.00002	<0.00005	-	-
	Pyrene	mg/L	0.00001	0.00002		0.000025		<0.00001	<0.00002	-	-
	Quinoline	mg/L	0.00002		0.0034	0.0034		<0.00002	0.000022	-	-
	Light Molecular Weight (PAH Sum)	mg/L	0.0001					<0.0001	<0.0001	-	-
	Heavy Molecular Weight (PAH Sum)	mg/L	0.00005					<0.00005	<0.00005	-	-
	PAHs (Sum of total)	mg/L	0.0001					<0.0001	<0.0001	-	-
	Aluminium	mg/L	0.003			0.1		<0.015	0.0187	0.01	0.005
	Aluminium (Filtered)	mg/L	0.0005	0.05		0.1		<0.005	0.0073	0.00435	0.002
	Antimony	mg/L	0.00002		0.009			<0.001	0.000158	0.00010	0.000
	Antimony (Filtered)	mg/L	0.00002		0.009			<0.001	0.00015	0.00010	0.000
	Arsenic	mg/L	0.00002	0.005		0.005		<0.0001	0.00084	0.00048	0.000
	Barium	mg/L	0.00005		1			0.0433	0.168	0.09	0.037
	Barium (Filtered)	mg/L	0.00002		1			0.0541	0.172	0.09	0.037
	Beryllium	mg/L	0.00001		0.00013			<0.00001	<0.005	-	-
	Beryllium (Filtered)	mg/L	0.00001		0.00013			<0.00001	<0.005	-	-
	Bismuth	mg/L	0.00001					<0.00001	<0.001	-	-
	Bismuth (Filtered)	mg/L	0.000005					<0.000005	<0.001	-	-
	Boron	mg/L	0.01	1.2		1.5	29	<0.01	0.133	0.09	0.043
	Boron (Filtered)	mg/L	0.01	1.2		1.5	29	<0.05	0.131	0.10	0.045
	Cadmium (Filtered)	mg/L	0.000005	Range*		Range*	Range*	<0.000005	0.000174	0.0001	0.000
	Calcium	mg/L	0.05					38.3	141	93.71	35.782
	Calcium (Filtered)	mg/L	0.05					41.1	148	94.81	39.066
	Chromium Total (III+VI)	mg/L	0.0001		0.0089			<0.0001	0.0002	0.0002	0.000
	Chromium Total (III+VI) (Filtered)	mg/L	0.0001		0.0089			<0.0001	0.00017	0.0002	0.000
	Cobalt	mg/L	0.00001	0.004				<0.0002	0.00054	0.0002	0.000

				Sample Date				Summary Statistics			
				Location Code							
				2019 Location Name							
				Lab Report Number							
Chemical Group	Chemical Name	Units	EQL	BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term	Minimum	Maximum	Average	Standard Deviation
Metals	Cobalt (Filtered)	mg/L	0.000005	0.11				<0.0002	0.00056	0.0002	0.000
	Copper	mg/L	0.0001	Range*		0.002		<0.0005	0.00102	0.0005	0.000
	Copper (Filtered)	mg/L	0.00005	0.002		0.002		<0.0002	0.000976	0.0004	0.000
	Iron	mg/L	0.005	1		0.3		<0.01	0.908	0.28	0.357
	Iron (Filtered)	mg/L	0.001	0.35		0.3		0.0063	0.413	0.14	0.164
	Lead	mg/L	0.00002	Range*		Range*		<0.00002	0.00035	0.00011	0.000
	Lead (Filtered)	mg/L	0.000005	0.003		0.001		<0.00005	0.0000194	0.00001	0.000
	Lithium	mg/L	0.0005		0.87			0.00503	0.0687	0.03	0.027
	Lithium (Filtered)	mg/L	0.0005		0.87			0.00477	0.0659	0.04	0.028
	Magnesium	mg/L	0.005					12	38.3	24.59	9.351
	Magnesium (Filtered)	mg/L	0.005					11.8	38.4	25.14	10.295
	Manganese	mg/L	0.0001	Range*				0.00209	0.227	0.06	0.082
	Mercury	mg/L	0.000002			0.000026		<0.000002	0.0000021	0.000002	-
	Mercury (Filtered)	mg/L	0.000002			0.000026		<0.000002	0.0000026	0.000003	-
	Molybdenum	mg/L	0.00005	2		0.073		<0.001	0.00568	0.0026	0.002
	Molybdenum (Filtered)	mg/L	0.00005	2		0.073		<0.001	0.0059	0.0027	0.002
	Nickel	mg/L	0.0001		Range*	Range*		<0.001	0.00083	0.0006	0.000
	Potassium	mg/L	0.05		373			0.48	2.84	1.95	0.905
	Potassium (Filtered)	mg/L	0.05		373			0.744	2.84	2.01	0.886
	Selenium	mg/L	0.00004	0.002		0.001		<0.00025	0.00055	0.0003	0.000
	Selenium (Filtered)	mg/L	0.00004	0.002		0.001		0.00012	0.00053	0.0003	0.000
	Silicon	mg/L	0.05					2.01	10.7	7.65	3.510
	Silicon (Filtered)	mg/L	0.05					2.29	10.5	7.84	3.074
	Silver	mg/L	0.00001	Range*		Range*		<0.00001	<0.00005	-	-
	Silver (Filtered)	mg/L	0.000005	0.0001		0.00025		<0.000005	<0.00002	-	-
	Sodium	mg/L	0.05					1.74	19	10.52	7.370
	Sodium (Filtered)	mg/L	0.05					1.83	19.9	11.04	7.854
	Strontium	mg/L	0.00005					0.168	1.13	0.74	0.557
	Strontium (Filtered)	mg/L	0.00005					0.171	1.11	0.76	0.571
	Sulphur (as S)	mg/L	3					<3	47.9	33.83	21.875
	Sulphur (as S) (Filtered)	mg/L	3					<3	50.4	35.93	23.542
	Thallium	mg/L	0.000002		0.0008	0.0008		<0.000002	0.0000032	0.0000033	0.00000014
	Thallium (Filtered)	mg/L	0.000002		0.0008	0.0008		<0.000002	0.0000028	0.0000030	0.00000028
	Tin	mg/L	0.0001					<0.00002	<0.0002	-	-
	Tin (Filtered)	mg/L	0.0001					<0.0001	<0.0002	-	-
	Titanium	mg/L	0.0003		2			<0.003	<0.002	-	-
	Titanium (Filtered)	mg/L	0.0003		2			<0.0005	<0.0005	-	-
	Uranium	mg/L	0.000005		0.0085	0.015	0.033	0.000299	0.000468	0.0006	0.001
	Uranium (Filtered)	mg/L	0.000002		0.0085	0.015	0.033	0.000229	0.000505	0.0006	0.001

				Sample Date							
				Location Code							
				2019 Location Name							
				Lab Report Number							
				BC WQG Approved - Fresh Water Aquatic Life	BC WQG Working - Fresh Water Aquatic Life	CWQG Aquatic Life Freshwater - Long Term	CWQG Aquatic Life Freshwater - Short Term	Summary Statistics			
Chemical Group	Chemical Name	Units	EQL					Minimum	Maximum	Average	Standard Deviation
	Vanadium	mg/L	0.0002					<0.0002	<0.0002	0.0005	-
	Vanadium (Filtered)	mg/L	0.0002					<0.0002	<0.0002	0.0005	-
	Zinc	mg/L	0.001	Range*		0.03		<0.003	0.0025	0.0028	0.001
	Zinc (Filtered)	mg/L	0.0001	0.033		Range*		<0.001	0.0015	0.0061	0.007
	Zirconium	mg/L	0.0001					<0.0001	<0.0001	0.0002	-
	Zirconium (Filtered)	mg/L	0.0001					<0.0001	<0.0001	0.0003	-

*WQGs are dependent on sample-specific parameters. See Appendix G for WQG calculations.

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your Project #: 126231
Site#: Crown Mountain
Your C.O.C. #: 552776-01-01

Attention: Jacqueline Huard

DILLON CONSULTING LTD.
510 - 3820 CESSNA DRIVE
Richmond, BC
CANADA V7B 0A2

Report Date: 2018/05/16
Report #: R2555339
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B835235
Received: 2018/05/09, 08:30

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	2	2018/05/12	2018/05/13	BBY6SOP-00026	SM 22 2320 B m
Bromide by IC (1)	2	N/A	2018/05/11	AB SOP-00052	SM 22 4110 B m
Chloride by Automated Colourimetry	2	N/A	2018/05/10	BBY6SOP-00011	SM 22 4500-Cl- E m
Carbon (DOC) - field filtered/preserved (2)	2	N/A	2018/05/14	BBY6SOP-00003	SM 22 5310 C m
Conductance - water	2	2018/05/12	2018/05/13	BBY6SOP-00026	SM 22 2510 B m
Fluoride	2	N/A	2018/05/10	BBY6SOP-00048	SM 22 4500-F C m
Hardness Total (calculated as CaCO3) (3)	2	N/A	2018/05/12	BBY WI-00033	Auto Calc
Hardness (calculated as CaCO3)	2	N/A	2018/05/14	BBY WI-00033	Auto Calc
Mercury (Dissolved) by CVAF	2	N/A	2018/05/10	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Mercury (Total) by CVAF	2	2018/05/10	2018/05/10	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	2	N/A	2018/05/14	BBY WI-00033	Auto Calc
Elements by ICPMS Low Level (dissolved)	2	N/A	2018/05/12	BBY7SOP-00002	EPA 6020b R2 m
Elements by ICPMS Digested LL (total)	2	2018/05/11	2018/05/12	BBY7SOP-00003,	EPA 6020b R2 m
Na, K, Ca, Mg, S by CRC ICPMS (total)	2	N/A	2018/05/12	BBY WI-00033	Auto Calc
Ammonia-N (Preserved)	2	N/A	2018/05/14	BBY6SOP-00009	EPA 350.1 m
Nitrate + Nitrite (N)	2	N/A	2018/05/10	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrite (N) by CFA	2	N/A	2018/05/10	BBY6SOP-00010	SM 22 4500-NO3- I m
Nitrogen - Nitrate (as N)	1	N/A	2018/05/10	BBY WI-00033	Auto Calc
Nitrogen - Nitrate (as N)	1	N/A	2018/05/11	BBY WI-00033	Auto Calc
PAH in Water by GC/MS (SIM)	2	2018/05/14	2018/05/14	BBY8SOP-00021	BCMOE BCLM Jul2017m
Total LMW, HMW, Total PAH Calc (4)	2	N/A	2018/05/15	BBY WI-00033	Auto Calc
Filter and HNO3 Preserve for Metals	2	N/A	2018/05/12	BBY7 WI-00004	BCMOE Reqs 08/14
pH Water (5)	2	2018/05/12	2018/05/13	BBY6SOP-00026	SM 22 4500-H+ B m
Orthophosphate by Konelab	2	N/A	2018/05/10	BBY6SOP-00013	SM 22 4500-P E m
Sulphate by Automated Colourimetry	2	N/A	2018/05/11	BBY6SOP-00017	SM 22 4500-SO42- E m
Carbon (Total Organic) (6)	2	N/A	2018/05/14	BBY6SOP-00003	SM 22 5310 C m
Total Phosphorus	2	N/A	2018/05/15	BBY6SOP-00013	SM 22 4500-P E m
Total Suspended Solids-Low Level	2	2018/05/11	2018/05/12	BBY6SOP-00034	SM 22 2540 D
Turbidity	2	N/A	2018/05/09	BBY6SOP-00027	SM 22 2130 B m

Remarks:

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: 126231
Site#: Crown Mountain
Your C.O.C. #: 552776-01-01

Attention: Jacqueline Huard

DILLON CONSULTING LTD.
510 - 3820 CESSNA DRIVE
Richmond, BC
CANADA V7B 0A2

Report Date: 2018/05/16
Report #: R2555339
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B835235
Received: 2018/05/09, 08:30

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

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Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
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Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Calgary Environmental
(2) DOC present in the sample should be considered as non-purgeable DOC.
(3) "Total Hardness" was calculated from Total Ca and Mg concentrations and may be biased high (Hardness, or Dissolved Hardness, calculated from Dissolved Ca and Mg, should be used for compliance if available).
(4) Total PAHs in Water include: Quinoline, Naphthalene, 1-Methylnaphthalene, 2-Methylnaphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Acridine, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b&j)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, and Benzo(g,h,i)perylene.
(5) The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.
(6) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Maxxam
16 May 2018 16:24:44

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Nahed Amer, Project Manager
Email: NAmer@maxxam.ca
Phone# (604) 734 7276

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Your Project #: 126231
Site#: Crown Mountain
Your C.O.C. #: 552776-01-01

Attention: Jacqueline Huard

DILLON CONSULTING LTD.
510 - 3820 CESSNA DRIVE
Richmond, BC
CANADA V7B 0A2

Report Date: 2018/05/16
Report #: R2555339
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B835235
Received: 2018/05/09, 08:30

signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam Job #: B835235
Report Date: 2018/05/16

DILLON CONSULTING LTD.
Client Project #: 126231

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		TK0833		TK0834		
Sampling Date		2018/05/05 15:30		2018/05/05 17:00		
COC Number		552776-01-01		552776-01-01		
	UNITS	18-WF-WL9B	QC Batch	18-WL9	RDL	QC Batch
ANIONS						
Nitrite (N)	mg/L	<0.0050	8985631	<0.0050	0.0050	8985607
Calculated Parameters						
Nitrate (N)	mg/L	<0.020	8983367	<0.020	0.020	8983367
Misc. Inorganics						
Fluoride (F)	mg/L	0.230	8985399	0.190	0.020	8985399
Dissolved Organic Carbon (C)	mg/L	17.2	8988904	13.7	0.50	8988904
Alkalinity (Total as CaCO3)	mg/L	273	8987650	255	1.0	8987650
Total Organic Carbon (C)	mg/L	18.2	8988905	15.0	0.50	8988905
Alkalinity (PP as CaCO3)	mg/L	6.5	8987650	5.6	1.0	8987650
Bicarbonate (HCO3)	mg/L	317	8987650	297	1.0	8987650
Carbonate (CO3)	mg/L	7.8	8987650	6.7	1.0	8987650
Hydroxide (OH)	mg/L	<1.0	8987650	<1.0	1.0	8987650
Anions						
Dissolved Bromide (Br)	mg/L	0.035	8987008	0.026	0.010	8987008
Dissolved Sulphate (SO4)	mg/L	183	8987790	157	1.0	8987790
Dissolved Chloride (Cl)	mg/L	4.9	8986711	2.4	1.0	8986711
Nutrients						
Orthophosphate (P)	mg/L	0.0078	8985852	0.0134	0.0050	8985852
Total Ammonia (N)	mg/L	0.11	8989303	0.074	0.020	8989303
Nitrate plus Nitrite (N)	mg/L	<0.020	8985630	<0.020	0.020	8985604
Total Phosphorus (P)	mg/L	0.0175	8990239	0.0388	0.0050	8990239
Physical Properties						
Conductivity	uS/cm	806	8987648	735	2.0	8987648
pH	pH	8.41	8987647	8.41		8987647
Physical Properties						
Total Suspended Solids	mg/L	3.0	8985182	7.4	1.0	8985182
Turbidity	NTU	1.56	8984306	1.48	0.10	8984306
RDL = Reportable Detection Limit						

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Maxxam Job #: B835235
Report Date: 2018/05/16

DILLON CONSULTING LTD.
Client Project #: 126231

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		TK0833	TK0834		
Sampling Date		2018/05/05 15:30	2018/05/05 17:00		
COC Number		552776-01-01	552776-01-01		
	UNITS	18-WF-WL9B	18-WL9	RDL	QC Batch
Total Metals by ICPMS					
Total Aluminum (Al)	ug/L	18.7	10.0	3.0	8986003
Total Antimony (Sb)	ug/L	0.115	0.109	0.020	8986003
Total Arsenic (As)	ug/L	0.496	0.507	0.020	8986003
Total Barium (Ba)	ug/L	95.6	70.0	0.050	8986003
Total Beryllium (Be)	ug/L	<0.010	<0.010	0.010	8986003
Total Bismuth (Bi)	ug/L	<0.010	<0.010	0.010	8986003
Total Boron (B)	ug/L	107	92	10	8986003
Total Cadmium (Cd)	ug/L	0.0051	0.0055	0.0050	8986003
Total Chromium (Cr)	ug/L	<0.10	<0.10	0.10	8986003
Total Cobalt (Co)	ug/L	0.104	0.163	0.010	8986003
Total Copper (Cu)	ug/L	0.38	0.24	0.10	8986003
Total Iron (Fe)	ug/L	69.5	212	5.0	8986003
Total Lead (Pb)	ug/L	0.031	0.031	0.020	8986003
Total Lithium (Li)	ug/L	54.3	38.4	0.50	8986003
Total Manganese (Mn)	ug/L	7.93	69.2	0.10	8986003
Total Molybdenum (Mo)	ug/L	1.63	4.08	0.050	8986003
Total Nickel (Ni)	ug/L	0.55	0.71	0.10	8986003
Total Phosphorus (P)	ug/L	27.8	68.3	5.0	8986003
Total Selenium (Se)	ug/L	0.335	0.255	0.040	8986003
Total Silicon (Si)	ug/L	10500	7510	50	8986003
Total Silver (Ag)	ug/L	<0.010	<0.010	0.010	8986003
Total Strontium (Sr)	ug/L	1290	1010	0.050	8986003
Total Thallium (Tl)	ug/L	0.0034	0.0032	0.0020	8986003
Total Tin (Sn)	ug/L	<0.20	<0.20	0.20	8986003
Total Titanium (Ti)	ug/L	<2.0	<2.0	2.0	8986003
Total Uranium (U)	ug/L	0.713	0.468	0.0050	8986003
Total Vanadium (V)	ug/L	<0.20	<0.20	0.20	8986003
Total Zinc (Zn)	ug/L	4.1	2.5	1.0	8986003
Total Zirconium (Zr)	ug/L	<0.10	<0.10	0.10	8986003
RDL = Reportable Detection Limit					

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LOW LEVEL DISSOLVED METALS WITH CV HG (WATER)

Maxxam ID		TK0833	TK0834		
Sampling Date		2018/05/05 15:30	2018/05/05 17:00		
COC Number		552776-01-01	552776-01-01		
	UNITS	18-WF-WL9B	18-WL9	RDL	QC Batch
Calculated Parameters					
Filter and HNO3 Preservation	N/A	FIELD	FIELD		ONSITE
Dissolved Hardness (CaCO3)	mg/L	429	393	0.50	8983013
Elements					
Dissolved Mercury (Hg)	ug/L	<0.0020	<0.0020	0.0020	8984805
Dissolved Metals by ICPMS					
Dissolved Aluminum (Al)	ug/L	4.63	3.31	0.50	8985000
Dissolved Antimony (Sb)	ug/L	0.118	0.112	0.020	8985000
Dissolved Arsenic (As)	ug/L	0.504	0.494	0.020	8985000
Dissolved Barium (Ba)	ug/L	95.5	68.7	0.020	8985000
Dissolved Beryllium (Be)	ug/L	<0.010	<0.010	0.010	8985000
Dissolved Bismuth (Bi)	ug/L	<0.0050	<0.0050	0.0050	8985000
Dissolved Boron (B)	ug/L	131	109	10	8985000
Dissolved Cadmium (Cd)	ug/L	<0.0050	<0.0050	0.0050	8985000
Dissolved Chromium (Cr)	ug/L	<0.10	<0.10	0.10	8985000
Dissolved Cobalt (Co)	ug/L	0.0937	0.0999	0.0050	8985000
Dissolved Copper (Cu)	ug/L	0.405	0.170	0.050	8985000
Dissolved Iron (Fe)	ug/L	54.2	94.4	1.0	8985000
Dissolved Lead (Pb)	ug/L	0.0194	0.0076	0.0050	8985000
Dissolved Lithium (Li)	ug/L	61.3	44.5	0.50	8985000
Dissolved Manganese (Mn)	ug/L	7.01	18.8	0.050	8985000
Dissolved Molybdenum (Mo)	ug/L	1.81	4.24	0.050	8985000
Dissolved Nickel (Ni)	ug/L	0.549	0.654	0.020	8985000
Dissolved Phosphorus (P)	ug/L	14.4	18.6	2.0	8985000
Dissolved Selenium (Se)	ug/L	0.307	0.258	0.040	8985000
Dissolved Silicon (Si)	ug/L	10500	7600	50	8985000
Dissolved Silver (Ag)	ug/L	<0.0050	<0.0050	0.0050	8985000
Dissolved Strontium (Sr)	ug/L	1330	1070	0.050	8985000
Dissolved Thallium (Tl)	ug/L	0.0032	0.0028	0.0020	8985000
Dissolved Tin (Sn)	ug/L	<0.20	<0.20	0.20	8985000
Dissolved Titanium (Ti)	ug/L	<0.50	<0.50	0.50	8985000
Dissolved Uranium (U)	ug/L	0.758	0.505	0.0020	8985000
Dissolved Vanadium (V)	ug/L	<0.20	<0.20	0.20	8985000
RDL = Reportable Detection Limit					

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LOW LEVEL DISSOLVED METALS WITH CV HG (WATER)

Maxxam ID		TK0833	TK0834		
Sampling Date		2018/05/05 15:30	2018/05/05 17:00		
COC Number		552776-01-01	552776-01-01		
	UNITS	18-WF-WL9B	18-WL9	RDL	QC Batch
Dissolved Zinc (Zn)	ug/L	17.0 (1)	1.50	0.10	8985000
Dissolved Zirconium (Zr)	ug/L	<0.10	<0.10	0.10	8985000
Dissolved Calcium (Ca)	mg/L	120	108	0.050	8983008
Dissolved Magnesium (Mg)	mg/L	31.3	29.9	0.050	8983008
Dissolved Potassium (K)	mg/L	2.84	2.79	0.050	8983008
Dissolved Sodium (Na)	mg/L	19.9	12.7	0.050	8983008
Dissolved Sulphur (S)	mg/L	57.4	50.4	3.0	8983008

RDL = Reportable Detection Limit
(1) Dissolved greater than total. Reanalysis yields similar results.

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LOW LEVEL TOTAL METALS WITH CV HG (WATER)

Maxxam ID		TK0833	TK0834		
Sampling Date		2018/05/05 15:30	2018/05/05 17:00		
COC Number		552776-01-01	552776-01-01		
	UNITS	**18-WF-WL9B**	**18-WL9**	**RDL**	**QC Batch**
Calculated Parameters					
Total Hardness (CaCO3)	mg/L	403	364	0.50	8983096
Elements					
Total Mercury (Hg)	ug/L	<0.0020	<0.0020	0.0020	8985145
Total Metals by ICPMS					
Total Calcium (Ca)	mg/L	116	103	0.25	8983450
Total Magnesium (Mg)	mg/L	27.7	26.0	0.25	8983450
Total Potassium (K)	mg/L	2.84	2.76	0.25	8983450
Total Sodium (Na)	mg/L	18.0	10.8	0.25	8983450
Total Sulphur (S)	mg/L	53.5	47.9	3.0	8983450
RDL = Reportable Detection Limit					

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CSR PAH IN WATER BY GC-MS (WATER)

Maxxam ID		TK0833	TK0834		
Sampling Date		2018/05/05 15:30	2018/05/05 17:00		
COC Number		552776-01-01	552776-01-01		
	UNITS	18-WF-WL9B	18-WL9	RDL	QC Batch
Calculated Parameters					
Low Molecular Weight PAH`s	ug/L	<0.10	<0.10	0.10	8983674
High Molecular Weight PAH`s	ug/L	<0.050	<0.050	0.050	8983674
Total PAH	ug/L	<0.10	<0.10	0.10	8983674
Polycyclic Aromatics					
Quinoline	ug/L	<0.020	<0.020	0.020	8988210
Naphthalene	ug/L	<0.10	<0.10	0.10	8988210
1-Methylnaphthalene	ug/L	<0.050	<0.050	0.050	8988210
2-Methylnaphthalene	ug/L	<0.10	<0.10	0.10	8988210
Acenaphthylene	ug/L	<0.050	<0.050	0.050	8988210
Acenaphthene	ug/L	<0.050	<0.050	0.050	8988210
Fluorene	ug/L	<0.050	<0.050	0.050	8988210
Phenanthrene	ug/L	<0.050	<0.050	0.050	8988210
Anthracene	ug/L	<0.010	<0.010	0.010	8988210
Acridine	ug/L	<0.050	<0.050	0.050	8988210
Fluoranthene	ug/L	<0.020	<0.020	0.020	8988210
Pyrene	ug/L	<0.020	<0.020	0.020	8988210
Benzo(a)anthracene	ug/L	<0.010	<0.010	0.010	8988210
Chrysene	ug/L	<0.020	<0.020	0.020	8988210
Benzo(b&j)fluoranthene	ug/L	<0.030	<0.030	0.030	8988210
Benzo(k)fluoranthene	ug/L	<0.050	<0.050	0.050	8988210
Benzo(a)pyrene	ug/L	<0.0050	<0.0050	0.0050	8988210
Indeno(1,2,3-cd)pyrene	ug/L	<0.050	<0.050	0.050	8988210
Dibenz(a,h)anthracene	ug/L	<0.0030	<0.0030	0.0030	8988210
Benzo(g,h,i)perylene	ug/L	<0.050	<0.050	0.050	8988210
Surrogate Recovery (%)					
D10-ANTHRACENE (sur.)	%	90	96		8988210
D8-ACENAPHTHYLENE (sur.)	%	96	98		8988210
D8-NAPHTHALENE (sur.)	%	70	75		8988210
TERPHENYL-D14 (sur.)	%	98	102		8988210
RDL = Reportable Detection Limit					

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Maxxam Job #: B835235
Report Date: 2018/05/16

DILLON CONSULTING LTD.
Client Project #: 126231

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	8.3°C

Sample TK0833 [18-WF-WL9B] : Sample was analyzed past method specified hold time for Turbidity. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.} Sample received past method specified hold time for Turbidity. Sample was analyzed past method specified hold time for Nitrate + Nitrite (N). Sample received past method specified hold time for Nitrate + Nitrite (N). Sample was analyzed past method specified hold time for Nitrite (N) by CFA. Sample received past method specified hold time for Nitrite (N) by CFA. Sample received past method specified hold time for Orthophosphate by Konelab. Sample was analyzed past method specified hold time for Orthophosphate by Konelab.

Sample TK0834 [18-WL9] : Sample was analyzed past method specified hold time for Turbidity. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.} Sample received past method specified hold time for Turbidity. Sample was analyzed past method specified hold time for Nitrate + Nitrite (N). Sample received past method specified hold time for Nitrate + Nitrite (N). Sample was analyzed past method specified hold time for Nitrite (N) by CFA. Sample received past method specified hold time for Nitrite (N) by CFA. Sample received past method specified hold time for Orthophosphate by Konelab. Sample was analyzed past method specified hold time for Orthophosphate by Konelab.

Results relate only to the items tested.

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Maxxam Job #: B835235
Report Date: 2018/05/16

QUALITY ASSURANCE REPORT

DILLON CONSULTING LTD.
Client Project #: 126231

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8988210	D10-ANTHRACENE (sur.)	2018/05/14	88	50 - 140	93	50 - 140	90	%		
8988210	D8-ACENAPHTHYLENE (sur.)	2018/05/14	97	50 - 140	100	50 - 140	99	%		
8988210	D8-NAPHTHALENE (sur.)	2018/05/14	67	50 - 140	69	50 - 140	74	%		
8988210	TERPHENYL-D14 (sur.)	2018/05/14	99	50 - 140	103	50 - 140	100	%		
8984306	Turbidity	2018/05/09			101	80 - 120	<0.10	NTU	2.1	20
8984805	Dissolved Mercury (Hg)	2018/05/10	97	80 - 120	103	80 - 120	<0.0020	ug/L	NC	20
8985000	Dissolved Aluminum (Al)	2018/05/12	93	80 - 120	98	80 - 120	<0.50	ug/L		
8985000	Dissolved Antimony (Sb)	2018/05/12	NC	80 - 120	101	80 - 120	<0.020	ug/L		
8985000	Dissolved Arsenic (As)	2018/05/12	NC	80 - 120	102	80 - 120	<0.020	ug/L	0.17	20
8985000	Dissolved Barium (Ba)	2018/05/12	93	80 - 120	101	80 - 120	<0.020	ug/L		
8985000	Dissolved Beryllium (Be)	2018/05/12	96	80 - 120	99	80 - 120	<0.010	ug/L		
8985000	Dissolved Bismuth (Bi)	2018/05/12	89	80 - 120	100	80 - 120	<0.0050	ug/L		
8985000	Dissolved Boron (B)	2018/05/12	NC	80 - 120	96	80 - 120	<10	ug/L		
8985000	Dissolved Cadmium (Cd)	2018/05/12	93	80 - 120	100	80 - 120	<0.0050	ug/L		
8985000	Dissolved Chromium (Cr)	2018/05/12	90	80 - 120	96	80 - 120	<0.10	ug/L		
8985000	Dissolved Cobalt (Co)	2018/05/12	90	80 - 120	99	80 - 120	<0.0050	ug/L		
8985000	Dissolved Copper (Cu)	2018/05/12	88	80 - 120	96	80 - 120	<0.050	ug/L		
8985000	Dissolved Iron (Fe)	2018/05/12	96	80 - 120	100	80 - 120	<1.0	ug/L		
8985000	Dissolved Lead (Pb)	2018/05/12	90	80 - 120	100	80 - 120	<0.0050	ug/L		
8985000	Dissolved Lithium (Li)	2018/05/12	91	80 - 120	97	80 - 120	<0.50	ug/L		
8985000	Dissolved Manganese (Mn)	2018/05/12	92	80 - 120	99	80 - 120	<0.050	ug/L		
8985000	Dissolved Molybdenum (Mo)	2018/05/12	95	80 - 120	104	80 - 120	<0.050	ug/L		
8985000	Dissolved Nickel (Ni)	2018/05/12	90	80 - 120	101	80 - 120	<0.020	ug/L		
8985000	Dissolved Phosphorus (P)	2018/05/12	96	80 - 120	98	80 - 120	<2.0	ug/L		
8985000	Dissolved Selenium (Se)	2018/05/12	94	80 - 120	99	80 - 120	<0.040	ug/L		
8985000	Dissolved Silicon (Si)	2018/05/12	NC	80 - 120	101	80 - 120	<50	ug/L		
8985000	Dissolved Silver (Ag)	2018/05/12	94	80 - 120	99	80 - 120	<0.0050	ug/L		
8985000	Dissolved Strontium (Sr)	2018/05/12	NC	80 - 120	101	80 - 120	<0.050	ug/L		
8985000	Dissolved Thallium (Tl)	2018/05/12	90	80 - 120	100	80 - 120	<0.0020	ug/L		
8985000	Dissolved Tin (Sn)	2018/05/12	94	80 - 120	99	80 - 120	<0.20	ug/L		
8985000	Dissolved Titanium (Ti)	2018/05/12	94	80 - 120	102	80 - 120	<0.50	ug/L		
8985000	Dissolved Uranium (U)	2018/05/12	90	80 - 120	102	80 - 120	<0.0020	ug/L		

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Maxxam Job #: B835235
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QUALITY ASSURANCE REPORT(CONT'D)

DILLON CONSULTING LTD.
Client Project #: 126231

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8985000	Dissolved Vanadium (V)	2018/05/12	94	80 - 120	100	80 - 120	<0.20	ug/L		
8985000	Dissolved Zinc (Zn)	2018/05/12	92	80 - 120	99	80 - 120	<0.10	ug/L		
8985000	Dissolved Zirconium (Zr)	2018/05/12	97	80 - 120	101	80 - 120	<0.10	ug/L		
8985145	Total Mercury (Hg)	2018/05/10	99	80 - 120	99	80 - 120	<0.0020	ug/L	NC	20
8985182	Total Suspended Solids	2018/05/12			101	80 - 120	<1.0	mg/L		
8985399	Fluoride (F)	2018/05/10	97	80 - 120	102	80 - 120	<0.020	mg/L	0	20
8985604	Nitrate plus Nitrite (N)	2018/05/10	107	80 - 120	106	80 - 120	<0.020	mg/L	3.0	25
8985607	Nitrite (N)	2018/05/10	105	80 - 120	102	80 - 120	<0.0050	mg/L	NC	20
8985630	Nitrate plus Nitrite (N)	2018/05/10	NC	80 - 120	108	80 - 120	<0.020	mg/L	0.18	25
8985631	Nitrite (N)	2018/05/10	104	80 - 120	105	80 - 120	<0.0050	mg/L	1.5	20
8985852	Orthophosphate (P)	2018/05/10	NC	80 - 120	89	80 - 120	<0.0050	mg/L	0.33	20
8986003	Total Aluminum (Al)	2018/05/12	101	80 - 120	94	80 - 120	<3.0	ug/L	1.7	20
8986003	Total Antimony (Sb)	2018/05/12	NC	80 - 120	98	80 - 120	<0.020	ug/L	2.1	20
8986003	Total Arsenic (As)	2018/05/12	NC	80 - 120	99	80 - 120	<0.020	ug/L	0.77	20
8986003	Total Barium (Ba)	2018/05/12	101	80 - 120	99	80 - 120	<0.050	ug/L	1.9	20
8986003	Total Beryllium (Be)	2018/05/12	92	80 - 120	86	80 - 120	<0.010	ug/L	NC	20
8986003	Total Bismuth (Bi)	2018/05/12	95	80 - 120	96	80 - 120	<0.010	ug/L	NC	20
8986003	Total Boron (B)	2018/05/12	NC	80 - 120	85	80 - 120	<10	ug/L	1.4	20
8986003	Total Cadmium (Cd)	2018/05/12	99	80 - 120	97	80 - 120	<0.0050	ug/L	NC	20
8986003	Total Chromium (Cr)	2018/05/12	98	80 - 120	95	80 - 120	<0.10	ug/L	NC	20
8986003	Total Cobalt (Co)	2018/05/12	95	80 - 120	93	80 - 120	<0.010	ug/L	2.6	20
8986003	Total Copper (Cu)	2018/05/12	95	80 - 120	94	80 - 120	<0.10	ug/L	4.4	20
8986003	Total Iron (Fe)	2018/05/12	104	80 - 120	101	80 - 120	<5.0	ug/L	2.2	20
8986003	Total Lead (Pb)	2018/05/12	97	80 - 120	96	80 - 120	<0.020	ug/L	7.6	20
8986003	Total Lithium (Li)	2018/05/12	98	80 - 120	87	80 - 120	<0.50	ug/L	0.34	20
8986003	Total Manganese (Mn)	2018/05/12	99	80 - 120	94	80 - 120	<0.10	ug/L	0.42	20
8986003	Total Molybdenum (Mo)	2018/05/12	107	80 - 120	100	80 - 120	<0.050	ug/L	10	20
8986003	Total Nickel (Ni)	2018/05/12	98	80 - 120	94	80 - 120	<0.10	ug/L	3.7	20
8986003	Total Phosphorus (P)	2018/05/12	104	80 - 120	96	80 - 120	<5.0	ug/L		
8986003	Total Selenium (Se)	2018/05/12	100	80 - 120	97	80 - 120	<0.040	ug/L	3.5	20
8986003	Total Silicon (Si)	2018/05/12	NC	80 - 120	98	80 - 120	<50	ug/L	1.1	20
8986003	Total Silver (Ag)	2018/05/12	97	80 - 120	96	80 - 120	<0.010	ug/L	NC	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8986003	Total Strontium (Sr)	2018/05/12	NC	80 - 120	98	80 - 120	<0.050	ug/L	0.88	20
8986003	Total Thallium (Tl)	2018/05/12	95	80 - 120	95	80 - 120	<0.0020	ug/L	NC	20
8986003	Total Tin (Sn)	2018/05/12	96	80 - 120	97	80 - 120	<0.20	ug/L	NC	20
8986003	Total Titanium (Ti)	2018/05/12	109	80 - 120	98	80 - 120	<2.0	ug/L	NC	20
8986003	Total Uranium (U)	2018/05/12	95	80 - 120	98	80 - 120	<0.0050	ug/L	8.5	20
8986003	Total Vanadium (V)	2018/05/12	101	80 - 120	96	80 - 120	<0.20	ug/L	NC	20
8986003	Total Zinc (Zn)	2018/05/12	94	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
8986003	Total Zirconium (Zr)	2018/05/12	100	80 - 120	99	80 - 120	<0.10	ug/L	NC	20
8986711	Dissolved Chloride (Cl)	2018/05/10	NC	80 - 120	96	80 - 120	<1.0	mg/L	0.61	20
8987008	Dissolved Bromide (Br)	2018/05/11	NC	80 - 120	101	80 - 120	<0.010	mg/L	1.4	20
8987647	pH	2018/05/13			101	97 - 103			0.12	20
8987648	Conductivity	2018/05/13			99	80 - 120	<2.0	uS/cm	0.091	20
8987650	Alkalinity (PP as CaCO3)	2018/05/13					<1.0	mg/L	0.17	20
8987650	Alkalinity (Total as CaCO3)	2018/05/13			88	80 - 120	<1.0	mg/L	0.21	20
8987650	Bicarbonate (HCO3)	2018/05/13					<1.0	mg/L	0.21	20
8987650	Carbonate (CO3)	2018/05/13					<1.0	mg/L	0.17	20
8987650	Hydroxide (OH)	2018/05/13					<1.0	mg/L	NC	20
8987790	Dissolved Sulphate (SO4)	2018/05/11			102	80 - 120	<1.0	mg/L		
8988210	1-Methylnaphthalene	2018/05/14	80	50 - 140	83	50 - 140	<0.050	ug/L		
8988210	2-Methylnaphthalene	2018/05/15	76	50 - 140	80	50 - 140	<0.10	ug/L	NC	40
8988210	Acenaphthene	2018/05/15	90	50 - 140	93	50 - 140	<0.050	ug/L	NC	40
8988210	Acenaphthylene	2018/05/15	89	50 - 140	91	50 - 140	<0.050	ug/L	NC	40
8988210	Acridine	2018/05/15	69	50 - 140	91	50 - 140	<0.050	ug/L	NC	40
8988210	Anthracene	2018/05/15	93	50 - 140	88	50 - 140	<0.010	ug/L	NC	40
8988210	Benzo(a)anthracene	2018/05/15	82	50 - 140	84	50 - 140	<0.010	ug/L	NC	40
8988210	Benzo(a)pyrene	2018/05/15	71	50 - 140	86	50 - 140	<0.0050	ug/L	NC	40
8988210	Benzo(b&j)fluoranthene	2018/05/15	75	50 - 140	89	50 - 140	<0.030	ug/L	NC	40
8988210	Benzo(g,h,i)perylene	2018/05/15	61	50 - 140	86	50 - 140	<0.050	ug/L	NC	40
8988210	Benzo(k)fluoranthene	2018/05/15	78	50 - 140	93	50 - 140	<0.050	ug/L	NC	40
8988210	Chrysene	2018/05/15	87	50 - 140	89	50 - 140	<0.020	ug/L	NC	40
8988210	Dibenz(a,h)anthracene	2018/05/15	66	50 - 140	91	50 - 140	<0.0030	ug/L	NC	40
8988210	Fluoranthene	2018/05/15	85	50 - 140	86	50 - 140	<0.020	ug/L	NC	40

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8988210	Fluorene	2018/05/15	84	50 - 140	87	50 - 140	<0.050	ug/L	NC	40
8988210	Indeno(1,2,3-cd)pyrene	2018/05/15	63	50 - 140	87	50 - 140	<0.050	ug/L	NC	40
8988210	Naphthalene	2018/05/15	64	50 - 140	68	50 - 140	<0.10	ug/L	NC	40
8988210	Phenanthrene	2018/05/15	78	50 - 140	87	50 - 140	<0.050	ug/L	NC	40
8988210	Pyrene	2018/05/15	89	50 - 140	90	50 - 140	<0.020	ug/L	NC	40
8988210	Quinoline	2018/05/15	100	50 - 140	102	50 - 140	<0.020	ug/L	NC	40
8988904	Dissolved Organic Carbon (C)	2018/05/14	93	80 - 120	104	80 - 120	<0.50	mg/L		
8988905	Total Organic Carbon (C)	2018/05/14	89	80 - 120	104	80 - 120	<0.50	mg/L	3.4	20
8989303	Total Ammonia (N)	2018/05/14	92	80 - 120	97	80 - 120	<0.020	mg/L	NC	20
8990239	Total Phosphorus (P)	2018/05/15			89	80 - 120	<0.0050	mg/L		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B835235
Report Date: 2018/05/16

DILLON CONSULTING LTD.
Client Project #: 126231

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

<Original signed by>

Andy Lu, Ph.D., P.Chem., Scientific Specialist

<Original signed by>

Harry (Peng) Liang, Senior Analyst

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Page of

INVOICE TO:

Company Name: #15986 DILLON CONSULTING LTD.
Contact Name: Accounts Payable
Address: 510 - 3820 CESSNA DRIVE, Richmond BC V7B 0A2
Phone: (604) 278-7847 x Fax: (604) 278-7894 x
Email: salmeida@dillon.ca

Report Information

Company Name: Dillon Consulting Limited
Contact Name: Jacqueline Huard
Address:
Phone: Fax:
Email: jhuard@dillon.ca; ldilley@dillon.ca; rpope@dillon.ca

Project Information

Quotation #: B70427
P.O. #:
Project #: 126231
Project Name:
Site #: Crown Mountain
Sampled By:

B835235_COC

C#552776-01-01

Bottle Order #: 552776
Project Manager: Nahed Amer

Regulatory Criteria:
- [x] CSR
- [x] CCME
- [ ] BC Water Quality
- [ ] Other:

Special Instructions: # short hold times

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	CSR PAH in Water by GC-MS	Low Level Dissolved Metals with CV Hg	Low Level Total Metals with CV Hg	Alkalinity, Bromide, Chloride, Conductivity, Fluoride	Ammonia, TOC, DOC, Total Phosphorus	Nitrate + Nitrite (N), Nitrate, Nitrite	Orthophosphate, pH, Sulphate, Turbidity	Total Suspended Solids-Low Level			# of Bottles	Comments
1		18-WF-WL9B	May 5, 18	1530	H2O	N	X	X	X	X	X	X	X	X				
2		18-WL9	May 5, 18	1700	H2O	N	X	X	X	X	X	X	X	X				
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: [x]
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
1 DAY [ ] 2 Day [ ] 3 Day [ ] Date Required: [ ]
Rush Confirmation Number: (call lab for #)

<Original signed by>	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Lab Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
	18/05/07	0845		2018/05/09	05:30	NA	[x]	8, 9, 8	[ ] Yes [ ] No NA

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

Maxxam
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Success Through Science®

Your Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD
Your C.O.C. #: G069689

Attention: RICHARD POPE

DILLON CONSULTING LTD.
510 - 3820 CESSNA DRIVE
Richmond, BC
CANADA V7B 0A2

Report Date: 2018/05/16
Report #: R2555396
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B835678
Received: 2018/05/10, 10:45

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	2	2018/05/12	2018/05/13	BBY6SOP-00026	SM 22 2320 B m
Bromide by IC (1)	2	N/A	2018/05/12	AB SOP-00052	SM 22 4110 B m
Chloride by Automated Colourimetry	2	N/A	2018/05/11	BBY6SOP-00011	SM 22 4500-Cl- E m
Carbon (DOC) - field filtered/preserved (2)	2	N/A	2018/05/14	BBY6SOP-00003	SM 22 5310 C m
Conductance - water	2	2018/05/12	2018/05/13	BBY6SOP-00026	SM 22 2510 B m
Fluoride	2	N/A	2018/05/11	BBY6SOP-00048	SM 22 4500-F C m
Hardness Total (calculated as CaCO3) (3)	2	N/A	2018/05/15	BBY WI-00033	Auto Calc
Hardness (calculated as CaCO3)	2	N/A	2018/05/15	BBY WI-00033	Auto Calc
Mercury (Dissolved) by CVAF	2	N/A	2018/05/11	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Mercury (Total) by CVAF	2	2018/05/14	2018/05/14	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	2	N/A	2018/05/15	BBY WI-00033	Auto Calc
Elements by ICPMS Low Level (dissolved)	2	N/A	2018/05/15	BBY7SOP-00002	EPA 6020b R2 m
Elements by ICPMS Digested LL (total)	2	2018/05/14	2018/05/15	BBY7SOP-00003,	EPA 6020b R2 m
Na, K, Ca, Mg, S by CRC ICPMS (total)	2	N/A	2018/05/15	BBY WI-00033	Auto Calc
Ammonia-N (Preserved)	2	N/A	2018/05/14	BBY6SOP-00009	EPA 350.1 m
Nitrate + Nitrite (N)	2	N/A	2018/05/11	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrite (N) by CFA	2	N/A	2018/05/11	BBY6SOP-00010	SM 22 4500-NO3- I m
Nitrogen - Nitrate (as N)	2	N/A	2018/05/11	BBY WI-00033	Auto Calc
PAH in Water by GC/MS (SIM)	2	2018/05/14	2018/05/14	BBY8SOP-00021	BCMOE BCLM Jul2017m
Total LMW, HMW, Total PAH Calc (4)	2	N/A	2018/05/15	BBY WI-00033	Auto Calc
Filter and HNO3 Preserve for Metals	2	N/A	2018/05/15	BBY7 WI-00004	BCMOE Reqs 08/14
pH Water (5)	2	2018/05/12	2018/05/13	BBY6SOP-00026	SM 22 4500-H+ B m
Orthophosphate by Konelab	2	N/A	2018/05/12	BBY6SOP-00013	SM 22 4500-P E m
Sulphate by Automated Colourimetry	2	N/A	2018/05/11	BBY6SOP-00017	SM 22 4500-SO42- E m
Carbon (Total Organic) (6)	2	N/A	2018/05/14	BBY6SOP-00003	SM 22 5310 C m
Total Phosphorus	2	N/A	2018/05/15	BBY6SOP-00013	SM 22 4500-P E m
Total Suspended Solids-Low Level	1	2018/05/14	2018/05/15	BBY6SOP-00034	SM 22 2540 D
Total Suspended Solids-Low Level	1	2018/05/15	2018/05/16	BBY6SOP-00034	SM 22 2540 D
Turbidity	2	N/A	2018/05/11	BBY6SOP-00027	SM 22 2130 B m

Remarks:

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD
Your C.O.C. #: G069689

Attention: RICHARD POPE

DILLON CONSULTING LTD.
510 - 3820 CESSNA DRIVE
Richmond, BC
CANADA V7B 0A2

Report Date: 2018/05/16
Report #: R2555396
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B835678
Received: 2018/05/10, 10:45

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Calgary Environmental
(2) DOC present in the sample should be considered as non-purgeable DOC.
(3) "Total Hardness" was calculated from Total Ca and Mg concentrations and may be biased high (Hardness, or Dissolved Hardness, calculated from Dissolved Ca and Mg, should be used for compliance if available).
(4) Total PAHs in Water include: Quinoline, Naphthalene, 1-Methylnaphthalene, 2-Methylnaphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Acridine, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b&j)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, and Benzo(g,h,i)perylene.
(5) The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.
(6) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Maxxam
16 May 2018 17:14:05

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Nahed Amer, Project Manager
Email: NAmer@maxxam.ca
Phone# (604) 734 7276

==========

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Your Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD
Your C.O.C. #: G069689

Attention: RICHARD POPE

DILLON CONSULTING LTD.
510 - 3820 CESSNA DRIVE
Richmond, BC
CANADA V7B 0A2

Report Date: 2018/05/16
Report #: R2555396
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B835678
Received: 2018/05/10, 10:45

signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam Job #: B835678
Report Date: 2018/05/16

DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		TK2635		TK2636		
Sampling Date		2018/05/08 10:00		2018/05/09 09:00		
COC Number		G069689		G069689		
	UNITS	18-WF-10	QC Batch	18-CSF-07	RDL	QC Batch
ANIONS						
Nitrite (N)	mg/L	<0.0050	8986807	<0.0050	0.0050	8986807
Calculated Parameters						
Filter and HNO3 Preservation	N/A	FIELD	ONSITE	FIELD		ONSITE
Nitrate (N)	mg/L	<0.020	8984747	0.241	0.020	8984747
Misc. Inorganics						
Fluoride (F)	mg/L	0.270	8987399	0.130	0.020	8987399
Dissolved Organic Carbon (C)	mg/L	13.4	8988904	2.86 (1)	0.50	8988904
Alkalinity (Total as CaCO3)	mg/L	195	8987603	136	1.0	8987603
Total Organic Carbon (C)	mg/L	15.9	8988908	1.81	0.50	8988908
Alkalinity (PP as CaCO3)	mg/L	<1.0	8987603	<1.0	1.0	8987603
Bicarbonate (HCO3)	mg/L	238	8987603	166	1.0	8987603
Carbonate (CO3)	mg/L	<1.0	8987603	<1.0	1.0	8987603
Hydroxide (OH)	mg/L	<1.0	8987603	<1.0	1.0	8987603
Anions						
Dissolved Bromide (Br)	mg/L	<0.010	8987623	<0.010	0.010	8987623
Dissolved Sulphate (SO4)	mg/L	<1.0	8987772	17.1	1.0	8987772
Dissolved Chloride (Cl)	mg/L	1.6	8987771	<1.0	1.0	8987771
Nutrients						
Orthophosphate (P)	mg/L	0.0454	8987580	<0.0050	0.0050	8987580
Total Ammonia (N)	mg/L	0.048	8989304	<0.020	0.020	8989303
Nitrate plus Nitrite (N)	mg/L	<0.020	8986805	0.241	0.020	8986805
Total Phosphorus (P)	mg/L	0.110	8990239	0.0229	0.0050	8990239
Physical Properties						
Conductivity	uS/cm	358	8987600	286	2.0	8987600
pH	pH	8.24	8987599	8.23		8987599
Physical Properties						
Total Suspended Solids	mg/L	4.0	8988383	2.5	1.0	8990110
Turbidity	NTU	1.69	8986909	0.97	0.10	8986909

RDL = Reportable Detection Limit
(1) Dissolved greater than total. Reanalysis yields similar results.

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Maxxam Job #: B835678
Report Date: 2018/05/16

DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

LOW LEVEL DISSOLVED METALS WITH CV HG (WATER)

Maxxam ID		TK2635	TK2636		
Sampling Date		2018/05/08 10:00	2018/05/09 09:00		
COC Number		G069689	G069689		
	UNITS	18-WF-10	18-CSF-07	RDL	QC Batch
Calculated Parameters					
Dissolved Hardness (CaCO3)	mg/L	183	151	0.50	8985446
Elements					
Dissolved Mercury (Hg)	ug/L	0.0026	<0.0020	0.0020	8986384
Dissolved Metals by ICPMS					
Dissolved Aluminum (Al)	ug/L	4.80	4.80	0.50	8988003
Dissolved Antimony (Sb)	ug/L	0.150	0.028	0.020	8988003
Dissolved Arsenic (As)	ug/L	0.590	0.139 (1)	0.020	8988003
Dissolved Barium (Ba)	ug/L	172	54.1 (1)	0.020	8988003
Dissolved Beryllium (Be)	ug/L	<0.010	<0.010	0.010	8988003
Dissolved Bismuth (Bi)	ug/L	<0.0050	<0.0050	0.0050	8988003
Dissolved Boron (B)	ug/L	<10	<10	10	8988003
Dissolved Cadmium (Cd)	ug/L	0.0281	0.174 (1)	0.0050	8988003
Dissolved Chromium (Cr)	ug/L	<0.10	0.15	0.10	8988003
Dissolved Cobalt (Co)	ug/L	0.0687	0.0283 (1)	0.0050	8988003
Dissolved Copper (Cu)	ug/L	0.976	0.174	0.050	8988003
Dissolved Iron (Fe)	ug/L	25.0	22.8	1.0	8988003
Dissolved Lead (Pb)	ug/L	0.0174	0.0067	0.0050	8988003
Dissolved Lithium (Li)	ug/L	3.64	4.77	0.50	8988003
Dissolved Manganese (Mn)	ug/L	7.02	48.0 (1)	0.050	8988003
Dissolved Molybdenum (Mo)	ug/L	1.25	0.835	0.050	8988003
Dissolved Nickel (Ni)	ug/L	0.831	0.132	0.020	8988003
Dissolved Phosphorus (P)	ug/L	72.1	17.8 (1)	2.0	8988003
Dissolved Selenium (Se)	ug/L	0.388	0.202	0.040	8988003
Dissolved Silicon (Si)	ug/L	10300	2880 (1)	50	8988003
Dissolved Silver (Ag)	ug/L	<0.0050	<0.0050	0.0050	8988003
Dissolved Strontium (Sr)	ug/L	118	171	0.050	8988003
Dissolved Thallium (Tl)	ug/L	<0.0020	<0.0020	0.0020	8988003
Dissolved Tin (Sn)	ug/L	<0.20	<0.20	0.20	8988003
Dissolved Titanium (Ti)	ug/L	<0.50	<0.50	0.50	8988003
Dissolved Uranium (U)	ug/L	0.435	0.322	0.0020	8988003
Dissolved Vanadium (V)	ug/L	0.45	<0.20	0.20	8988003

RDL = Reportable Detection Limit
(1) Dissolved greater than total. Reanalysis yields similar results.

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DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

LOW LEVEL DISSOLVED METALS WITH CV HG (WATER)

Maxxam ID		TK2635	TK2636		
Sampling Date		2018/05/08 10:00	2018/05/09 09:00		
COC Number		G069689	G069689		
	UNITS	**18-WF-10**	**18-CSF-07**	**RDL**	**QC Batch**
Dissolved Zinc (Zn)	ug/L	1.59	4.24 (1)	0.10	8988003
Dissolved Zirconium (Zr)	ug/L	0.27	<0.10	0.10	8988003
Dissolved Calcium (Ca)	mg/L	50.4	41.1	0.050	8984540
Dissolved Magnesium (Mg)	mg/L	13.8	11.8	0.050	8984540
Dissolved Potassium (K)	mg/L	1.60	0.747 (1)	0.050	8984540
Dissolved Sodium (Na)	mg/L	2.03	1.83	0.050	8984540
Dissolved Sulphur (S)	mg/L	<3.0	4.8	3.0	8984540

RDL = Reportable Detection Limit
(1) Dissolved greater than total. Reanalysis yields similar results.

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DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

LL TOTAL METALS (DIGESTED) WITH CV HG

Maxxam ID		TK2635	TK2636		
Sampling Date		2018/05/08 10:00	2018/05/09 09:00		
COC Number		G069689	G069689		
	UNITS	18-WF-10	18-CSF-07	RDL	QC Batch
Calculated Parameters					
Total Hardness (CaCO3)	mg/L	189	145	0.50	8985441
Elements					
Total Mercury (Hg)	ug/L	0.0021	<0.0020	0.0020	8989328
Total Metals by ICPMS					
Total Aluminum (Al)	ug/L	10.8	12.7	3.0	8988115
Total Antimony (Sb)	ug/L	0.158	0.024	0.020	8988115
Total Arsenic (As)	ug/L	0.575	0.105	0.020	8988115
Total Barium (Ba)	ug/L	168	43.3	0.050	8988115
Total Beryllium (Be)	ug/L	<0.010	<0.010	0.010	8988115
Total Bismuth (Bi)	ug/L	<0.010	<0.010	0.010	8988115
Total Boron (B)	ug/L	<10	<10	10	8988115
Total Cadmium (Cd)	ug/L	0.0679	<0.0050	0.0050	8988115
Total Chromium (Cr)	ug/L	<0.10	0.20	0.10	8988115
Total Cobalt (Co)	ug/L	0.074	0.017	0.010	8988115
Total Copper (Cu)	ug/L	1.02	0.30	0.10	8988115
Total Iron (Fe)	ug/L	32.4	34.1	5.0	8988115
Total Lead (Pb)	ug/L	0.029	<0.020	0.020	8988115
Total Lithium (Li)	ug/L	3.74	5.03	0.50	8988115
Total Manganese (Mn)	ug/L	8.75	5.00	0.10	8988115
Total Molybdenum (Mo)	ug/L	1.28	0.832	0.050	8988115
Total Nickel (Ni)	ug/L	0.83	0.14	0.10	8988115
Total Phosphorus (P)	ug/L	109	7.3	5.0	8988115
Total Selenium (Se)	ug/L	0.383	0.247	0.040	8988115
Total Silicon (Si)	ug/L	10700	2010	50	8988115
Total Silver (Ag)	ug/L	<0.010	<0.010	0.010	8988115
Total Strontium (Sr)	ug/L	118	168	0.050	8988115
Total Thallium (Tl)	ug/L	<0.0020	<0.0020	0.0020	8988115
Total Tin (Sn)	ug/L	<0.20	<0.20	0.20	8988115
Total Titanium (Ti)	ug/L	<2.0	<2.0	2.0	8988115
Total Uranium (U)	ug/L	0.422	0.337	0.0050	8988115
Total Vanadium (V)	ug/L	0.48	<0.20	0.20	8988115
Total Zinc (Zn)	ug/L	1.9	2.5	1.0	8988115
RDL = Reportable Detection Limit					

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DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

LL TOTAL METALS (DIGESTED) WITH CV HG

Maxxam ID		TK2635	TK2636		
Sampling Date		2018/05/08 10:00	2018/05/09 09:00		
COC Number		G069689	G069689		
	UNITS	18-WF-10	18-CSF-07	RDL	QC Batch
Total Zirconium (Zr)	ug/L	0.18	<0.10	0.10	8988115
Total Calcium (Ca)	mg/L	51.9	38.3	0.25	8984543
Total Magnesium (Mg)	mg/L	14.4	12.0	0.25	8984543
Total Potassium (K)	mg/L	1.64	0.48	0.25	8984543
Total Sodium (Na)	mg/L	2.10	1.74	0.25	8984543
Total Sulphur (S)	mg/L	<3.0	5.1	3.0	8984543
RDL = Reportable Detection Limit					

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DILLON CONSULTING LTD.
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CSR PAH IN WATER BY GC-MS (WATER)

Maxxam ID		TK2635	TK2636		
Sampling Date		2018/05/08 10:00	2018/05/09 09:00		
COC Number		G069689	G069689		
	UNITS	18-WF-10	18-CSF-07	RDL	QC Batch
Calculated Parameters					
Low Molecular Weight PAH`s	ug/L	<0.10	<0.10	0.10	8984588
High Molecular Weight PAH`s	ug/L	<0.050	<0.050	0.050	8984588
Total PAH	ug/L	<0.10	<0.10	0.10	8984588
Polycyclic Aromatics					
Quinoline	ug/L	0.022	<0.020	0.020	8988210
Naphthalene	ug/L	<0.10	<0.10	0.10	8988210
1-Methylnaphthalene	ug/L	<0.050	<0.050	0.050	8988210
2-Methylnaphthalene	ug/L	<0.10	<0.10	0.10	8988210
Acenaphthylene	ug/L	<0.050	<0.050	0.050	8988210
Acenaphthene	ug/L	<0.050	<0.050	0.050	8988210
Fluorene	ug/L	<0.050	<0.050	0.050	8988210
Phenanthrene	ug/L	<0.050	<0.050	0.050	8988210
Anthracene	ug/L	<0.010	<0.010	0.010	8988210
Acridine	ug/L	<0.050	<0.050	0.050	8988210
Fluoranthene	ug/L	<0.020	<0.020	0.020	8988210
Pyrene	ug/L	<0.020	<0.020	0.020	8988210
Benzo(a)anthracene	ug/L	<0.010	<0.010	0.010	8988210
Chrysene	ug/L	<0.020	<0.020	0.020	8988210
Benzo(b&j)fluoranthene	ug/L	<0.030	<0.030	0.030	8988210
Benzo(k)fluoranthene	ug/L	<0.050	<0.050	0.050	8988210
Benzo(a)pyrene	ug/L	<0.0050	<0.0050	0.0050	8988210
Indeno(1,2,3-cd)pyrene	ug/L	<0.050	<0.050	0.050	8988210
Dibenz(a,h)anthracene	ug/L	<0.0030	<0.0030	0.0030	8988210
Benzo(g,h,i)perylene	ug/L	<0.050	<0.050	0.050	8988210
Surrogate Recovery (%)					
D10-ANTHRACENE (sur.)	%	96	95		8988210
D8-ACENAPHTHYLENE (sur.)	%	98	98		8988210
D8-NAPHTHALENE (sur.)	%	74	75		8988210
TERPHENYL-D14 (sur.)	%	105	101		8988210
RDL = Reportable Detection Limit					

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DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	4.7°C

Sample TK2635 [18-WF-10] : Sample was analyzed past method specified hold time for Orthophosphate by Konelab. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.}

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8988210	D10-ANTHRACENE (sur.)	2018/05/14	88	50 - 140	93	50 - 140	90	%		
8988210	D8-ACENAPHTHYLENE (sur.)	2018/05/14	97	50 - 140	100	50 - 140	99	%		
8988210	D8-NAPHTHALENE (sur.)	2018/05/14	67	50 - 140	69	50 - 140	74	%		
8988210	TERPHENYL-D14 (sur.)	2018/05/14	99	50 - 140	103	50 - 140	100	%		
8986384	Dissolved Mercury (Hg)	2018/05/11	96	80 - 120	102	80 - 120	<0.0020	ug/L	1.1	20
8986805	Nitrate plus Nitrite (N)	2018/05/11			105	80 - 120	<0.020	mg/L		
8986807	Nitrite (N)	2018/05/11			102	80 - 120	<0.0050	mg/L		
8986909	Turbidity	2018/05/11			102	80 - 120	<0.10	NTU	1.3	20
8987399	Fluoride (F)	2018/05/11	110	80 - 120	106	80 - 120	<0.020	mg/L	0	20
8987580	Orthophosphate (P)	2018/05/12	64 (1)	80 - 120	98	80 - 120	<0.0050	mg/L	2.2	20
8987599	pH	2018/05/12			101	97 - 103			0.26	20
8987600	Conductivity	2018/05/12			101	80 - 120	<2.0	uS/cm		
8987603	Alkalinity (PP as CaCO3)	2018/05/12					<1.0	mg/L		
8987603	Alkalinity (Total as CaCO3)	2018/05/12	NC	80 - 120	102	80 - 120	<1.0	mg/L		
8987603	Bicarbonate (HCO3)	2018/05/12					<1.0	mg/L		
8987603	Carbonate (CO3)	2018/05/12					<1.0	mg/L		
8987603	Hydroxide (OH)	2018/05/12					<1.0	mg/L		
8987623	Dissolved Bromide (Br)	2018/05/12	103	80 - 120	102	80 - 120	<0.010	mg/L	NC	20
8987771	Dissolved Chloride (Cl)	2018/05/11	107	80 - 120	98	80 - 120	<1.0	mg/L	0.92	20
8987772	Dissolved Sulphate (SO4)	2018/05/11			101	80 - 120	<1.0	mg/L	0.0022	20
8988003	Dissolved Aluminum (Al)	2018/05/15	95	80 - 120	96	80 - 120	<0.50	ug/L	9.1	20
8988003	Dissolved Antimony (Sb)	2018/05/15	103	80 - 120	104	80 - 120	<0.020	ug/L	0.27	20
8988003	Dissolved Arsenic (As)	2018/05/15	104	80 - 120	104	80 - 120	<0.020	ug/L	1.8	20
8988003	Dissolved Barium (Ba)	2018/05/15	100	80 - 120	103	80 - 120	<0.020	ug/L	0.077	20
8988003	Dissolved Beryllium (Be)	2018/05/15	94	80 - 120	96	80 - 120	<0.010	ug/L	NC	20
8988003	Dissolved Bismuth (Bi)	2018/05/15	98	80 - 120	102	80 - 120	<0.0050	ug/L	NC	20
8988003	Dissolved Boron (B)	2018/05/15	93	80 - 120	94	80 - 120	<10	ug/L	0.12	20
8988003	Dissolved Cadmium (Cd)	2018/05/15	102	80 - 120	103	80 - 120	<0.0050	ug/L	NC	20
8988003	Dissolved Chromium (Cr)	2018/05/15	104	80 - 120	105	80 - 120	<0.10	ug/L	NC	20
8988003	Dissolved Cobalt (Co)	2018/05/15	101	80 - 120	104	80 - 120	<0.0050	ug/L	3.1	20
8988003	Dissolved Copper (Cu)	2018/05/15	98	80 - 120	102	80 - 120	<0.050	ug/L	2.3	20

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QUALITY ASSURANCE REPORT(CONT'D)

DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8988003	Dissolved Iron (Fe)	2018/05/15	102	80 - 120	107	80 - 120	<1.0	ug/L	3.6	20
8988003	Dissolved Lead (Pb)	2018/05/15	99	80 - 120	103	80 - 120	<0.0050	ug/L	NC	20
8988003	Dissolved Lithium (Li)	2018/05/15	95	80 - 120	99	80 - 120	<0.50	ug/L	0.46	20
8988003	Dissolved Manganese (Mn)	2018/05/15	103	80 - 120	106	80 - 120	<0.050	ug/L	2.9	20
8988003	Dissolved Molybdenum (Mo)	2018/05/15	NC	80 - 120	107	80 - 120	<0.050	ug/L	1.6	20
8988003	Dissolved Nickel (Ni)	2018/05/15	103	80 - 120	106	80 - 120	<0.020	ug/L	18	20
8988003	Dissolved Phosphorus (P)	2018/05/15	98	80 - 120	95	80 - 120	<2.0	ug/L	NC	20
8988003	Dissolved Selenium (Se)	2018/05/15	104	80 - 120	103	80 - 120	<0.040	ug/L	1.2	20
8988003	Dissolved Silicon (Si)	2018/05/15	100	80 - 120	101	80 - 120	<50	ug/L	2.2	20
8988003	Dissolved Silver (Ag)	2018/05/15	101	80 - 120	103	80 - 120	<0.0050	ug/L	NC	20
8988003	Dissolved Strontium (Sr)	2018/05/15	NC	80 - 120	105	80 - 120	<0.050	ug/L	0.52	20
8988003	Dissolved Thallium (Tl)	2018/05/15	99	80 - 120	102	80 - 120	<0.0020	ug/L	NC	20
8988003	Dissolved Tin (Sn)	2018/05/15	102	80 - 120	101	80 - 120	<0.20	ug/L	NC	20
8988003	Dissolved Titanium (Ti)	2018/05/15	107	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
8988003	Dissolved Uranium (U)	2018/05/15	104	80 - 120	107	80 - 120	<0.0020	ug/L	0.28	20
8988003	Dissolved Vanadium (V)	2018/05/15	106	80 - 120	106	80 - 120	<0.20	ug/L	1.3	20
8988003	Dissolved Zinc (Zn)	2018/05/15	102	80 - 120	105	80 - 120	<0.10	ug/L	NC	20
8988003	Dissolved Zirconium (Zr)	2018/05/15	105	80 - 120	104	80 - 120	<0.10	ug/L	16	20
8988115	Total Aluminum (Al)	2018/05/15	100	80 - 120	103	80 - 120	<3.0	ug/L	2.0	20
8988115	Total Antimony (Sb)	2018/05/15	104	80 - 120	105	80 - 120	<0.020	ug/L	12	20
8988115	Total Arsenic (As)	2018/05/15	105	80 - 120	104	80 - 120	<0.020	ug/L	1.9	20
8988115	Total Barium (Ba)	2018/05/15	101	80 - 120	104	80 - 120	<0.050	ug/L	0.64	20
8988115	Total Beryllium (Be)	2018/05/15	101	80 - 120	101	80 - 120	<0.010	ug/L	NC	20
8988115	Total Bismuth (Bi)	2018/05/15	98	80 - 120	104	80 - 120	<0.010	ug/L	NC	20
8988115	Total Boron (B)	2018/05/15	100	80 - 120	104	80 - 120	<10	ug/L	NC	20
8988115	Total Cadmium (Cd)	2018/05/15	103	80 - 120	104	80 - 120	<0.0050	ug/L	8.0	20
8988115	Total Chromium (Cr)	2018/05/15	103	80 - 120	105	80 - 120	<0.10	ug/L	7.9	20
8988115	Total Cobalt (Co)	2018/05/15	99	80 - 120	102	80 - 120	<0.010	ug/L	0.74	20
8988115	Total Copper (Cu)	2018/05/15	97	80 - 120	102	80 - 120	<0.10	ug/L	3.2	20
8988115	Total Iron (Fe)	2018/05/15	98	80 - 120	104	80 - 120	<5.0	ug/L	2.5	20
8988115	Total Lead (Pb)	2018/05/15	99	80 - 120	103	80 - 120	<0.020	ug/L	0.14	20

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QUALITY ASSURANCE REPORT(CONT'D)

DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8988115	Total Lithium (Li)	2018/05/15	103	80 - 120	103	80 - 120	<0.50	ug/L	4.6	20
8988115	Total Manganese (Mn)	2018/05/15	98	80 - 120	106	80 - 120	<0.10	ug/L	0.92	20
8988115	Total Molybdenum (Mo)	2018/05/15	107	80 - 120	107	80 - 120	<0.050	ug/L	6.3	20
8988115	Total Nickel (Ni)	2018/05/15	98	80 - 120	102	80 - 120	<0.10	ug/L	2.9	20
8988115	Total Phosphorus (P)	2018/05/15	102	80 - 120	101	80 - 120	<5.0	ug/L		
8988115	Total Selenium (Se)	2018/05/15	103	80 - 120	104	80 - 120	<0.040	ug/L	5.7	20
8988115	Total Silicon (Si)	2018/05/15	NC	80 - 120	106	80 - 120	<50	ug/L		
8988115	Total Silver (Ag)	2018/05/15	102	80 - 120	104	80 - 120	<0.010	ug/L	NC	20
8988115	Total Strontium (Sr)	2018/05/15	NC	80 - 120	106	80 - 120	<0.050	ug/L	3.0	20
8988115	Total Thallium (Tl)	2018/05/15	100	80 - 120	102	80 - 120	<0.0020	ug/L	NC	20
8988115	Total Tin (Sn)	2018/05/15	99	80 - 120	104	80 - 120	<0.20	ug/L	NC	20
8988115	Total Titanium (Ti)	2018/05/15	105	80 - 120	108	80 - 120	<2.0	ug/L		
8988115	Total Uranium (U)	2018/05/15	105	80 - 120	106	80 - 120	<0.0050	ug/L	1.6	20
8988115	Total Vanadium (V)	2018/05/15	104	80 - 120	105	80 - 120	<0.20	ug/L	4.8	20
8988115	Total Zinc (Zn)	2018/05/15	101	80 - 120	106	80 - 120	<1.0	ug/L	1.4	20
8988115	Total Zirconium (Zr)	2018/05/15	105	80 - 120	104	80 - 120	<0.10	ug/L		
8988210	1-Methylnaphthalene	2018/05/14	80	50 - 140	83	50 - 140	<0.050	ug/L		
8988210	2-Methylnaphthalene	2018/05/15	76	50 - 140	80	50 - 140	<0.10	ug/L	NC	40
8988210	Acenaphthene	2018/05/15	90	50 - 140	93	50 - 140	<0.050	ug/L	NC	40
8988210	Acenaphthylene	2018/05/15	89	50 - 140	91	50 - 140	<0.050	ug/L	NC	40
8988210	Acridine	2018/05/15	69	50 - 140	91	50 - 140	<0.050	ug/L	NC	40
8988210	Anthracene	2018/05/15	93	50 - 140	88	50 - 140	<0.010	ug/L	NC	40
8988210	Benzo(a)anthracene	2018/05/15	82	50 - 140	84	50 - 140	<0.010	ug/L	NC	40
8988210	Benzo(a)pyrene	2018/05/15	71	50 - 140	86	50 - 140	<0.0050	ug/L	NC	40
8988210	Benzo(b&j)fluoranthene	2018/05/15	75	50 - 140	89	50 - 140	<0.030	ug/L	NC	40
8988210	Benzo(g,h,i)perylene	2018/05/15	61	50 - 140	86	50 - 140	<0.050	ug/L	NC	40
8988210	Benzo(k)fluoranthene	2018/05/15	78	50 - 140	93	50 - 140	<0.050	ug/L	NC	40
8988210	Chrysene	2018/05/15	87	50 - 140	89	50 - 140	<0.020	ug/L	NC	40
8988210	Dibenz(a,h)anthracene	2018/05/15	66	50 - 140	91	50 - 140	<0.0030	ug/L	NC	40
8988210	Fluoranthene	2018/05/15	85	50 - 140	86	50 - 140	<0.020	ug/L	NC	40
8988210	Fluorene	2018/05/15	84	50 - 140	87	50 - 140	<0.050	ug/L	NC	40

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Maxxam Job #: B835678
Report Date: 2018/05/16

QUALITY ASSURANCE REPORT(CONT'D)

DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8988210	Indeno(1,2,3-cd)pyrene	2018/05/15	63	50 - 140	87	50 - 140	<0.050	ug/L	NC	40
8988210	Naphthalene	2018/05/15	64	50 - 140	68	50 - 140	<0.10	ug/L	NC	40
8988210	Phenanthrene	2018/05/15	78	50 - 140	87	50 - 140	<0.050	ug/L	NC	40
8988210	Pyrene	2018/05/15	89	50 - 140	90	50 - 140	<0.020	ug/L	NC	40
8988210	Quinoline	2018/05/15	100	50 - 140	102	50 - 140	<0.020	ug/L	NC	40
8988383	Total Suspended Solids	2018/05/15			97	80 - 120	<1.0	mg/L		
8988904	Dissolved Organic Carbon (C)	2018/05/14	93	80 - 120	104	80 - 120	<0.50	mg/L	12	20
8988908	Total Organic Carbon (C)	2018/05/14	101	80 - 120	103	80 - 120	<0.50	mg/L	13	20
8989303	Total Ammonia (N)	2018/05/14	92	80 - 120	97	80 - 120	<0.020	mg/L	NC	20
8989304	Total Ammonia (N)	2018/05/14	81	80 - 120	106	80 - 120	<0.020	mg/L	NC	20
8989328	Total Mercury (Hg)	2018/05/14	97	80 - 120	107	80 - 120	<0.0020	ug/L	NC	20
8990110	Total Suspended Solids	2018/05/16			97	80 - 120	<1.0	mg/L		
8990239	Total Phosphorus (P)	2018/05/15			89	80 - 120	<0.0050	mg/L		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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Maxxam Job #: B835678
Report Date: 2018/05/16

DILLON CONSULTING LTD.
Client Project #: 126231
Site Location: CROWN MOUNTAIN SPARWOOD

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

<Original signed by>

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

<Original signed by>

Nahed Amer, Project Manager

<Original signed by>

Rob Reinert, B.Sc., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam

4606 Canada Way, Burnaby, BC Canada V5G 1K5

B835678_COC

CHAIN OF CUSTODY RECORD

Page: 1 of 1

G 069689

Invoice To: Require Report? Yes ☒ No ☐

Company Name: Dillon Consulting
Contact Name:
Address:
PC:
Phone / Fax#: Ph: Fax:
E-mail: rpope@dillon.ca

Company Name:
Contact Name:
Address:
PC:
Phone / Fax#: Ph: Fax:
E-mail

PO #:
Quotation #: B70427
Project # : 121231
Proj. Name:
Location: Crown Mountain Sparwood
Sampled By: JRH

REGULATORY REQUIREMENTS SERVICE REQUESTED:

☒ CSR
☒ CCME
☐ BC Water Quality
☐ Other
☐ DRINKING WATER

☒ Regular Turn Around Time (TAT) (5 days for most tests)
☐ RUSH (Please contact the lab)
☐ 1 Day ☐ 2 Day ☐ 3 Day
Date Required:

Special Instructions:

Return Cooler ☐ Ship Sample Bottles (please specify) ☐

* Short hold times

ANALYSIS REQUESTED

	Sample Identification	Lab Identification	Sample Type	Date/Time Sampled
1	18-WF-10		H_2O	19/5/8 1000
2	18 WF-07		H_2O	18/5/9 900
3	↳ all IDs			
4	18-WF-07;			
5	But Please change			
6	the label to:			
7	18-CSF-07			
8				
9				
10				
11				
12				

BTEX/VPH ☐ MTBE ☐
VOC/VPH ☐
EPH ☐ TEH ☐
PAH ☒ LEPH/HEPH ☐
CCME-PHC (Fractions 1-4 Plus BTEX)
CCME-PHC (Fractions 2-4)
CCME BTEX (Fraction 1 Plus BTEX)
PCB
Phenols by 4AAP ☐ Phenols by GCMS ☐
TOG ☐ MOG ☐ SWOG ☐
16w low! Dissolved Metals ☐ Field Filtered? N ☒ Y ☐
Field Acidified? N ☒ Y ☐
Totals Metals Field Acidified? N ☒ Y ☐
Nitrate ☒ Ammonia ☐
Chloride ☐ Fluoride ☐ Sulphate ☐
Total Suspended Solids-TSS ☒ TDS ☐
pH ☒ Conductivity ☒ Alkalinity ☒
BOD ☐
COD ☒
Coliform, Total & E.coli ☐ Fecal ☐
Asbestos ☐
Bromide chloride TOC Total phenols
Turbidity
Sulphate
HOLD ☐

Samples are from a Drinking Water Source? YES ☐ NO ☒
Does source supply multiple households? YES ☐ NO ☒

Laboratory Use Only

Date (YY/MM/DD):	Time:	Received by:	Date (YY/MM/DD):	Time:	Time Sensitive	Temperature on Receipt (°C)	Custody Seal Intact on Cooler?
18/05/09	1807	<Original signed by>	2018/05/10	10:45	☒	5, 5, 4	Yes ☐ No ☐

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

COC-1020 (05/10)

Maxxam International Corporation o/a Maxxam Analytics

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your Project #: 126231
Site#: Crown Mountain
Your C.O.C. #: 558117-01-01

Attention: RICHARD POPE

DILLON CONSULTING LTD.
510 - 3820 CESSNA DRIVE
Richmond, BC
CANADA V7B 0A2

Report Date: 2018/07/16
Report #: R2589773
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B855658
Received: 2018/07/07, 16:23

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	2	N/A	2018/07/11	BBY6SOP-00026	SM 22 2320 B m
Bromide by IC (1)	2	N/A	2018/07/11	AB SOP-00052	SM 22 4110 B m
Chloride by Automated Colourimetry	1	N/A	2018/07/10	BBY6SOP-00011	SM 22 4500-Cl- E m
Chloride by Automated Colourimetry	1	N/A	2018/07/12	BBY6SOP-00011	SM 22 4500-Cl- E m
Carbon (DOC) -Lab Filtered (1, 2)	1	N/A	2018/07/13	CAL SOP-00077	MMCW 119 1996 m
Carbon (DOC) (1, 3)	1	N/A	2018/07/13	CAL SOP-00077	MMCW 119 1996 m
Conductance - water	2	N/A	2018/07/11	BBY6SOP-00026	SM 22 2510 B m
Fluoride	1	N/A	2018/07/11	BBY6SOP-00048	SM 22 4500-F C m
Fluoride	1	N/A	2018/07/12	BBY6SOP-00048	SM 22 4500-F C m
Hardness Total (calculated as CaCO3) (4)	2	N/A	2018/07/12	BBY WI-00033	Auto Calc
Hardness (calculated as CaCO3)	2	N/A	2018/07/12	BBY WI-00033	Auto Calc
Mercury (Dissolved) by CVAF	2	N/A	2018/07/12	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Mercury (Total) by CVAF	2	2018/07/11	2018/07/11	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	2	N/A	2018/07/12	BBY WI-00033	Auto Calc
Elements by CRC ICPMS (dissolved)	2	N/A	2018/07/11	BBY7SOP-00002	EPA 6020b R2 m
Na, K, Ca, Mg, S by CRC ICPMS (total)	2	2018/07/09	2018/07/12	BBY WI-00033	Auto Calc
Elements by CRC ICPMS (total)	2	2018/07/11	2018/07/12	BBY7SOP-00003,	EPA 6020b R2 m
Ammonia-N (Preserved)	2	N/A	2018/07/13	BBY6SOP-00009	EPA 350.1 m
Nitrate and Nitrite (1)	1	N/A	2018/07/12	AB WI-00065	Auto Calc
Nitrate and Nitrite (1)	1	N/A	2018/07/13	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated) (1)	1	N/A	2018/07/12	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated) (1)	1	N/A	2018/07/13	AB WI-00065	Auto Calc
Nitrogen (Nitrite - Nitrate) by IC (1)	1	N/A	2018/07/10	AB SOP-00023	SM 23 4110 B m
Nitrogen (Nitrite - Nitrate) by IC (1)	1	N/A	2018/07/11	AB SOP-00023	SM 23 4110 B m
PAH in Water by GC/MS (SIM)	2	2018/07/11	2018/07/11	BBY8SOP-00021	BCMOE BCLM Jul2017m
Total LMW, HMW, Total PAH Calc (5)	2	N/A	2018/07/12	BBY WI-00033	Auto Calc
Filter and HNO3 Preserve for Metals	1	N/A	2018/07/09	BBY7 WI-00004	BCMOE Reqs 08/14
Filter and HNO3 Preserve for Metals	1	N/A	2018/07/11	BBY7 WI-00004	BCMOE Reqs 08/14
pH Water (6)	2	N/A	2018/07/11	BBY6SOP-00026	SM 22 4500-H+ B m
Orthophosphate by Konelab (1)	2	N/A	2018/07/09	AB SOP-00025	SM 23 4500-P A,F m

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Your Project #: 126231
Site#: Crown Mountain
Your C.O.C. #: 558117-01-01

Attention: RICHARD POPE

DILLON CONSULTING LTD.
510 - 3820 CESSNA DRIVE
Richmond, BC
CANADA V7B 0A2

Report Date: 2018/07/16
Report #: R2589773
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B855658
Received: 2018/07/07, 16:23

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Sulphate by Automated Colourimetry	1	N/A	2018/07/10	BBY6SOP-00017	SM 22 4500-SO42- E m
Sulphate by Automated Colourimetry	1	N/A	2018/07/12	BBY6SOP-00017	SM 22 4500-SO42- E m
Carbon (Total Organic) (1, 7)	2	N/A	2018/07/13	CAL SOP-00077	MMCW 119 1996 m
Total Phosphorus	2	2018/07/14	2018/07/14	BBY6SOP-00013	SM 22 4500-P E m
Total Suspended Solids	1	2018/07/11	2018/07/11	BBY6SOP-00034	SM 22 2540 D
Total Suspended Solids	1	2018/07/12	2018/07/16	BBY6SOP-00034	SM 22 2540 D
Turbidity (1)	2	N/A	2018/07/09	CAL SOP-00081	SM 22 2130 B m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 126231
Site#: Crown Mountain
Your C.O.C. #: 558117-01-01

Attention: RICHARD POPE

DILLON CONSULTING LTD.
510 - 3820 CESSNA DRIVE
Richmond, BC
CANADA V7B 0A2

Report Date: 2018/07/16
Report #: R2589773
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B855658

Received: 2018/07/07, 16:23

(1) This test was performed by Maxxam Calgary Environmental
(2) DOC present in the sample should be considered as non-purgeable DOC.
(3) DOC present in the sample should be considered as non-purgeable DOC. Dissolved > Total Imbalance: Whenever applicable, Dissolved >Total for any parameter that falls within method uncertainty for duplicates is likely equivalent. If RPD is >20% samples were reanalyzed and confirmed.
(4) "Total Hardness" was calculated from Total Ca and Mg concentrations and may be biased high (Hardness, or Dissolved Hardness, calculated from Dissolved Ca and Mg, should be used for compliance if available).
(5) Total PAHs in Water include: Quinoline, Naphthalene, 1-Methylnaphthalene, 2-Methylnaphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Acridine, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b&j)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, and Benzo(g,h,i)perylene.
(6) The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.
(7) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Maxxam
16 Jul 2018 15:38:58

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Nahed Amer, Project Manager
Email: NAmer@maxxam.ca
Phone# (604) 734 7276

==========

This report has been generated and distributed using a secure automated process.
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B855658
Report Date: 2018/07/16

DILLON CONSULTING LTD.
Client Project #: 126231

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		TU9434			TU9435		
Sampling Date		2018/07/05 17:25			2018/07/04 18:30		
COC Number		558117-01-01			558117-01-01		
	UNITS	WL 1	RDL	QC Batch	WET 21	RDL	QC Batch
Calculated Parameters							
Filter and HNO3 Preservation	N/A	FIELD		ONSITE	LAB		9058362
Dissolved Nitrate (NO3)	mg/L	0.092	0.044	9055459	<0.044	0.044	9055459
Nitrate plus Nitrite (N)	mg/L	0.021	0.014	9055124	<0.014	0.014	9055124
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9055459	<0.033	0.033	9055459
Misc. Inorganics							
Fluoride (F)	mg/L	0.210	0.020	9059257	0.260	0.020	9060762
Dissolved Organic Carbon (C)	mg/L	<1.0 (1)	1.0	9060291			
Alkalinity (Total as CaCO3)	mg/L	201	1.0	9058202	331	1.0	9059754
Total Organic Carbon (C)	mg/L	29 (1)	1.0	9061652	24 (2)	1.0	9061652
Alkalinity (PP as CaCO3)	mg/L	6.2	1.0	9058202	<1.0	1.0	9059754
Bicarbonate (HCO3)	mg/L	230	1.0	9058202	404	1.0	9059754
Carbonate (CO3)	mg/L	7.4	1.0	9058202	<1.0	1.0	9059754
Hydroxide (OH)	mg/L	<1.0	1.0	9058202	<1.0	1.0	9059754
Lab Filtered Inorganics							
Dissolved Organic Carbon (C)	mg/L				24 (1)	1.0	9061653
Anions							
Dissolved Bromide (Br)	mg/L	<0.010	0.010	9057697	<0.010	0.010	9057697
Dissolved Sulphate (SO4)	mg/L	44.5	1.0	9059166	103	1.0	9062451
Dissolved Chloride (Cl)	mg/L	<1.0	1.0	9059161	5.6	1.0	9062449
Nutrients							
Orthophosphate (P)	mg/L	0.0073	0.0030	9056259	0.0069	0.0030	9056259
Total Ammonia (N)	mg/L	<0.020	0.020	9062843	0.042	0.020	9062843
Total Phosphorus (P)	mg/L	0.0466	0.0050	9063822	0.0107	0.0050	9063822
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9056006	<0.010	0.010	9055643
Dissolved Nitrate (N)	mg/L	0.021	0.010	9056006	<0.010	0.010	9055643
Physical Properties							
Conductivity	uS/cm	446	2.0	9058199	750	2.0	9059756
pH	pH	8.46		9058197	8.06		9059755
Physical Properties							
Total Suspended Solids	mg/L	13.8	4.0	9060293	<4.0	4.0	9058818

RDL = Reportable Detection Limit
(1) Detection limits raised due to sample matrix.
(2) Detection limits raised due to dilution to bring analyte within the calibrated range.

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Maxxam Job #: B855658
Report Date: 2018/07/16

DILLON CONSULTING LTD.
Client Project #: 126231

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		TU9434			TU9435		
Sampling Date		2018/07/05 17:25			2018/07/04 18:30		
COC Number		558117-01-01			558117-01-01		
	UNITS	WL 1	RDL	QC Batch	WET 21	RDL	QC Batch
Turbidity	NTU	0.48 (1)	0.10	9056447	0.82 (1)	0.10	9056447

RDL = Reportable Detection Limit
(1) Sample was analyzed after holding time expired.

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Maxxam Job #: B855658
Report Date: 2018/07/16

DILLON CONSULTING LTD.
Client Project #: 126231

CSR/CCME DISS. METALS IN WATER W/ CV HG (WATER)

Maxxam ID		TU9434		TU9435		
Sampling Date		2018/07/05 17:25		2018/07/04 18:30		
COC Number		558117-01-01		558117-01-01		
	UNITS	WL 1	QC Batch	WET 21	RDL	QC Batch
Calculated Parameters						
Dissolved Hardness (CaCO3)	mg/L	231	9056053	411	0.50	9057087
Elements						
Dissolved Mercury (Hg)	ug/L	<0.0020	9059730	<0.0020	0.0020	9059730
Dissolved Metals by ICPMS						
Dissolved Aluminum (Al)	ug/L	21.7 (1)	9058834	4.4	3.0	9058834
Dissolved Antimony (Sb)	ug/L	<0.50	9058834	<0.50	0.50	9058834
Dissolved Arsenic (As)	ug/L	0.11	9058834	0.45	0.10	9058834
Dissolved Barium (Ba)	ug/L	56.2	9058834	64.3	1.0	9058834
Dissolved Beryllium (Be)	ug/L	<0.10	9058834	<0.10	0.10	9058834
Dissolved Bismuth (Bi)	ug/L	<1.0	9058834	<1.0	1.0	9058834
Dissolved Boron (B)	ug/L	<50	9058834	127	50	9058834
Dissolved Cadmium (Cd)	ug/L	<0.010	9058834	<0.010	0.010	9058834
Dissolved Chromium (Cr)	ug/L	<1.0	9058834	<1.0	1.0	9058834
Dissolved Cobalt (Co)	ug/L	<0.20	9058834	<0.20	0.20	9058834
Dissolved Copper (Cu)	ug/L	0.39	9058834	0.31	0.20	9058834
Dissolved Iron (Fe)	ug/L	6.3	9058834	57.5	5.0	9058834
Dissolved Lead (Pb)	ug/L	<0.20	9058834	<0.20	0.20	9058834
Dissolved Lithium (Li)	ug/L	16.1	9058834	65.0	2.0	9058834
Dissolved Manganese (Mn)	ug/L	<1.0	9058834	1.6	1.0	9058834
Dissolved Molybdenum (Mo)	ug/L	<1.0	9058834	<1.0	1.0	9058834
Dissolved Nickel (Ni)	ug/L	<1.0	9058834	<1.0	1.0	9058834
Dissolved Selenium (Se)	ug/L	1.27	9058834	0.53	0.10	9058834
Dissolved Silicon (Si)	ug/L	2290	9058834	7930	100	9058834
Dissolved Silver (Ag)	ug/L	<0.020	9058834	<0.020	0.020	9058834
Dissolved Strontium (Sr)	ug/L	263	9058834	1110	1.0	9058834
Dissolved Thallium (Tl)	ug/L	<0.010	9058834	<0.010	0.010	9058834
Dissolved Tin (Sn)	ug/L	<5.0	9058834	<5.0	5.0	9058834
Dissolved Titanium (Ti)	ug/L	<5.0	9058834	<5.0	5.0	9058834
Dissolved Uranium (U)	ug/L	0.41	9058834	0.27	0.10	9058834
Dissolved Vanadium (V)	ug/L	<5.0	9058834	<5.0	5.0	9058834
Dissolved Zinc (Zn)	ug/L	10.8	9058834	<5.0	5.0	9058834
Dissolved Zirconium (Zr)	ug/L	<0.10	9058834	<0.10	0.10	9058834

RDL = Reportable Detection Limit
(1) Dissolved greater than total. Reanalysis yields similar results.

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Report Date: 2018/07/16

DILLON CONSULTING LTD.
Client Project #: 126231

CSR/CCME DISS. METALS IN WATER W/ CV HG (WATER)

Maxxam ID		TU9434		TU9435		
Sampling Date		2018/07/05 17:25		2018/07/04 18:30		
COC Number		558117-01-01		558117-01-01		
	UNITS	WL 1	QC Batch	WET 21	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	58.5	9055700	114	0.050	9057119
Dissolved Magnesium (Mg)	mg/L	20.7	9055700	30.6	0.050	9057119
Dissolved Potassium (K)	mg/L	0.959	9055700	2.37	0.050	9057119
Dissolved Sodium (Na)	mg/L	5.00	9055700	17.4	0.050	9057119
Dissolved Sulphur (S)	mg/L	16.8	9055700	31.1	3.0	9057119
RDL = Reportable Detection Limit						

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Maxxam Job #: B855658
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DILLON CONSULTING LTD.
Client Project #: 126231

CSR/CCME TOT. METALS IN WATER W/ CV HG (WATER)

Maxxam ID		TU9434	TU9435		
Sampling Date		2018/07/05 17:25	2018/07/04 18:30		
COC Number		558117-01-01	558117-01-01		
	UNITS	WL 1	WET 21	RDL	QC Batch
Calculated Parameters					
Total Hardness (CaCO3)	mg/L	214	402	0.50	9056047
Elements					
Total Mercury (Hg)	ug/L	<0.0020	<0.0020	0.0020	9059441
Total Metals by ICPMS					
Total Aluminum (Al)	ug/L	5.4	6.5	3.0	9058972
Total Antimony (Sb)	ug/L	<0.50	<0.50	0.50	9058972
Total Arsenic (As)	ug/L	<0.10	0.47	0.10	9058972
Total Barium (Ba)	ug/L	57.8	64.2	1.0	9058972
Total Beryllium (Be)	ug/L	<0.10	<0.10	0.10	9058972
Total Bismuth (Bi)	ug/L	<1.0	<1.0	1.0	9058972
Total Boron (B)	ug/L	<50	133	50	9058972
Total Cadmium (Cd)	ug/L	<0.010	<0.010	0.010	9058972
Total Chromium (Cr)	ug/L	<1.0	<1.0	1.0	9058972
Total Cobalt (Co)	ug/L	<0.20	<0.20	0.20	9058972
Total Copper (Cu)	ug/L	<0.50	<0.50	0.50	9058972
Total Iron (Fe)	ug/L	<10	61	10	9058972
Total Lead (Pb)	ug/L	<0.20	<0.20	0.20	9058972
Total Lithium (Li)	ug/L	17.3	68.7	2.0	9058972
Total Manganese (Mn)	ug/L	<1.0	3.6	1.0	9058972
Total Molybdenum (Mo)	ug/L	<1.0	<1.0	1.0	9058972
Total Nickel (Ni)	ug/L	<1.0	<1.0	1.0	9058972
Total Selenium (Se)	ug/L	1.28	0.55	0.10	9058972
Total Silicon (Si)	ug/L	2270	7530	100	9058972
Total Silver (Ag)	ug/L	<0.020	<0.020	0.020	9058972
Total Strontium (Sr)	ug/L	265	1130	1.0	9058972
Total Thallium (Tl)	ug/L	<0.010	<0.010	0.010	9058972
Total Tin (Sn)	ug/L	<5.0	<5.0	5.0	9058972
Total Titanium (Ti)	ug/L	<5.0	<5.0	5.0	9058972
Total Uranium (U)	ug/L	0.44	0.30	0.10	9058972
Total Vanadium (V)	ug/L	<5.0	<5.0	5.0	9058972
Total Zinc (Zn)	ug/L	<5.0	<5.0	5.0	9058972
Total Zirconium (Zr)	ug/L	<0.10	<0.10	0.10	9058972
Total Calcium (Ca)	mg/L	54.1	112	0.050	9056055
RDL = Reportable Detection Limit					

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CSR/CCME TOT. METALS IN WATER W/ CV HG (WATER)

Maxxam ID		TU9434	TU9435		
Sampling Date		2018/07/05 17:25	2018/07/04 18:30		
COC Number		558117-01-01	558117-01-01		
	UNITS	**WL 1**	**WET 21**	**RDL**	**QC Batch**
Total Magnesium (Mg)	mg/L	19.2	29.9	0.050	9056055
Total Potassium (K)	mg/L	0.826	2.20	0.050	9056055
Total Sodium (Na)	mg/L	4.44	16.4	0.050	9056055
Total Sulphur (S)	mg/L	12.4	28.8	3.0	9056055
RDL = Reportable Detection Limit					

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CSR PAH IN WATER BY GC-MS (WATER)

Maxxam ID		TU9434	TU9435		
Sampling Date		2018/07/05 17:25	2018/07/04 18:30		
COC Number		558117-01-01	558117-01-01		
	UNITS	WL 1	WET 21	RDL	QC Batch
Calculated Parameters					
Low Molecular Weight PAH`s	ug/L	<0.10	<0.10	0.10	9055539
High Molecular Weight PAH`s	ug/L	<0.050	<0.050	0.050	9055539
Total PAH	ug/L	<0.10	<0.10	0.10	9055539
Polycyclic Aromatics					
Quinoline	ug/L	<0.020	<0.020	0.020	9058592
Naphthalene	ug/L	<0.10	<0.10	0.10	9058592
1-Methylnaphthalene	ug/L	<0.050	<0.050	0.050	9058592
2-Methylnaphthalene	ug/L	<0.10	<0.10	0.10	9058592
Acenaphthylene	ug/L	<0.050	<0.050	0.050	9058592
Acenaphthene	ug/L	<0.050	<0.050	0.050	9058592
Fluorene	ug/L	<0.050	<0.050	0.050	9058592
Phenanthrene	ug/L	<0.050	<0.050	0.050	9058592
Anthracene	ug/L	<0.010	<0.010	0.010	9058592
Acridine	ug/L	<0.050	<0.050	0.050	9058592
Fluoranthene	ug/L	<0.020	<0.020	0.020	9058592
Pyrene	ug/L	<0.020	<0.020	0.020	9058592
Benzo(a)anthracene	ug/L	<0.010	<0.010	0.010	9058592
Chrysene	ug/L	<0.020	<0.020	0.020	9058592
Benzo(b&j)fluoranthene	ug/L	<0.030	<0.030	0.030	9058592
Benzo(k)fluoranthene	ug/L	<0.050	<0.050	0.050	9058592
Benzo(a)pyrene	ug/L	<0.0050	<0.0050	0.0050	9058592
Indeno(1,2,3-cd)pyrene	ug/L	<0.050	<0.050	0.050	9058592
Dibenz(a,h)anthracene	ug/L	<0.0030	<0.0030	0.0030	9058592
Benzo(g,h,i)perylene	ug/L	<0.050	<0.050	0.050	9058592
Surrogate Recovery (%)					
D10-ANTHRACENE (sur.)	%	79	88		9058592
D8-ACENAPHTHYLENE (sur.)	%	85	87		9058592
D8-NAPHTHALENE (sur.)	%	76	83		9058592
TERPHENYL-D14 (sur.)	%	86	96		9058592
RDL = Reportable Detection Limit					

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	4.3°C

Sample TU9435 [WET 21] : Sample was analyzed past method specified hold time for Nitrogen (Nitrite - Nitrate) by IC. Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.}

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

DILLON CONSULTING LTD.
Client Project #: 126231

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9058592	D10-ANTHRACENE (sur.)	2018/07/11	83	50 - 140	89	50 - 140	90	%		
9058592	D8-ACENAPHTHYLENE (sur.)	2018/07/11	86	50 - 140	93	50 - 140	87	%		
9058592	D8-NAPHTHALENE (sur.)	2018/07/11	77	50 - 140	80	50 - 140	73	%		
9058592	TERPHENYL-D14 (sur.)	2018/07/11	90	50 - 140	101	50 - 140	98	%		
9055643	Dissolved Nitrate (N)	2018/07/10	109	80 - 120	103	80 - 120	<0.010	mg/L	1.4	20
9055643	Dissolved Nitrite (N)	2018/07/10	107	80 - 120	102	80 - 120	<0.010	mg/L	3.1	20
9056006	Dissolved Nitrate (N)	2018/07/10	NC	80 - 120	101	80 - 120	<0.010	mg/L	0.35	20
9056006	Dissolved Nitrite (N)	2018/07/10	103	80 - 120	100	80 - 120	<0.010	mg/L		
9056259	Orthophosphate (P)	2018/07/09	99	80 - 120	100	80 - 120	<0.0030	mg/L	3.8	20
9056447	Turbidity	2018/07/09			99	80 - 120	<0.10	NTU	0.90	20
9057697	Dissolved Bromide (Br)	2018/07/11	98	80 - 120	98	80 - 120	<0.010	mg/L	0.51	20
9058197	pH	2018/07/11			101	97 - 103				
9058199	Conductivity	2018/07/11			100	80 - 120	<2.0	uS/cm		
9058202	Alkalinity (PP as CaCO3)	2018/07/11					<1.0	mg/L	NC	20
9058202	Alkalinity (Total as CaCO3)	2018/07/11	NC	80 - 120	99	80 - 120	<1.0	mg/L	1.8	20
9058202	Bicarbonate (HCO3)	2018/07/11					<1.0	mg/L	1.8	20
9058202	Carbonate (CO3)	2018/07/11					<1.0	mg/L	NC	20
9058202	Hydroxide (OH)	2018/07/11					<1.0	mg/L	NC	20
9058592	1-Methylnaphthalene	2018/07/11	NC	50 - 140	83	50 - 140	<0.050	ug/L	NC	40
9058592	2-Methylnaphthalene	2018/07/11	NC	50 - 140	81	50 - 140	<0.10	ug/L	NC	40
9058592	Acenaphthene	2018/07/11	NC	50 - 140	86	50 - 140	<0.050	ug/L	NC	40
9058592	Acenaphthylene	2018/07/11	89	50 - 140	84	50 - 140	<0.050	ug/L	NC	40
9058592	Acridine	2018/07/11	101	50 - 140	92	50 - 140	<0.050	ug/L	NC	40
9058592	Anthracene	2018/07/11	107	50 - 140	86	50 - 140	<0.010	ug/L	NC	40
9058592	Benzo(a)anthracene	2018/07/11	92	50 - 140	87	50 - 140	<0.010	ug/L	NC	40
9058592	Benzo(a)pyrene	2018/07/11	90	50 - 140	86	50 - 140	<0.0050	ug/L	NC	40
9058592	Benzo(b&j)fluoranthene	2018/07/11	95	50 - 140	91	50 - 140	<0.030	ug/L	NC	40
9058592	Benzo(g,h,i)perylene	2018/07/11	77	50 - 140	77	50 - 140	<0.050	ug/L	NC	40
9058592	Benzo(k)fluoranthene	2018/07/11	91	50 - 140	91	50 - 140	<0.050	ug/L	NC	40
9058592	Chrysene	2018/07/11	89	50 - 140	85	50 - 140	<0.020	ug/L	NC	40
9058592	Dibenz(a,h)anthracene	2018/07/11	81	50 - 140	81	50 - 140	<0.0030	ug/L	NC	40
9058592	Fluoranthene	2018/07/11	NC	50 - 140	89	50 - 140	<0.020	ug/L	NC	40

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QUALITY ASSURANCE REPORT(CONT'D)

DILLON CONSULTING LTD.
Client Project #: 126231

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9058592	Fluorene	2018/07/11	NC	50 - 140	83	50 - 140	<0.050	ug/L	NC	40
9058592	Indeno(1,2,3-cd)pyrene	2018/07/11	78	50 - 140	79	50 - 140	<0.050	ug/L	NC	40
9058592	Naphthalene	2018/07/11	NC	50 - 140	87	50 - 140	<0.10	ug/L	NC	40
9058592	Phenanthrene	2018/07/11	NC	50 - 140	80	50 - 140	<0.050	ug/L	NC	40
9058592	Pyrene	2018/07/11	NC	50 - 140	93	50 - 140	<0.020	ug/L	NC	40
9058592	Quinoline	2018/07/11	109	50 - 140	103	50 - 140	<0.020	ug/L	NC	40
9058818	Total Suspended Solids	2018/07/11	102	80 - 120	100	80 - 120	<4.0	mg/L	NC	20
9058834	Dissolved Aluminum (Al)	2018/07/11	97	80 - 120	101	80 - 120	<3.0	ug/L		
9058834	Dissolved Antimony (Sb)	2018/07/11	101	80 - 120	101	80 - 120	<0.50	ug/L		
9058834	Dissolved Arsenic (As)	2018/07/11	101	80 - 120	97	80 - 120	<0.10	ug/L		
9058834	Dissolved Barium (Ba)	2018/07/11	100	80 - 120	101	80 - 120	<1.0	ug/L		
9058834	Dissolved Beryllium (Be)	2018/07/11	98	80 - 120	100	80 - 120	<0.10	ug/L		
9058834	Dissolved Bismuth (Bi)	2018/07/11	100	80 - 120	104	80 - 120	<1.0	ug/L		
9058834	Dissolved Boron (B)	2018/07/11	105	80 - 120	106	80 - 120	<50	ug/L		
9058834	Dissolved Cadmium (Cd)	2018/07/11	99	80 - 120	100	80 - 120	<0.010	ug/L	1.1	20
9058834	Dissolved Chromium (Cr)	2018/07/11	93	80 - 120	96	80 - 120	<1.0	ug/L		
9058834	Dissolved Cobalt (Co)	2018/07/11	92	80 - 120	95	80 - 120	<0.20	ug/L		
9058834	Dissolved Copper (Cu)	2018/07/11	89	80 - 120	93	80 - 120	<0.20	ug/L		
9058834	Dissolved Iron (Fe)	2018/07/11	98	80 - 120	100	80 - 120	<5.0	ug/L		
9058834	Dissolved Lead (Pb)	2018/07/11	99	80 - 120	103	80 - 120	<0.20	ug/L		
9058834	Dissolved Lithium (Li)	2018/07/11	101	80 - 120	102	80 - 120	<2.0	ug/L		
9058834	Dissolved Manganese (Mn)	2018/07/11	94	80 - 120	98	80 - 120	<1.0	ug/L		
9058834	Dissolved Molybdenum (Mo)	2018/07/11	102	80 - 120	104	80 - 120	<1.0	ug/L		
9058834	Dissolved Nickel (Ni)	2018/07/11	91	80 - 120	94	80 - 120	<1.0	ug/L		
9058834	Dissolved Selenium (Se)	2018/07/11	98	80 - 120	94	80 - 120	<0.10	ug/L		
9058834	Dissolved Silicon (Si)	2018/07/11	106	80 - 120	109	80 - 120	<100	ug/L		
9058834	Dissolved Silver (Ag)	2018/07/11	100	80 - 120	101	80 - 120	<0.020	ug/L		
9058834	Dissolved Strontium (Sr)	2018/07/11	NC	80 - 120	99	80 - 120	<1.0	ug/L		
9058834	Dissolved Thallium (Tl)	2018/07/11	100	80 - 120	103	80 - 120	<0.010	ug/L		
9058834	Dissolved Tin (Sn)	2018/07/11	100	80 - 120	102	80 - 120	<5.0	ug/L		
9058834	Dissolved Titanium (Ti)	2018/07/11	98	80 - 120	99	80 - 120	<5.0	ug/L		
9058834	Dissolved Uranium (U)	2018/07/11	101	80 - 120	102	80 - 120	<0.10	ug/L		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9058834	Dissolved Vanadium (V)	2018/07/11	96	80 - 120	95	80 - 120	<5.0	ug/L		
9058834	Dissolved Zinc (Zn)	2018/07/11	90	80 - 120	97	80 - 120	<5.0	ug/L		
9058834	Dissolved Zirconium (Zr)	2018/07/11	95	80 - 120	95	80 - 120	<0.10	ug/L		
9058972	Total Aluminum (Al)	2018/07/12	105	80 - 120	106	80 - 120	<3.0	ug/L	NC	20
9058972	Total Antimony (Sb)	2018/07/12	106	80 - 120	106	80 - 120	<0.50	ug/L	NC	20
9058972	Total Arsenic (As)	2018/07/12	108	80 - 120	106	80 - 120	<0.10	ug/L	NC	20
9058972	Total Barium (Ba)	2018/07/12	107	80 - 120	108	80 - 120	<1.0	ug/L	NC	20
9058972	Total Beryllium (Be)	2018/07/12	107	80 - 120	106	80 - 120	<0.10	ug/L	NC	20
9058972	Total Bismuth (Bi)	2018/07/12	100	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
9058972	Total Boron (B)	2018/07/12	103	80 - 120	99	80 - 120	<50	ug/L	NC	20
9058972	Total Cadmium (Cd)	2018/07/12	105	80 - 120	105	80 - 120	<0.010	ug/L	NC	20
9058972	Total Chromium (Cr)	2018/07/12	104	80 - 120	108	80 - 120	<1.0	ug/L	NC	20
9058972	Total Cobalt (Co)	2018/07/12	105	80 - 120	107	80 - 120	<0.20	ug/L	NC	20
9058972	Total Copper (Cu)	2018/07/12	103	80 - 120	105	80 - 120	<0.50	ug/L	NC	20
9058972	Total Iron (Fe)	2018/07/12	104	80 - 120	106	80 - 120	<10	ug/L	NC	20
9058972	Total Lead (Pb)	2018/07/12	108	80 - 120	107	80 - 120	<0.20	ug/L	NC	20
9058972	Total Lithium (Li)	2018/07/12	106	80 - 120	110	80 - 120	<2.0	ug/L	NC	20
9058972	Total Manganese (Mn)	2018/07/12	104	80 - 120	108	80 - 120	<1.0	ug/L	NC	20
9058972	Total Molybdenum (Mo)	2018/07/12	110	80 - 120	106	80 - 120	<1.0	ug/L	NC	20
9058972	Total Nickel (Ni)	2018/07/12	103	80 - 120	108	80 - 120	<1.0	ug/L	NC	20
9058972	Total Selenium (Se)	2018/07/12	105	80 - 120	106	80 - 120	<0.10	ug/L	NC	20
9058972	Total Silicon (Si)	2018/07/12	NC	80 - 120	104	80 - 120	<100	ug/L	NC	20
9058972	Total Silver (Ag)	2018/07/12	105	80 - 120	103	80 - 120	<0.020	ug/L	NC	20
9058972	Total Strontium (Sr)	2018/07/12	NC	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
9058972	Total Thallium (Tl)	2018/07/12	110	80 - 120	107	80 - 120	<0.010	ug/L	NC	20
9058972	Total Tin (Sn)	2018/07/12	105	80 - 120	102	80 - 120	<5.0	ug/L	NC	20
9058972	Total Titanium (Ti)	2018/07/12	107	80 - 120	108	80 - 120	<5.0	ug/L	NC	20
9058972	Total Uranium (U)	2018/07/12	107	80 - 120	105	80 - 120	<0.10	ug/L	NC	20
9058972	Total Vanadium (V)	2018/07/12	104	80 - 120	104	80 - 120	<5.0	ug/L	NC	20
9058972	Total Zinc (Zn)	2018/07/12	105	80 - 120	109	80 - 120	<5.0	ug/L	NC	20
9058972	Total Zirconium (Zr)	2018/07/12	105	80 - 120	100	80 - 120	<0.10	ug/L	NC	20
9059161	Dissolved Chloride (Cl)	2018/07/10	105	80 - 120	100	80 - 120	<1.0	mg/L	0.77	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9059166	Dissolved Sulphate (SO4)	2018/07/10			96	80 - 120	<1.0	mg/L		
9059257	Fluoride (F)	2018/07/11	NC	80 - 120	100	80 - 120	<0.020	mg/L	0	20
9059441	Total Mercury (Hg)	2018/07/11	96	80 - 120	105	80 - 120	<0.0020	ug/L	NC	20
9059730	Dissolved Mercury (Hg)	2018/07/12	89	80 - 120	109	80 - 120	<0.0020	ug/L	NC	20
9059754	Alkalinity (PP as CaCO3)	2018/07/11					<1.0	mg/L		
9059754	Alkalinity (Total as CaCO3)	2018/07/11	NC	80 - 120	95	80 - 120	<1.0	mg/L		
9059754	Bicarbonate (HCO3)	2018/07/11					<1.0	mg/L		
9059754	Carbonate (CO3)	2018/07/11					<1.0	mg/L		
9059754	Hydroxide (OH)	2018/07/11					<1.0	mg/L		
9059755	pH	2018/07/11			101	97 - 103			0.38	20
9059756	Conductivity	2018/07/11			98	80 - 120	<2.0	uS/cm		
9060291	Dissolved Organic Carbon (C)	2018/07/13	110	80 - 120	105	80 - 120	<0.50	mg/L	0.60	20
9060293	Total Suspended Solids	2018/07/16	105	80 - 120	102	80 - 120	<4.0	mg/L	NC	20
9060762	Fluoride (F)	2018/07/12	94	80 - 120	102	80 - 120	<0.020	mg/L	0	20
9061652	Total Organic Carbon (C)	2018/07/13	99	80 - 120	97	80 - 120	<0.50	mg/L	NC	20
9061653	Dissolved Organic Carbon (C)	2018/07/13	NC	80 - 120	97	80 - 120	<0.50	mg/L	0.37	20
9062449	Dissolved Chloride (Cl)	2018/07/12	109	80 - 120	101	80 - 120	<1.0	mg/L	4.9	20
9062451	Dissolved Sulphate (SO4)	2018/07/12	118	80 - 120	105	80 - 120	<1.0	mg/L	9.3	20
9062843	Total Ammonia (N)	2018/07/13	106	80 - 120	100	80 - 120	<0.020	mg/L	16	20
9063822	Total Phosphorus (P)	2018/07/14			99	80 - 120	<0.0050	mg/L		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B855658
Report Date: 2018/07/16

DILLON CONSULTING LTD.
Client Project #: 126231

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

<Original signed by>

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

<Original signed by>

Harry (Peng) Liang, Senior Analyst

<Original signed by>

Rob Reinert, B.Sc., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Chain Of Custody Record

Page of

INVOICE TO:		Report Information		Project Information		Laboratory Use Only	
Company Name	#15986 DILLON CONSULTING LTD.	Company Name		Quotation #	B70427	Maxxam Job #	Bottle Order #:
Contact Name	Accounts Payable	Contact Name	Jacqueline Huard	P.O. #			558117
Address	510 - 3820 CESSNA DRIVE Richmond BC V7B 0A2	Address		Project #	126231	Chain Of Custody Record	Project Manager
Phone	(604) 278-7847 Fax: (604) 278-7894	Phone	Fax:	Project Name		C#558117-01-01	Nahed Amer
Email	salmeida@dillon.ca	Email	jhuard@dillon.ca; ldilley@dillon.ca; rpope@dillon.ca	Site #	Crown Mountain		
				Sampled By			

Regulatory Criteria:
- [ ] CSR
- [ ] CCME
- [x] BC Water Quality
- [ ] Other

Special Instructions:

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: [x]
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
1 DAY [ ] 2 Day [ ] 3 Day [ ] Date Required: _____ [ ]
Rush Confirmation Number: _____ (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	CSR PAH in Water by GC-MS	Low Level Dissolved Metals with CV Hg	Low Level Total Metals with CV Hg	Alkalinity, Bromide, Chloride, Conductivity, Fluoride	Ammonia, TOC, DOC, Total Phosphorus	Nitrate + Nitrite (N), Nitrate, Nitrite	Orthophosphate, pH, Sulphate, Turbidity	Total Suspended Solids-Low Level			# of Bottles	Comments
1		WL1	2018-07-05	17:25		Y	✓	✓	✓	✓	✓	✓	✓	✓			14	
2		WET 21	2018-07-04	18:30		Y	✓	✓	✓	✓	✓	✓	✓	✓			9	
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

07-Jul-18 16:23
Nahed Amer
B855658
IL4 INS-0001

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Lab Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
<Original signed by>	18/07/07	16:20	[signature]	18/07/07	16:23		[ ]	5, 4, 4	[ ] Yes [x] No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

DILLON CONSULTING LIMITED
ATTN: Jacqueline Huard
510 - 3820 Cessna Drive
Richmond BC V7B 0A2

Date Received: 13-MAY-19
Report Date: 23-MAY-19 15:44 (MT)
Version: FINAL

Client Phone: 604-278-7847

Certificate of Analysis

Lab Work Order #: L2271768

Project P.O. #: NOT SUBMITTED
Job Reference: 126231
C of C Numbers: 17-701629
Legal Site Desc:

<Original signed by>

Ryan Smyth, B.A.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2271768-1	L2271768-2			
	Description	Water	Water			
	Sampled Date	09-MAY-19	09-MAY-19			
	Sampled Time	14:30	16:15			
	Client ID	WF-WL15-19	CSF-WL117-19			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	1010	660			
	Hardness (as CaCO3) (mg/L)	529	424			
	pH (pH)	8.35	8.37			
	Total Suspended Solids (mg/L)	<1.0	5.7			
	Turbidity (NTU)	0.54	3.26			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	244	327			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.8	8.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Phenolphthalein (mg/L)	2.4	4.0			
	Alkalinity, Total (as CaCO3) (mg/L)	249	335			
	Ammonia as N (mg/L)	0.0673	0.262			
	Bromide (Br) (mg/L)	<0.25 DLHC	<0.25 DLHC			
	Chloride (Cl) (mg/L)	11.7 DLHC	<2.5 DLHC			
	Fluoride (F) (mg/L)	0.21 DLHC	0.23 DLHC			
	Nitrate and Nitrite (as N) (mg/L)	0.081	<0.025			
	Nitrate (as N) (mg/L)	0.081 DLHC	<0.025 DLHC			
	Nitrite (as N) (mg/L)	<0.0050 DLHC	<0.0050 DLHC			
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	0.0137			
	Phosphorus (P)-Total (mg/L)	0.0127	0.0483			
	Sulfate (SO4) (mg/L)	332 DLHC	128 DLHC			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	25.0	21.2			
	Total Organic Carbon (mg/L)	25.2	21.7			
Total Metals	Aluminum (Al)-Total (mg/L)	<0.015 DLM	<0.015 DLM			
	Antimony (Sb)-Total (mg/L)	<0.00050 DLM	<0.00050 DLM			
	Arsenic (As)-Total (mg/L)	0.00050 DLM	0.00084 DLM			
	Barium (Ba)-Total (mg/L)	0.0854 DLM	0.0704 DLM			
	Beryllium (Be)-Total (mg/L)	<0.00050 DLM	<0.00050 DLM			
	Boron (B)-Total (mg/L)	0.120 DLM	0.074 DLM			
	Cadmium (Cd)-Total (mg/L)	<0.000025 DLM	<0.000025 DLM			
	Calcium (Ca)-Total (mg/L)	141 DLM	116 DLM			
	Chromium (Cr)-Total (mg/L)	<0.00050 DLM	<0.00050 DLM			
	Cobalt (Co)-Total (mg/L)	<0.00050 DLM	0.00054 DLM			
	Copper (Cu)-Total (mg/L)	<0.0025 DLM	<0.0025 DLM			
	Iron (Fe)-Total (mg/L)	<0.050 DLM	0.908 DLM			
	Lead (Pb)-Total (mg/L)	0.00035 DLM	<0.00025 DLM			
	Lithium (Li)-Total (mg/L)	0.0640 DLM	0.0349 DLM			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2271768-1	L2271768-2			
	Description	Water	Water			
	Sampled Date	09-MAY-19	09-MAY-19			
	Sampled Time	14:30	16:15			
	Client ID	WF-WL15-19	CSF-WL117-19			
Grouping	**Analyte**					
WATER						
Total Metals	Magnesium (Mg)-Total (mg/L)	38.3 DLM	32.0 DLM			
	Manganese (Mn)-Total (mg/L)	0.00209 DLM	0.124 DLM			
	Mercury (Hg)-Total (mg/L)	<0.000025 DLM	<0.000025 DLM			
	Molybdenum (Mo)-Total (mg/L)	0.00375 DLM	0.00568 DLM			
	Nickel (Ni)-Total (mg/L)	<0.0025 DLM	<0.0025 DLM			
	Potassium (K)-Total (mg/L)	2.75 DLM	2.15 DLM			
	Selenium (Se)-Total (mg/L)	0.00031 DLM	<0.00025 DLM			
	Silver (Ag)-Total (mg/L)	<0.000050 DLM	<0.000050 DLM			
	Sodium (Na)-Total (mg/L)	19.0 DLM	13.4 DLM			
	Thallium (Tl)-Total (mg/L)	<0.000050 DLM	<0.000050 DLM			
	Tin (Sn)-Total (mg/L)	<0.00050 DLM	<0.00050 DLM			
	Titanium (Ti)-Total (mg/L)	<0.0015 DLM	<0.0015 DLM			
	Uranium (U)-Total (mg/L)	0.00197 DLM	0.000662 DLM			
	Vanadium (V)-Total (mg/L)	<0.0025 DLM	<0.0025 DLM			
	Zinc (Zn)-Total (mg/L)	<0.015 DLM	<0.015 DLM			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	LAB	LAB			
	Aluminum (Al)-Dissolved (mg/L)	0.0073 DLM	<0.0050 DLM			
	Antimony (Sb)-Dissolved (mg/L)	<0.00050 DLM	<0.00050 DLM			
	Arsenic (As)-Dissolved (mg/L)	0.00052 DLM	0.00089 DLM			
	Barium (Ba)-Dissolved (mg/L)	0.0894 DLM	0.0742 DLM			
	Beryllium (Be)-Dissolved (mg/L)	<0.00050 DLM	<0.00050 DLM			
	Boron (B)-Dissolved (mg/L)	0.124 DLM	0.073 DLM			
	Cadmium (Cd)-Dissolved (mg/L)	<0.000025 DLM	<0.000025 DLM			
	Calcium (Ca)-Dissolved (mg/L)	148 DLM	118 DLM			
	Chromium (Cr)-Dissolved (mg/L)	<0.00050 DLM	<0.00050 DLM			
	Cobalt (Co)-Dissolved (mg/L)	<0.00050 DLM	0.00056 DLM			
	Copper (Cu)-Dissolved (mg/L)	<0.0010 DLM	<0.0010 DLM			
	Iron (Fe)-Dissolved (mg/L)	<0.050 DLM	0.413 DLM			
	Lead (Pb)-Dissolved (mg/L)	<0.00025 DLM	<0.00025 DLM			
	Lithium (Li)-Dissolved (mg/L)	0.0659 DLM	0.0357 DLM			
	Magnesium (Mg)-Dissolved (mg/L)	38.4 DLM	31.5 DLM			
	Manganese (Mn)-Dissolved (mg/L)	0.00203 DLM	0.122 DLM			
	Mercury (Hg)-Dissolved (mg/L)	<0.000025 DLM	<0.000025 DLM			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00394 DLM	0.00590 DLM			
	Nickel (Ni)-Dissolved (mg/L)	<0.0025 DLM	<0.0025 DLM			
	Potassium (K)-Dissolved (mg/L)	2.83 DLM	2.19 DLM			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2271768-1	L2271768-2			
	Description	Water	Water			
	Sampled Date	09-MAY-19	09-MAY-19			
	Sampled Time	14:30	16:15			
	Client ID	WF-WL15-19	CSF-WL117-19			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	DLM <0.00025	DLM <0.00025			
	Silver (Ag)-Dissolved (mg/L)	DLM <0.000050	DLM <0.000050			
	Sodium (Na)-Dissolved (mg/L)	DLM 19.3	DLM 12.7			
	Thallium (Tl)-Dissolved (mg/L)	DLM <0.000050	DLM <0.000050			
	Tin (Sn)-Dissolved (mg/L)	DLM <0.00050	DLM <0.00050			
	Titanium (Ti)-Dissolved (mg/L)	DLM <0.0015	DLM <0.0015			
	Uranium (U)-Dissolved (mg/L)	DLM 0.00198	DLM 0.000647			
	Vanadium (V)-Dissolved (mg/L)	DLM <0.0025	DLM <0.0025			
	Zinc (Zn)-Dissolved (mg/L)	DLM <0.0050	DLM <0.0050			
Polycyclic Aromatic Hydrocarbons	Acenaphthene (ug/L)	<0.010	<0.010			
	Acenaphthylene (ug/L)	<0.010	<0.010			
	Acridine (ug/L)	<0.010	<0.010			
	Anthracene (ug/L)	<0.010	<0.010			
	Benz(a)anthracene (ug/L)	<0.010	<0.010			
	Benzo(a)pyrene (ug/L)	<0.0050	<0.0050			
	Benzo(b&j)fluoranthene (ug/L)	<0.010	<0.010			
	Benzo(g,h,i)perylene (ug/L)	<0.010	<0.010			
	Benzo(k)fluoranthene (ug/L)	<0.010	<0.010			
	Chrysene (ug/L)	<0.010	<0.010			
	Dibenz(a,h)anthracene (ug/L)	<0.0050	<0.0050			
	Fluoranthene (ug/L)	<0.010	<0.010			
	Fluorene (ug/L)	<0.010	<0.010			
	Indeno(1,2,3-c,d)pyrene (ug/L)	<0.010	<0.010			
	1-Methylnaphthalene (ug/L)	<0.050	<0.050			
	2-Methylnaphthalene (ug/L)	<0.020	<0.020			
	Naphthalene (ug/L)	<0.020	<0.020			
	Phenanthrene (ug/L)	<0.020	<0.020			
	Pyrene (ug/L)	<0.010	<0.010			
	Quinoline (ug/L)	<0.050	<0.050			
	Surrogate: Acenaphthene d10 (%)	108.2	121.8			
	Surrogate: Chrysene d12 (%)	90.2	112.9			
	Surrogate: Phenanthrene d10 (%)	107.8	124.9			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
EHR	Exceeded Recommended Holding Time prior to receipt at the lab. - HOLD TIME FOR NO2/NO3/PO4/TURBIDITY EXCEEDED UPON ARRIVAL

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Total	MS-B	L2271768-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2271768-1, -2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2271768-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PP-CL	Water	Alkalinity, Phenolphthalein Endpoint	APHA 2320 B-Auto-Pot. Titration

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Phenolphthalein alkalinity is determined by potentiometric titration to a pH 8.3 endpoint.

BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-IC-N-CL	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-CL	Water	Electrical Conductivity (EC)	APHA 2510 B

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-CL	Water	Hardness	APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents.

Reference Information

Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-CL	Water	Dissolved Mercury in Water by CVAAS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.

HG-T-CVAA-CL	Water	Total Mercury in Water by CVAAS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.

MET-D-CCMS-CL	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-CL	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N2N3-CALC-CL	Water	Nitrate+Nitrite	CALCULATION
NH3-L-F-CL	Water	Ammonia, Total (as N)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-L-COL-CL	Water	Phosphorus (P)-Total	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PAH-BCCSR-CL	Water	PAHs - BC CSR Regs	EPA 3511/8270D

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS.
Container: 250 ML AMBER-EPH/PAH

PH-CL	Water	pH	APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL	Water	Orthophosphate-Dissolved (as P)	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TSS-L-CL	Water	Total Suspended Solids	APHA 2540 D-Gravimetric

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, and by drying the filter at 104 deg. C.

TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

Reference Information

17-701629

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2271768-COFC

COC Number: 17 - 701629

Page of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Dillon Consulting Limited	Select Report Format: [X] PDF [X] EXCEL [ ] EDD (DIGITAL)	Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Jacqueline Huard	Quality Control (QC) Report with Report [X] YES [ ] NO	PRIORITY (Business Days): 4 day [P4-20%] [ ]; 3 day [P3-25%] [ ]; 2 day [P2-50%] [ ]
Phone:	778 678 0637	[ ] Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E-100%] [ ]; Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] [ ]
	Company address below will appear on the final report	Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX	
Street:	Suite 510, 3820 Cessna Dr	Email 1 or Fax: jhuard@Dillon.ca	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	Richmond, BC	Email 2: Ldilley@Dillon.ca	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:		Email 3: rpope@dillon.ca	

Invoice To		Invoice Distribution
	Same as Report To [X] YES [ ] NO	Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX
	Copy of Invoice with Report [ ] YES [ ] NO	
Company:		Email 1 or Fax
Contact:		Email 2

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Q73225	AFE/Cost Center:	PO#:
Job #:	1262231	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Jasmeen	Sampler: JRH

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Gen Chem	Dissolved metals	Hg	PAH/EPH/LEPH/HEPH	Nutrients total	Nutrients Diss	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	WF-WL15-19	09-05-19	1430	Water		X	X	X	X	X			
	CSF-WL117-19	09-05-19	1615	"		X	X	X	X	X			

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? [ ] YES [X] NO	*Short hold time Samples - See full Crown list
Are samples for human consumption/ use? [ ] YES [X] NO	

SAMPLE CONDITION AS RECEIVED (lab use only)					
Frozen [ ]	SIF Observations	Yes [ ]	No [ ]		
Ice Packs [ ]	Ice Cubes [ ]	Custody seal intact	Yes [ ]	No [ ]	
Cooling Initiated [ ]					
INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C	
				16	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: <Original signed by>	Date: May 9, 2019	Time: 1700	Received by:	Date:	Time:	Received by:	Date: 5/13	Time: 8:45

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

DILLON CONSULTING LIMITED
ATTN: Jacqueline Huard
510 - 3820 Cessna Drive
Richmond BC V7B 0A2

Date Received: 24-MAY-19
Report Date: 03-JUN-19 16:21 (MT)
Version: FINAL

Client Phone: 604-278-7847

Certificate of Analysis

Lab Work Order #: L2278661

Project P.O. #: NOT SUBMITTED
Job Reference: 126231 - CROWN MOUNTAIN
C of C Numbers: 17-701630
Legal Site Desc:

<Original signed by>

Ryan Smyth, B.A.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2278661-1				
	Description	WATER				
	Sampled Date	21-MAY-19				
	Sampled Time	14:30				
	Client ID	CSF - 4.1-19				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	399				
	Hardness (as CaCO3) (mg/L)	204				
	pH (pH)	8.16				
	Total Suspended Solids (mg/L)	1.6				
	Turbidity (NTU)	1.16				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	211				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Phenolphthalein (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	211				
	Ammonia as N (mg/L)	0.0984				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	0.110				
	Nitrate and Nitrite (as N) (mg/L)	<0.0051				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Orthophosphate-Dissolved (as P) (mg/L)	0.0019				
	Phosphorus (P)-Total (mg/L)	0.0155				
	Sulfate (SO4) (mg/L)	9.43				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	10.1				
	Total Organic Carbon (mg/L)	10.5				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0032				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00032				
	Barium (Ba)-Total (mg/L)	0.0848				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Boron (B)-Total (mg/L)	0.013				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	71.5				
	Chromium (Cr)-Total (mg/L)	0.00013				
	Cobalt (Co)-Total (mg/L)	0.00015				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	0.669				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0057				

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2278661-1				
	Description	WATER				
	Sampled Date	21-MAY-19				
	Sampled Time	14:30				
	Client ID	CSF - 4.1-19				
Grouping	**Analyte**					
WATER						
Total Metals	Magnesium (Mg)-Total (mg/L)	16.4				
	Manganese (Mn)-Total (mg/L)	0.227				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.000892				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Potassium (K)-Total (mg/L)	0.814				
	Selenium (Se)-Total (mg/L)	0.000081				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	2.68				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.00030				
	Uranium (U)-Total (mg/L)	0.000299				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0012				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00029				
	Barium (Ba)-Dissolved (mg/L)	0.0774				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010				
	Boron (B)-Dissolved (mg/L)	0.015				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	59.0				
	Chromium (Cr)-Dissolved (mg/L)	0.00017				
	Cobalt (Co)-Dissolved (mg/L)	0.00013				
	Copper (Cu)-Dissolved (mg/L)	<0.00020				
	Iron (Fe)-Dissolved (mg/L)	0.348				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0069				
	Magnesium (Mg)-Dissolved (mg/L)	13.8				
	Manganese (Mn)-Dissolved (mg/L)	0.213				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.000835				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Potassium (K)-Dissolved (mg/L)	0.744				

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2278661-1				
	Description	WATER				
	Sampled Date	21-MAY-19				
	Sampled Time	14:30				
	Client ID	CSF - 4.1-19				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	0.000115				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	2.49				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.000229				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (ug/L)	<0.010				
	Acenaphthylene (ug/L)	<0.010				
	Acridine (ug/L)	<0.010				
	Anthracene (ug/L)	<0.010				
	Benz(a)anthracene (ug/L)	<0.010				
	Benzo(a)pyrene (ug/L)	<0.0050				
	Benzo(b&j)fluoranthene (ug/L)	<0.010				
	Benzo(g,h,i)perylene (ug/L)	<0.010				
	Benzo(k)fluoranthene (ug/L)	<0.010				
	Chrysene (ug/L)	<0.010				
	Dibenz(a,h)anthracene (ug/L)	<0.0050				
	Fluoranthene (ug/L)	<0.010				
	Fluorene (ug/L)	<0.010				
	Indeno(1,2,3-c,d)pyrene (ug/L)	<0.010				
	1-Methylnaphthalene (ug/L)	<0.050				
	2-Methylnaphthalene (ug/L)	<0.020				
	Naphthalene (ug/L)	<0.020				
	Phenanthrene (ug/L)	<0.020				
	Pyrene (ug/L)	<0.010				
	Quinoline (ug/L)	<0.050				
	Surrogate: Acenaphthene d10 (%)	121.4				
	Surrogate: Chrysene d12 (%)	114.3				
	Surrogate: Phenanthrene d10 (%)	118.0				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PP-CL	Water	Alkalinity, Phenolphthalein Endpoint	APHA 2320 B-Auto-Pot. Titration

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Phenolphthalein alkalinity is determined by potentiometric titration to a pH 8.3 endpoint.

BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-IC-N-CL	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-CL	Water	Electrical Conductivity (EC)	APHA 2510 B

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-CL	Water	Hardness	APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-CL	Water	Dissolved Mercury in Water by CVAAS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.

HG-T-CVAA-CL	Water	Total Mercury in Water by CVAAS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.

MET-D-CCMS-CL	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-CL	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N2N3-CALC-CL	Water	Nitrate+Nitrite	CALCULATION
NH3-L-F-CL	Water	Ammonia, Total (as N)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society

Reference Information

of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-L-COL-CL	Water	Phosphorus (P)-Total	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PAH-BCCSR-CL	Water	PAHs - BC CSR Regs	EPA 3511/8270D

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS.
Container: 250 ML AMBER-EPH/PAH

PH-CL	Water	pH	APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL	Water	Orthophosphate-Dissolved (as P)	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TSS-L-CL	Water	Total Suspended Solids	APHA 2540 D-Gravimetric

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, and by drying the filter at 104 deg. C.

TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

17-701630

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2278661-COFC

COC Number: 17 - 701630

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Dillon Consulting Limited
Contact:	Jacqueline Hward J.
Phone:	778 073 0637
Company address below will appear on the final report	
Street:	3820 Cessna Drive, Suite 510
City/Province:	Richmond, BC
Postal Code:	V7B 0A2

Report Format / Distribution	
Select Report Format:	[X] PDF [X] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report	[X] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	[X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	jhward@dillon.ca
Email 2	JLdilley@dillon.ca
Email 3	

Invoice To		
	Same as Report To	[X] YES [ ] NO
	Copy of Invoice with Report	[ ] YES [ ] NO
Company:		
Contact:		

Invoice Distribution	
Select Invoice Distribution:	[X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	Q73225
Job #:	126231 - Crown Mountain
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): [ ] 4 day [P4-20%] [ ] 3 day [P3-25%] [ ] 2 day [P2-50%]

EMERGENCY: [ ] 1 Business day [E-100%] [ ] Same Day, Weekend or Statutory holiday [E2-200%] (Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chemistry	Metals Diss + Hg	Metals Total + Hg	PAH/EPH/LEPH/HEPH	"	Total Nutrients	Diss Nutrients	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	CSF - 4.1 - 19	21-May-19	1430	Water	X	X	X	X	X	X	X			9

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? [ ] YES [X] NO	★ short hold t-t
Are samples for human consumption/ use? [ ] YES [X] NO	★ use quote for full analysis required

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
9°							

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: <Original signed by>	Date: May 21, 19	Time:	Received by: DK	Date: 5/24	Time: 0900	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Appendix G

Parameter-Dependent Water Quality Guidelines

ALUMINUM (DISSOLVED) - BC WQG AND CCME CWQG

BC WQG Guideline applies to dissolved aluminum concentrations.

Long- and short-term average WQGs and CWQGs for aluminum (dissolved) are pH dependent.

Notes: pH >= 6.5; therefore long-term average BC WQG is 0.05 mg/L

Notes: pH >= 6.5; therefore short-term average BC WQG and CCME CWQG is 0.1 mg/L

SW checked for accuracy of the WQGs corresponding to the sample

Appendix G-1: Aluminum Guideline Calculations

Sample ID	Date Sampled	Field pH	BC WQG				CWQG	
			Long-Term BC WQG (ug/L)	**Aluminum (Dissolved) (mg/L)**	*Short-Term BC WQG (ug/L)*	**Aluminum (Dissolved) (mg/L)**	*Long-Term CWQG (ug/L)*	**Aluminum (Total) (mg/L)**
18-WF-WL9B	2018-05-05	7.54	*0.05*	**0.00436**	*0.1*	**0.00436**	*0.1*	**0.0187**
18-WL9	2018-05-05	7.62	*0.05*	**0.00331**	*0.1*	**0.00331**	*0.1*	**0.01**
18-WF-10	2018-05-08	7.68	*0.05*	**0.0048**	*0.1*	**0.0048**	*0.1*	**0.0108**
18-CSF-07	2018-05-09	7.83	*0.05*	**0.0048**	*0.1*	**0.0048**	*0.1*	**0.0127**
WET21	2018-07-04	8.06*	*0.05*	**0.0044**	*0.1*	**0.0044**	*0.1*	**0.0065**
WL1	2018-07-05	8.46*	*0.05*	**0.0217**	*0.1*	**0.0217**	*0.1*	**0.0054**
WF-WL15-19	2019-05-09	7.50	*0.05*	**0.0073**	*0.1*	**0.0073**	*0.1*	**<0.015**
CSF-WL117-19	2019-05-09	7.54	*0.05*	**<0.005**	*0.1*	**<0.005**	*0.1*	**<0.015**
CSF - 4.1-19	2019-05-21	6.87	*0.05*	**0.0012**	*0.1*	**0.0012**	*0.1*	**0.0032**

*Field pH unavailable; lab pH provided

AMMONIA (NH3) - BC WQG and CCME CWQG

Long- and short-term average WQGs for ammonia nitrogen (NH3 as ug/L) are pH and temperature dependent.

*Note: "Ammonia" used in place of "Ammonia (as N)" when latter not provided.

SW checked for accuracy of the WQGs corresponding to the sample, determined unable to average for long term, answered above questions - needs further work if we are addressing these questions,

Applied 2 approaches (scroll below for Approach 2).

If temp data was missing, temp was averaged between the sample before and after the missing one (highlighted in yellow), if temp was <0, rounded to 0, pH and Temp was always rounded up (more conservative) except some exceedances in CCME so those were rounded to the nearest half number so they didn't exceed.

Appendix G-2: Ammonia Guideline Calculations

Sample ID	Date Sampled	Field pH	pH - Rounded	Temperature (°C)	Temperature Rounded‡ (°C)	BC WQG				CWQG			
						Long-Term BC WQG (mg/L)	**Ammonia (as N) (mg/L)**	*Short-Term BC WQG (mg/L)*	**Ammonia (as N) (mg/L)**	pH - Rounded	Temperature rounded (°C)‡	*Long-Term CWQG (mg/L)*	**Ammonia (as N) (mg/L)**
18-WF-WL9B◊	2018-05-05	7.54	7.60	18.25	19.00	*1.33*	**0.11**	*10.6*	**0.11**	8	20	*0.499*	**0.11**
18-WL9◊	2018-05-05	7.62	7.70	19.38	20.00	*1.24*	**0.074**	*9.12*	**0.074**	8	20	*0.499*	**0.074**
18-WF-10◊	2018-05-08	7.68	7.70	15.47	16.00	*1.66*	**0.048**	*9.26*	**0.048**	8	20	*0.499*	**0.048**
18-CSF-07◊	2018-05-09	7.83	7.90	4.88	5.00	*1.41*	**<0.02**	*7.33*	**<0.02**	8	5	*1.54*	**<0.02**
WET21◊,*	2018-07-04	8.18	8.20	20.00	20.00	*0.49*	**0.042**	*3.61*	**0.042**	8.5	20	*0.171*	**0.042**
WL1◊,*	2018-07-05	8.27	8.30	20.00	20.00	*0.40*	**<0.02**	*2.91*	**<0.02**	8.5	20	*0.171*	**<0.02**
WF-WL15-19	2019-05-09	8.35	8.40	10.40	11.00	*0.46*	**0.0673**	*2.38*	**0.0673**	8.5	15	*0.239*	**0.0673**
CSF-WL117-19	2019-05-09	8.32	8.40	15.80	16.00	*0.42*	**0.262**	*2.35*	**0.262**	8.5	20	*0.171*	**0.262**
CSF - 4.1-19	2019-05-21	8.21	8.30	10.40	11.00	*0.57*	**0.0984**	*2.97*	**0.0984**	8.5	15	*0.239*	**0.0984**

*Temperature data not available; used most conservative estimate

◊Ammonia (as N) not available; used results for Ammonia

‡pH and temperature were rounded up to maintain conservative approach

Red shading indicates guideline exceedance

CADMIUM (DISSOLVED) - BC WQG and CCME CWQG

BC WQG Guideline applies to dissolved cadmium concentrations.

Long- and short-term average WQGs for cadmium (dissolved) are hardness dependent.

SW checked for accuracy of the WQGs corresponding to the sample, equations entered correctly, and hardness bounds

Appendix G-3: Cadmium Guideline Calculations

Sample ID	Sample Date	Hardness as CaCO3 (Filtered) (mg/L)	BC WQG				CWQG			
			Long-Term Aquatic WQG (mg/L)	**Cadmium (Dissolved) (mg/L)**	*Short-Term Aquatic WQG (mg/L)*	**Cadmium (Dissolved) (mg/L)**	*CCME Long-Term Aquatic WQG (mg/L)*	**Cadmium (Dissolved) (mg/L)**	*CCME Short-Term Aquatic WQG (mg/L)*	**Cadmium (Total) (mg/L)**
18-WF-WL9B	2018-05-05	429	Site-Specific	**<0.000005**	*0.002636*	**<0.000005**	n/a	**<0.000005**	n/a	**<0.000005**
18-WL9	2018-05-05	393	Site-Specific	**<0.000005**	*0.002409*	**<0.000005**	n/a	**<0.000005**	n/a	**<0.000005**
18-WF-10	2018-05-08	183	*0.000296*	**0.0000281**	*0.001096*	**0.0000281**	*0.000559*	**0.0000281**	*0.001802*	**0.0000281**
18-CSF-07	2018-05-09	151	*0.000267*	**0.000174**	*0.000899*	**0.000174**	*0.000521*	**0.000174**	*0.001655*	**0.000174**
WET21	2018-07-04	411	Site-Specific	**<0.00001**	*0.002522*	**<0.00001**	n/a	**<0.00001**	n/a	**<0.00001**
WL1	2018-07-05	231	*0.000392*	**<0.00001**	*0.001393*	**<0.00001**	*0.000608*	**<0.00001**	*0.001997*	**<0.00001**
WF-WL15-19*	2019-05-09	529	Site-Specific	**<0.000025**	Site-Specific	**<0.000025**	n/a	**<0.000025**	n/a	**<0.000025**
CSF-WL117-19*	2019-05-09	424	Site-Specific	**<0.000025**	*0.002604*	**<0.000025**	n/a	**<0.000025**	n/a	**<0.000025**
CSF - 4.1-19*	2019-05-21	204	*0.000357*	**<0.000005**	*0.001226*	**<0.000005**	*0.000581*	**<0.000005**	*0.001890*	**<0.000005**

*Hardness as CaCO3 (filtered) not available, used non-filtered Hardness as CaCO3

Indicates water hardness is outside hardness range tested (i.e. lower or upper bound), and a site-specific assessment may be required

"n/a" indicates that a guideline is not specified for water hardness outside valid range

Appendix G-4: Copper Guideline Calculations

Sample ID	Date	Temperature (°C)	Field pH	DOC (mg/L)	Hardness as CaCO3 (Filtered) (mg/L)	BC WQG‡				CWQG	
						Short-Term (Acute) Copper Guideline (mg/L)	**Copper Dissolved (mg/L)**	*Long-Term (Chronic) Copper Guideline (mg/L)*	**Copper Dissolved (mg/L)**	*Long-Term CWQG (mg/L)*	**Copper Total (mg/L)**
18-WF-WL9B	2018-05-05	18.25	7.54	17.2	429	*NA*	**0.00038**	*0.0084*	**0.00038**	*0.004*	**0.00038**
18-WL9	2018-05-05	19.38	7.62	13.7	393	*NA*	**0.00024**	*0.0075*	**0.00024**	*0.004*	**0.00024**
18-WF-10	2018-05-08	15.47	7.68	13.4	183	*NA*	**0.00102**	*0.0069*	**0.00102**	*0.004*	**0.00102**
18-CSF-07	2018-05-09	4.88	7.83	2.86	151	*NA*	**0.0003**	*0.0015*	**0.0003**	*0.003*	**0.0003**
WET21	2018-07-04	-	8.06**	24	411	*NA*	**<0.0005**	*0.0219*	**<0.0005**	*0.004*	**<0.0005**
WL1	2018-07-05	-	8.46**	<1	231	*NA*	**<0.0005**	*0.0018*	**<0.0005**	*0.004*	**<0.0005**
WF-WL15-19*	2019-05-09	10.4	7.50	25	529	*NA*	**<0.0025**	*0.0089*	**<0.0025**	*0.004*	**<0.0025**
CSF-WL117-19*	2019-05-09	15.8	7.54	21.2	424	*NA*	**<0.0025**	*0.0096*	**<0.0025**	*0.004*	**<0.0025**
CSF - 4.1-19*	2019-05-21	10.4	6.87	10.1	204	*NA*	**<0.0005**	*0.0018*	**<0.0005**	*0.004*	**<0.0005**

‡Calculated using the Biotic Ligand Model (BLM): *https://www2.gov.bc.ca › approved-wqgs › copper › bc_blm_users_manual - BLM output provided below*

*Hardness as CaCO3 (filtered) not available, used unfiltered Hardness as CaCO3

**Field pH unavailable; lab pH provided

If water quality input values were greater or lower than these bounds set for the model, the BC BLM software automatically applied the upper or lower bounds while calculating BC WQGs

Acute Copper Biotic Ligand Model (BLM) for Aquatic Life

British Columbia Copper BLM Software Version 1.11
(Based on Windward BLM Version 3.40.2.45)

For the following calculation, the BLM is used in conjunction with acceptable acute toxicity data for copper.

Site Characteristics:

Ion Ratios: (British Columbia median values (default))
Ca:Mg = 3.33
Ca:Na = 3.30
Ca:K = 23.51
SO4:Cl = 3.86
pCO2 = 10^-3.2

Site Name	Sample Name	Temp. C	pH	DOC mg C/L	Hardness mg/L $CaCO_3$
Crown	18-WF-WL9B	18.3	7.54	17.2	236
Crown	18-WL9	19.4	7.62	13.7	236
Crown	18-WF-10	15.5	7.68	13.4	183
Crown	18-CSF-07	4.88	7.83	2.86	151
Crown	WET21	27	8.06	20	236
Crown	WL1	27	8.46	1	231
Crown	WF-WL15-19	10.4	7.5	20	236
Crown	CSF-WL17-19	15.8	7.54	20	236
Crown	CSF-4.1-19	10.4	6.87	10.1	204

Estimated Complete Site Chemistry:

Site Name	Sample Name	Temp. C	pH	DOC mg C/L	HA %	Alk. mg/L $CaCO_3$
Crown	18-WF-WL9B	18.3	7.54	17.2	10	20.03
Crown	18-WL9	19.4	7.62	13.7	10	23.58
Crown	18-WF-10	15.5	7.68	13.4	10	29.07
Crown	18-CSF-07	4.88	7.83	2.8	10	51.99
Crown	WET21	27	8.06	20	10	56.8
Crown	WL1	27	8.46	1	10	149.6
Crown	WF-WL15-19	10.4	7.5	20	10	21.76
Crown	CSF-WL17-19	15.8	7.54	20	10	21.14
Crown	CSF-4.1-19	10.4	6.87	10.1	10	5.12

Site Name	Sample Name	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	SO4 mg/L	Cl mg/L
Crown	18-WF-WL9B	72.7	13.2	12.6	3.02	214	20.5
Crown	18-WL9	72.7	13.2	12.6	3.02	211	20.2
Crown	18-WF-10	56.4	10.3	9.8	2.34	158	15.1
Crown	18-CSF-07	46.5	8.47	8.08	1.93	120	11.4
Crown	WET21	72.7	13.2	12.6	3.02	183	17.5
Crown	WL1	71.1	13	12.4	2.95	111	10.6
Crown	WF-WL15-19	72.7	13.2	12.6	3.02	215	20.6
Crown	CSF-WL17-19	72.7	13.2	12.6	3.02	214	20.5
Crown	CSF-4.1-19	62.8	11.4	10.9	2.61	194	18.5

*The lower limit of this parameter was used in the model because input value was too low.
**The upper limit of this parameter was used in the model because input value was too high.

Aquatic Life Guideline:

#	Site Name	Sample Name	Copper Concentration (ug/L)	Acute Guideline (ug/L)
1	Crown	18-WF-WL9B	0.38	49.5
2	Crown	18-WL9	0.24	43.6
3	Crown	18-WF-10	1.02	40.6
4	Crown	18-CSF-07	0.3	8.7
5	Crown	WET21	0.5	117
6	Crown	WL1	0.5	9.1
7	Crown	WF-WL15-19	0.25	52.5
8	Crown	CSF-WL17-19	0.25	56.5
9	Crown	CSF-4.1-19	0.5	11.4

Parameter Limits:

Parameter	Units	Lower Limit	Upper Limit
Temp.	C	4.4	27
pH		5	9
DOC	mg C/L	0.05	20
HA	%	0.01	99
Ca	mg/L	2.2	72.94
Mg	mg/L	0.58	18.4
Na	mg/L	0.86	70.97
K	mg/L	0.59	156
SO_4	mg/L	0.5	1320
Cl	mg/L	0.2	119.8

Chronic Copper Biotic Ligand Model (BLM) for Aquatic Life

British Columbia Copper BLM Software Version 1.11
(Based on Windward BLM Version 3.40.2.45)

For the following calculation, the BLM is used in conjunction with acceptable chronic toxicity data for copper.

Site Characteristics:

Ion Ratios: (British Columbia median values (default))
Ca:Mg = 3.33
Ca:Na = 3.30
Ca:K = 23.51
SO4:Cl = 3.86
pCO_2 = 10^-3.0 (plants/algae) or 10^-3.2 (fish/inverts/amphibians)

Site Name	Sample Name	Temp. C	pH	DOC mg C/L	Hardness mg/L $CaCO_3$
Crown	18-WF-WL9B	18.3	7.54	17.2	236
Crown	18-WL9	19.4	7.62	13.7	236
Crown	18-WF-10	15.5	7.68	13.4	183
Crown	18-CSF-07	4.88	7.83	2.86	151
Crown	WET21	27	8.06	20	236
Crown	WL1	27	8.46	1	231
Crown	WF-WL15-19	10.4	7.5	20	236
Crown	CSF-WL17-19	15.8	7.54	20	236
Crown	CSF-4.1-19	10.4	6.87	10.1	204

Esimated Complete Site Chemistry:

Site Name	Sample Name	Temp. C	pH	DOC mg C/L	HA %	Fish Alk. mg/L $CaCO_3$	Plant Alk. mg/L $CaCO_3$
Crown	18-WF-WL9B	18.3	7.54	17.2	10	19.94	31.62
Crown	18-WL9	19.4	7.62	13.7	10	23.46	37.21
Crown	18-WF-10	15.5	7.68	13.4	10	28.94	45.91
Crown	18-CSF-07	4.88	7.83	2.86	10	51.8	82.21
Crown	WET21	27	8.06	20	10	56.11	89.08
Crown	WL1	27	8.46	1	10	146.3	232.4
Crown	WF-WL15-19	10.4	7.5	20	10	21.68	34.38
Crown	CSF-WL17-19	15.8	7.54	20	10	21.04	33.37 Crown
CSF-4.1-19	10.4	6.87	10.1	10	5.116	8.109	

Site Name	Sample Name	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	SO_4 mg/L	Cl mg/L
Crown	18-WF-WL9B	72.7	13.2	12.6	3.02	214	20.5
Crown	18-WL9	72.7	13.2	12.6	3.02	211	20.2
Crown	18-WF-10	56.4	10.3	9.8	2.34	158	15.1
Crown	18-CSF-07	46.5	8.47	8.08	1.93	120	11.4
Crown	WET21	72.7	13.2	12.6	3.02	183	17.5
Crown	WL1	71.1	13	12.4	2.95	111	10.6
Crown	WF-WL15-19	72.7	13.2	12.6	3.02	215	20.6
Crown	CSF-WL17-19	72.7	13.2	12.6	3.02	214	20.5
Crown	CSF-4.1-19	62.8	11.4	10.9	2.61	194	18.5

*The lower limit of this parameter was used in the model because input value was too low.
**The upper limit of this parameter was used in the model because input value was too high.

Aquatic Life Guideline:

#	Site Name	Sample Name	Copper Concentration (ug/L)	Chronic Guideline (ug/L)
1	Crown	18-WF-WL9B	0.38	8.4
2	Crown	18-WL9	0.24	7.5
3	Crown	18-WF-10	1.02	6.9
4	Crown	18-CSF-07	0.3	1.5
5	Crown	WET21	0.5	21.9
6	Crown	WL1	0.5	1.8
7	Crown	WF-WL15-19	0.25	8.9
8	Crown	CSF-WL17-19	0.25	9.6
9	Crown	CSF-4.1-19	0.5	1.8

Parameter Limits:

Parameter	Units	Lower Limit	Upper Limit
Temp.	C	4.4	27
pH		5	9
DOC	mg C/L	0.05	20
HA	%	0.01	99
Ca	mg/L	2.2	72.94
Mg	mg/L	0.58	18.4
Na	mg/L	0.86	70.97
K	mg/L	0.59	156
SO_4	mg/L	0.5	1320
Cl	mg/L	0.2	119.8

FLUORIDE - BC WQG

Short-term average WQGs for fluoride are hardness dependent. Long-term WQGs do not exist.

SW checked for accuracy of equation, accuracy of the WQGs corresponding to the sample, hardness is within bounds, CCME CWQG exist - already in esdat

Appendix G-5: Fluoride Guideline Calculations

Sample ID	Sample Date	Hardness as CaCO3 (Filtered) (mg/L)	BC WQG	
			Short-Term BC WQG (mg/L)	**Fluoride (Total) (mg/L)**
18-WF-WL9B	2018-05-05	429	Site-Specific	**0.23**
18-WL9	2018-05-05	393	Site-Specific	**0.19**
18-WF-10	2018-05-08	183	*1.5771*	**0.27**
18-CSF-07	2018-05-09	151	*1.4998*	**0.13**
WET21	2018-07-04	411	Site-Specific	**0.26**
WL1	2018-07-05	231	*1.6707*	**0.21**
WF-WL15-19*	2019-05-09	529	Site-Specific	**0.21**
CSF-WL117-19*	2019-05-09	424	Site-Specific	**0.23**
CSF - 4.1-19*	2019-05-21	204	*1.6207*	**0.11**

*Hardness as CaCO3 (filtered) not available, used unfiltered Hardness as CaCO3

Indicates water hardness is outside hardness range tested (i.e. lower or upper bound), and a site-specific assessment may be required

LEAD (TOTAL) - BC WQG AND CCME CWQG

BC WQG Guideline applies to total lead concentrations.

Long- and short-term average WQGs and CWQGs for lead (total) are hardness dependent.

SW checked for accuracy of equations, hardness bounds, accuracy of the WQGs corresponding to the sample

Appendix G-6: Lead Guideline Calculations

Sample ID	Sample Date	Hardness as CaCO3 (Filtered) (mg/L)	BC WQG				CWQG		
			Long-Term Aquatic WQG (mg/L)	**Lead (Total) (mg/L)**	*Short-Term Aquatic WQG (mg/L)*	**Lead (Total) (mg/L)**	*Long-Term CWQG (mg/L)*	**Lead (Total) (mg/L)**	**Lead (Filtered) (mg/L)**
18-WF-WL9B	2018-05-05	429	Site-Specific	**0.000031**	Site-Specific	**0.000031**	*0.007*	**0.000031**	**0.0000194**
18-WL9	2018-05-05	393	Site-Specific	**0.000031**	Site-Specific	**0.000031**	*0.007*	**0.000031**	**0.0000076**
18-WF-10	2018-05-08	183	*0.01018*	**0.000029**	*0.1762*	**0.000029**	*0.007*	**0.000029**	**0.0000174**
18-CSF-07	2018-05-09	151	*0.00869*	**<0.00002**	*0.1380*	**<0.00002**	*0.00538*	**<0.00002**	**0.0000067**
WET21	2018-07-04	411	Site-Specific	**<0.0002**	Site-Specific	**<0.0002**	*0.007*	**<0.0002**	**<0.0002**
WL1	2018-07-05	231	*0.01255*	**<0.0002**	*0.2370*	**<0.0002**	*0.007*	**<0.0002**	**<0.0002**
WF-WL15-19*	2019-05-09	529	Site-Specific	**0.00035**	Site-Specific	**0.00035**	*0.007*	**0.00035**	**<0.00025**
CSF-WL117-19*	2019-05-09	424	Site-Specific	**<0.00025**	Site-Specific	**<0.00025**	*0.007*	**<0.00025**	**<0.00025**
CSF - 4.1-19*	2019-05-21	204	*0.01120*	**<0.00005**	*0.2023*	**<0.00005**	*0.007*	**<0.00005**	**<0.00005**

*Hardness as CaCO3 (filtered) not available, used non-filtered Hardness as CaCO3

Indicates water hardness is outside hardness range tested (i.e. lower or upper bound), and a site-specific assessment may be required

MANGANESE (TOTAL) - BC WQG

BC WQG Guideline applies to total manganese concentrations.

Long- and short-term average WQGs for manganese (total) are hardness dependent.

SW checked for accuracy of equations, hardness bounds, accuracy of the WQGs corresponding to the sample, checked - no CCME CWQG

Appendix G-7: Manganese Guideline Calculations

Sample ID	Sample Date	Hardness as CaCO3 (Filtered) (mg/L)	BC WQG			
			Long-Term BC WQG (mg/L)	**Manganese (Total) mg/L**	*Short-Term BC WQG (mg/L)*	**Manganese (Total) mg/L**
18-WF-WL9B	2018-05-05	429	*2.4926*	**0.00793**	Site-Specific	**0.00793**
18-WL9	2018-05-05	393	*2.3342*	**0.0692**	Site-Specific	**0.0692**
18-WF-10	2018-05-08	183	*1.4102*	**0.00875**	*2.55666*	**0.00875**
18-CSF-07	2018-05-09	151	*1.2694*	**0.005**	*2.20402*	**0.005**
WET21	2018-07-04	411	*2.4134*	**0.0036**	Site-Specific	**0.0036**
WL1	2018-07-05	231	*1.6214*	**<0.001**	*3.08562*	**<0.001**
WF-WL15-19*	2019-05-09	529	Site-Specific	**0.00209**	Site-Specific	**0.00209**
CSF-WL117-19*	2019-05-09	424	*2.4706*	**0.124**	Site-Specific	**0.124**
CSF - 4.1-19*	2019-05-21	204	*1.5026*	**0.227**	*2.78808*	**0.227**

*Hardness as CaCO3 (filtered) not available, used non-filtered Hardness as CaCO3

Indicates water hardness is outside hardness range tested (i.e. lower or upper bound), and a site-specific assessment may be required

Appendix G-8: Nickel Guideline Calculations

Sample ID	Sample Date	Hardness as CaCO3 (Filtered) mg/L	BC WWQG	CWQG
			Long-Term CWQG (mg/L)	**Nickel (Total) (mg/L)**
18-WF-WL9B	2018-05-05	429	*0.15*	**0.00055**
18-WL9	2018-05-05	393	*0.15*	**0.00071**
18-WF-10	2018-05-08	183	*0.15*	**0.00083**
18-CSF-07	2018-05-09	151	*0.13*	**0.00014**
WET21	2018-07-04	411	*0.15*	**<0.001**
WL1	2018-07-05	231	*0.15*	**<0.001**
WF-WL15-19*	2019-05-09	529	*0.15*	**<0.0025**
CSF-WL117-19*	2019-05-09	424	*0.15*	**<0.0025**
CSF - 4.1-19*	2019-05-21	204	*0.15*	**<0.0005**
*Hardness as CaCO3 (filtered) not available, used unfiltered Hardness as CaCO3				

NITRITE - BC WQG

Long- and short-term average WQGs for nitrite are chloride dependent.

SW checked for accuracy of equations, accuracy of the WQGs corresponding to the sample

Appendix G-9: Nitrite Guideline Calculations

Sample ID	Sample Date	Chloride (Filtered) (mg/L)	BC WQG			
			Short-Term BC WQG (mg/L)	**Nitrite (ug/L)**	*Long-Term BC WQG (mg/L)*	**Nitrite (ug/L)**
18-WF-WL9B	2018-05-05	4.9	*0.6*	**<0.005**	*0.2*	**<0.005**
18-WL9	2018-05-05	2.4	*0.6*	**<0.005**	*0.2*	**<0.005**
18-WF-10	2018-05-08	1.6	*0.06*	**<0.02**	*0.02*	**<0.02**
18-CSF-07	2018-05-09	<1	*0.6*	**0.241**	*0.2*	**0.241**
WET21	2018-07-04	5.6	*0.6*	**<0.01****	*0.2*	**<0.01****
WL1	2018-07-05	<1	*0.6*	**<0.01****	*0.2*	**<0.01****
WF-WL15-19*	2019-05-09	11.7	*0.06*	**<0.005**	*0.02*	**<0.005**
CSF-WL117-19*	2019-05-09	<2.5	*0.6*	**<0.005**	*0.2*	**<0.005**
CSF - 4.1-19*	2019-05-21	<0.5	*0.6*	**<0.001**	*0.2*	**<0.001**

*Chloride (filtered) not available; used unfiltered chloride concentration

**Nitrite (mg/L) not available; used Nitrite (as N)

SILVER (TOTAL) - BC WQG

Appendix G-10: Silver Guideline Calculations

Site ID	Sample Date	Hardness as CaCO3 (mg/L)	*Long-Term BC WQG (mg/L)*	**Silver (Total) (mg/L)**	*Short-Term BC WQG (mg/L)*	**Silver (Total) (ug/L)**
18-WF-WL9B	2018-05-05	429	*0.0015*	**<0.00001**	*0.003*	**<0.00001**
18-WL9	2018-05-05	393	*0.0015*	**<0.00001**	*0.003*	**<0.00001**
18-WF-10	2018-05-08	183	*0.0015*	**<0.00001**	*0.003*	**<0.00001**
18-CSF-07	2018-05-09	151	*0.0015*	**<0.00001**	*0.003*	**<0.00001**
WET21	2018-07-04	411	*0.0015*	**<0.00002**	*0.003*	**<0.00002**
WL1	2018-07-05	231	*0.0015*	**<0.00002**	*0.003*	**<0.00002**
WF-WL15-19*	2019-05-09	529	*0.0015*	**<0.00005**	*0.003*	**<0.00005**
CSF-WL117-19*	2019-05-09	424	*0.0015*	**<0.00005**	*0.003*	**<0.00005**
CSF - 4.1-19*	2019-05-21	204	*0.0015*	**<0.00001**	*0.003*	**<0.00001**

*Hardness as CaCO3 (filtered) not available, used non-filtered Hardness as CaCO3

SULFATE - BC WQG

Long-term average WQGs for sulfate are hardness dependent.

SW checked for accuracy of equations, hardness bounds, accuracy of the WQGs corresponding to the sample, checked - no CCME CWQG

Notes: "Sulphate (SO4)" results used, though only few results were reported under this column. When no results for "Sulphate (SO4)", "Sulphate (SO4) (Filtered)" was used.

Appendix G-11: Sulphate Guideline Calculations

Sample ID	Sample Date	Hardness as CaCO3 (Filtered) (mg/L)	***BC WQG***	
			Long-Term BC WQG (mg/L)	**Sulphate (SO_4) Filtered (mg/L)**
18-WF-WL9B	2018-05-05	429	Site-Specific	183**
18-WL9	2018-05-05	393	Site-Specific	157**
18-WF-10	2018-05-08	183	*429*	<1**
18-CSF-07	2018-05-09	151	*309*	17.1**
WET21	2018-07-04	411	Site-Specific	103**
WL1	2018-07-05	231	*429*	44.5**
WF-WL15-19*	2019-05-09	529	Site-Specific	332
CSF-WL117-19*	2019-05-09	424	Site-Specific	128
CSF - 4.1-19*	2019-05-21	204	*429*	9.43

*Hardness as CaCO3 (filtered) not available, used non-filtered Hardness as CaCO3

**Sulphate (total) not available, used dissolved sulphate concentrations

ZINC (TOTAL) - BC WQG and CCME CWQG

BC WQG Guideline applies to TOTAL zinc concentrations. CWQG applies to DISSOLVED zinc concentrations

Long-term average WQGs for zinc (total) are hardness dependent.

CWQG Short-Term guidelines only valid for hardness between 13.8 - 250.5 mg/L and DOC between 0.3 - 17.3 mg/L

CWQG Long-Term guidelines only valid for hardness between 23.4 - 399 mg/L, pH between 6.5-8.13, and DOC between 0.3 - 22.9 mg/L

BC WQG Short-Term guidelines: use equation when hardness > 90 mg/L. Guideline = 33 ug/L when hardness <= 90

BC WQG Long-Term guidelines: use equation when hardness > 90 mg/L. Guideline = 7.5 ug/L when hardness <= 90

SW checked for accuracy of equations, hardness bounds, accuracy of the WQGs corresponding to the sample, averaged longterm standards if discrete samples exceeded or labelled as site specifi

Most CCME long term data cannot be used because pH not within the limits, not entered into the All Guidelines do

Appendix G-12: Zinc Guideline Calculations

Site ID	Site Location	Hardness as CaCO3 (Filtered) (mg/L)	pH	Dissolved Organic Carbon - Filtered (mg/L)	BC WQG				CWQG			
					Long-Term BC WQG (mg/L)	**Zinc (Total) (mg/L)**	*Short-Term BC WQG (mg/L)*	**Zinc (Total) (mg/L)**	*Long-Term CWQG (mg/L)*	**Zinc (Dissolved) (mg/L)**	*Short-Term CWQG (mg/L)*	**Zinc (Dissolved) (mg/L)**
18-WF-WL9B	2018-05-05	429	7.54	17.2	Site-Specific	**0.0041**	*0.287*	**0.0041**	n/a	**0.017**	n/a	**0.017**
18-WL9	2018-05-05	393	7.62	13.7	Site-Specific	**0.0025**	*0.260*	**0.0025**	*0.166*	**0.0015**	n/a	**0.0015**
18-WF-10	2018-05-08	183	7.68	13.4	*0.08*	**0.0019**	*0.103*	**0.0019**	*0.076*	**0.00159**	*0.242*	**0.00159**
18-CSF-07	2018-05-09	151	7.83	2.86	*0.05*	**0.00159**	*0.079*	**0.00159**	*0.030*	**0.00424**	*0.142*	**0.00424**
WET21	2018-07-04	411	8.06	24	Site-Specific	**<0.005**	*0.274*	**<0.005**	n/a	**<0.005**	n/a	**<0.005**
WL1	2018-07-05	231	8.46	1**	*0.11*	**<0.005**	*0.139*	**<0.005**	*0.018*	**0.0108**	*0.158*	**0.0108**
WF-WL15-19*	2019-05-09	529	7.50	25	Site-Specific	**<0.015**	Site-Specific	**<0.015**	n/a	**<0.005**	n/a	**<0.005**
CSF-WL117-19*	2019-05-09	424	7.54	21.2	Site-Specific	**<0.015**	*0.284*	**<0.015**	n/a	**<0.005**	n/a	**<0.005**
CSF - 4.1-19*	2019-05-21	204	6.87	10.1	*0.09*	**<0.003**	*0.119*	**<0.003**	*0.146*	**<0.001**	*0.247*	**<0.001**

*Hardness as CaCO3 (filtered) not available, used non-filtered Hardness as CaCO3

**Filtered DOC value <1, DOC = 1 assumed for calculation of CWQG

Indicates water hardness is outside hardness range tested (i.e. lower or upper bound), and a site-specific assessment may be required

"n/a" indicates that a guideline is not specified for water hardness outside valid range